Bio-briquette marketing risk mitigation design

Shofi Fitrotis Salimah [1*], *Sabarudin* Akhmad[1], *Kukuh* Winarso[1], *Sugeng* Purwoko[1], *Mu'alim*[1], *Delvina* Putri Hamidiyah[1]

[1]Departement of Industrial Engineering, Faculty of Engineering, Universitas Trunojoyo Madura, Indonesia

Abstract. Biobriquettes are a renewable energy product developed as an environmentally friendly alternative to fossil fuels. However, marketing these biobriquettes faces several challenges, including low consumer interest, limited distribution networks, uncompetitive pricing, and competition from substitute products. These challenges can hinder marketing objectives and the sustainability of the business. This study aims to identify and assess the marketing risks associated with biobriquettes and to design effective strategies for mitigating these risks. The research employs a descriptive qualitative method, using the Enterprise Risk Management (ERM) approach, and collects data through interviews with relevant stakeholders. The study applies the 4P framework of marketing—product, price, place, and promotion—to identify potential risks. Proposed mitigation strategies include increasing product innovation and quality control, implementing competitive pricing and discount programs, expanding distribution networks, and enhancing promotional activities through collaboration and the use of informative materials. These strategies offer practical solutions to address challenges faced by the marketing of biobriquettes.

1 Introduction

Using agricultural residues in briquette production not only reduces waste from the agricultural sector but also reduces dependence on fossil fuels, offering a more sustainable and environmentally friendly alternative to conventional energy sources [1]-[2]. Farmers often use agricultural residues and biomass as a cheap method to clean their fields, but this practice contributes to air pollution by emitting harmful gases and greenhouse gases [3]-[4]. Briquettes are a form of renewable energy that can be easily produced, both in terms of raw materials and manufacturing methods, giving them strong potential for further development [5]-[7]. Bio-briquettes, primarily made from green waste and various organic materials, are commonly used for electricity generation, heating, and cooking purposes. They serve as an ideal and sustainable alternative to traditional firewood [8]. The advancement of briquettes derived from agricultural waste can improve efficiency in the household sector and has the potential to replace conventional, polluting fuels such as firewood [9]. However, in reality, the use of bio-briquettes remains of little interest, especially in marketing, in the Madura region. This research will therefore seek to mitigate the risks associated with marketing bio-briquettes, ensuring that the product remains competitive and sustainable in the renewable energy market. A company's efforts to detect and manage risk have a significant impact on SME performance [10].

One approach to managing enterprise risk is known as Enterprise Risk Management (ERM). ERM is a structured framework that integrates the recognition, assessment, and control of risks into corporate governance practices. This integration aims to enhance transparency and strengthen decision-making within an organization [11]. Many companies adopt ERM because it is believed to improve overall performance by managing risks at every step of the business process [12]-[15]. The benefits of ERM include the development of effective regulatory policies for risk management and the ability to establish a competitive advantage in a highly competitive market [16].

This research develops a marketing risk mitigation plan for bio-briquettes using the Enterprise Risk Management (ERM) framework. The study focuses on identifying potential risks that arise throughout the bio-briquette production and marketing processes, including issues related to product quality, pricing, distribution, and promotion [17]. Through qualitative descriptive analysis supported by interviews and field observations, this research aims to evaluate the likelihood and impact of each identified risk and propose effective mitigation strategies [18].

2 Methods

The approach used in this study is based on the enterprise risk management framework, which provides a structured process to identify, evaluate, and mitigate risks that could affect organizational objectives. This research employs a contextual investigation approach by directly involving bio-briquette producers and consumers to identify problems and potential risks in the marketing process, ensuring that the results are accurate and reflect real conditions in the field.

Risk management is a continuous and structured process implemented by management and all

* Corresponding author: shofi.fitrotis@trunojoyo.ac.id

organizational members to ensure that potential risks hindering the achievement of objectives are adequately identified and controlled, thereby keeping them within acceptable limits [19]. The primary purpose of risk management is to identify and evaluate potential risks, develop action plans to mitigate their impact and likelihood, and provide recommendations for their effective management. Effective risk management should be an integral part of every organizational function to ensure risks are adequately controlled [17]. In essence, risk management offers several advantages to organizations, such as [19]:

1. Simplifying decision-making processes, particularly in complex situations
2. Assisting in producing more accurate cost estimations.
3. Supporting decision-making by providing insights, judgment, and informed considerations for better outcomes.
4. Alerting relevant stakeholders to potential risks and uncertainties that may hinder strategic goals.
5. Enhancing decision quality through a systematic and logical approach.
6. Providing clear guidelines for identifying and formulating solutions to existing problems.
7. Offering comprehensive analytical tools to evaluate and compare all possible alternatives.

Tabel 1. Probability measurement.

Level	Description	Detailed Description Example	Frequency
5	Almost certainly	it is likely to occur in many situations	> 1 time a year
4	Often	It may happen frequently in various conditions	³ 1 time a year
3	Moderate	It is expected to take place simultaneously	³ 1 time in 5 years
2	Rare	It might occur concurrently under spesific situations	³ 1 time in 10 years
1	Very rare	Such events arise only under particular circumstances	< 1 time in 10 years

In this research, ERM method is employed to analyze and design a marketing risk mitigation framework for bio briquettes. The research focuses on identifying, assessing, and managing potential risks that arise throughout the production and marketing processes of bio-briquettes. The scale used is a Likert scale to measure the probability and impact of each risk identified in the production and marketing of bio briquettes [20]. The respondents in this research were selected using a purposive sampling technique, based on specific criteria relevant to the production and marketing activities of bio-briquettes. The severity of the impact is categorized into five levels: very high, high, moderate, low, and very low [21]. The 4Ps of marketing —namely, Product, Price, Place, and Promotion —serve as a foundational framework for effectively strategizing [22]. Starting with Product, companies must focus on developing high-quality, innovative bio-briquettes to address inconsistencies and meet consumer demands, such as through regular quality controls. Price strategies involve setting competitive pricing while accounting for fluctuations in raw materials, potentially by offering discounts or analyzing costs to ensure affordability. The place emphasizes expanding distribution networks and improving coordination to overcome limited availability, thereby making the Product more accessible in various markets [23]. Finally, promotion entails using collaborative approaches with government institutions and creating informative, visually appealing materials to counter ineffective efforts and competition, ultimately driving brand awareness and sales.

Probability measurement is used to determine the likelihood of a risk occurring within the bio-briquette marketing process. It helps classify risks based on their frequency, ranging from very rare to widespread events. This assessment provides a foundation for prioritizing risks that require immediate mitigation actions [24]. Each level provides a clear description of how frequently a risk might occur, allowing researchers and decision-makers to understand better and evaluate the potential exposure within the marketing process [25].

Tabel 2. Impact measurement.

Number Risk	Impact rating	Interpretation
1-2	Negligible	Very low risk, can be ignored
2-4	Acceptable	Low risk acceptable
5-6	Undesirable	Medium risk requires control
7-10	Unacceptable	High risk requires mitigation

Impact measurement is used to assess the level of consequences that may result from identified risks in the bio-briquette marketing process. It categorizes the severity of risk impacts into four levels: negligible, acceptable, undesirable, and unacceptable [21]. This evaluation helps determine which risks require immediate attention and which can be tolerated within the organization's risk threshold.

3 Result and discussion

Table 3 presents the four main marketing aspects — products, price, place, and promotion — along with potential risk factors that may arise within each of these aspects. In the product aspect, risks are related to quality consistency and lack of innovation, while in the price aspect, challenges arise from uncompetitive pricing and fluctuating raw material costs.

Table 4 shows 4 marketing aspects, namely product, price, place, and promotion. The factors of the product aspect include, product quantity, product innovation, product excellence, and product branding and image. The factors of price aspect include price is too high, price is not flexible, and discounts are rarely offered. The factor of place aspect include sales location

accessibility, sales distribution network, and stock availability. Last factor is promotion include promotional media is unattractive.

Tabel 3. Influencing factors.

Marketing Aspects	Influencing Factors
Product	a. Product quality b. Product innovation c. Product excellence d. Product branding and image
Price	a. Price is too high b. Price is not flexible c. Discounts are rarely offered
Place	a. Sales location accessibility b. Sales distribution network c. Stock availability
Promotion	Promotional media is unattractive

Tabel 4. Possible risks

Marketing Aspects	Possible risks
Product	a. Consumer dissatisfaction with product quality b. Lack of consumer understanding about the benefits of bio-briquettes c. Consumers find it difficult to use the product due to a lack of information or education
Price	a. Consumers feel that the price is not proportional to the benefits received b. Price uncertainty due to frequent price changes c. Consumers delay purchases while waiting for promotional offers
Place	a. Consumers find it difficult to access the product because sales locations are far away b. Inconsistent product availability in stores or distribution agents causes consumers to feel disappointed and switch to other products
Promotion	a. Unclear promotional information causes confusion and lack of consumer trust b. Consumers feel bored with excessive or irrelevant promotions, leading them to ignore marketing messages

Table 4 shows he possible risks that may arise within the four main marketing aspects: product, price, place, and promotion. In the product aspect, the main risks identified include consumer dissatisfaction with product quality, lack of understanding regarding the benefits of bio-briquettes, and difficulty in using the product due to limited information or education. These challenges underscore the importance of maintaining consistent quality control, increasing consumer awareness, and enhancing educational outreach to foster greater acceptance and trust in bio-briquette products. In terms of price, place, and promotion, several crucial risks are also identified. The price aspect faces issues such as consumer perceptions of prices being disproportionate to value, uncertainty caused by fluctuating prices, and purchase delays as buyers wait for promotions to become available. The place aspect is marked by limited accessibility and inconsistent product availability, which may lead to consumer disappointment. Meanwhile, the promotion aspect highlights unclear promotional information and consumer fatigue from excessive or irrelevant advertisements. Addressing these issues through effective pricing strategies, improved distribution, and transparent promotional communication is essential to strengthening the overall marketing performance of bio-briquettes.

Tabel 5. Risk analysis.

Marketing Aspects	Types of Risks	Possibility	Impact	Value
Product	Inconsistent bio-briquette quality (A1)	3	2	6
	Lack of attractive product innovation (A2)	2	2	4
Price	Uncompetitive product pricing (B1)	2	3	6
	Fluctuation in raw material prices (B2)	3	2	6
Place	Limited product distribution (C3)	2	2	4
	Inconsistent product availability (C4)	2	2	4
Promotion	Ineffective promotion (D1)	3	3	9
	Promotional competition with substitute products (D2)	3	2	6

Table 5 presents the results of the risk analysis for each marketing aspect of the bio-briquette product, encompassing product, price, place, and promotion. In the product aspect, two main risks are identified: inconsistent bio-briquette quality and a lack of attractive product innovation. These risks indicate potential weaknesses in maintaining production standards and developing new product variations to meet consumer preferences. Proper quality control and continuous innovation are therefore essential to sustain consumer trust and product competitiveness in the market. Additionally, the price, place, and promotion aspects also present significant risk factors. The price aspect faces uncompetitive pricing and fluctuations in raw material costs, which could impact market stability and profit margins. The geographical aspect reveals limitations in product distribution and inconsistencies in

product availability, affecting consumer accessibility. Meanwhile, the promotion aspect indicates an ineffective promotional strategy with the highest risk value, suggesting that current marketing efforts have not effectively reached or influenced the target audience.

Table 6 shows four marketing aspect tables, each evaluated by value and categorized by risk levels. The risk categories are distributed as follows: 6 instances are classified as Unacceptable, 4 as Acceptable, 6 as Undesirable, another 6 as Undesirable, 4 as Acceptable, 4 as Acceptable, 9 as Unacceptable, and 6 as Undesirable. These categorizations help in identifying areas that require attention and improvement to minimize potential risks and maximize marketing effectiveness. This detailed categorization underscores the varying degrees of risk present across different marketing aspects, providing a comprehensive overview for strategic decision-making.

Tabel 6. Risk category.

Marketing Aspects	Value	Risk category
Product	6	Unacceptable
	4	Acceptable
Price	6	Undesirable
	6	Undesirable
Place	4	Acceptable
	4	Acceptable
Promotion	9	Unacceptable
	6	Undesirable

Table 7 shows that risk evaluation in Enterprise Risk Management (ERM) involves developing an evaluation matrix that considers both the likelihood and impact of risks. This matrix, often referred to as a risk map, uses color coding to represent different risk levels: red indicates high risk, yellow signifies moderate risk, and green represents low risk. This approach helps prioritize risks, making it easier to determine which risks require immediate attention based on the assessment outcomes.

Tabel 7. Risk matrix.

Probability	5					
	4					
	3					
	2		A1, D2			D1
	1	C2	B1, B2	C1		A2
		1	2	3	4	5
		Impact				

Table 8 presents the four key marketing aspects—Product, Price, Place, and Promotion—along with their associated risks and corresponding risk control measures, providing a structured overview of potential challenges in a bio-briquette business. For the Product aspect, the identified risks include inconsistent bio-briquette quality and a lack of attractive product innovation, which can be mitigated by developing innovative products and conducting regular quality control or routine quality supervision to ensure consistency and appeal. In the Price aspect, risks such as uncompetitive product pricing and fluctuations in raw material prices are addressed by offering discounts or seasonal promotional programs to attract new buyers, as well as by analyzing the production cost structure to maintain affordability and stability. Moving to the Place and Promotions aspects, Table 8 highlights risks such as limited product distribution and inconsistent product availability for Place, which can be mitigated by expanding the distribution network through local involvement and improving coordination and communication among distribution parties to enhance reach and reliability. For Promotions, the risks include ineffective promotion and promotional competition with substitute products, which can be mitigated by employing collaborative promotional strategies with government institutions and refining promotional materials to be more informative and visually appealing. The structured risk management framework outlined in Table 8 ultimately supports proactive decision-making to enhance market performance.

Tabel 8. Risk control.

Marketing Aspects	Risk Name	Risk Control
Product	Inconsistent bio-briquette quality	Developing product innovations
	Lack of attractive product innovation	Conducting reguler quality control or routine quality supervision
Price	Uncompetitive product pricing	Offering discounts or seasonal promotional programs to attract new buyers
	Fluctuation in raw material prices	Analyzing the production cost structure
Place	Limited product distribution	Expanding the distribution network by involving local stores and cooperatives
	Inconsistent product availability	Improving coordination and communication among distribution parties
Promotion	Ineffective promotion	Using collaborative promotional strategies with government institutions
	Promotional competition with substitute products	Adjusting promotional materials to be more informative with attractive visuals

4 Conclusion

This study successfully identified and assessed the marketing risks associated with bio-briquettes and designed a mitigation

plan using the Enterprise Risk Management (ERM) approach along with descriptive qualitative methods. As an environmentally friendly alternative fuel, bio-briquettes face several significant marketing risks that threaten their business sustainability. Key challenges include low consumer interest, limited distribution, uncompetitive pricing, and competition from substitute products. The research utilized the 4P framework of marketing—product, price, place, and promotion—to identify potential risks. A risk analysis was conducted using a Likert scale to measure both the probability and impact of these risks, categorizing their severity into four levels: negligible, acceptable, undesirable, and unacceptable. Product-related risks include inconsistent quality and a lack of innovation. Price risks stem from uncompetitive pricing and fluctuations in raw material costs. Distribution challenges and promotional inefficiencies also pose threats to market penetration. By categorizing these risks based on their likelihood and impact, the research established a clear prioritization of risks, highlighting areas that require immediate attention for mitigation. The proposed strategies to mitigate these challenges include enhancing product innovation and quality control, implementing competitive pricing along with discount programs, expanding distribution networks, and improving promotional activities through partnerships and informative materials. These practical solutions aim to effectively address the identified marketing risks.

References

1. N. Annuciate *et al.*, Assessment of Adoption, Market Potential and Environmental Impact of Carbonized Briquettes Among Farmers in Western Uganda's Beef-Producing Regions. International Journal of Economy, Energy and Environment. (2023). https://doi.org/10.11648/j.ijeee.20230802.12
2. P. D. Sanchez, M. M. Aspe, K. N. Sindol, An overview on the production of bio-briquettes from agricultural wastes: methods, processes, and quality. Journal of Agricultural and Food Engineering. 1, 2716-6236 (2022). https://web.archive.org/web/20220427220330id_/https://www.myjafe.com/wp-content/uploads/2022/03/MYJAFE2021-0036-1.pdf
3. C Maraveas *et al.,* Agricultural greenhouses: Resource management technologies and perspectives for zero greenhouse gas emissions. Agriculture. 13, 7, 1464 (2023). https://doi.org/10.3390/agriculture13071464
4. M. Kumari, Environmental, Social And Economic Impacts of 'Briquetting Plant And Briquettes'. Journal of Wastes and Biomass Management. 4, 1, 32–40 (2022). https://doi.org/10.26480/jwbm.01.2022.32.40
5. A. Rahmayanti, U. Sidoarjo, I. Khilyatul Afkar, and E. Rosyidah, Business Development Strategy and Energy Analysis in the Manufacture of Agricultural Waste Bio-briquette in Post COVID-19 Pandemic. Review of Politics and Public Policy in Emerging Economies. 4, 2, 71-82 (2022). https://doi.org/10.26710/rope.v4i2.2759
6. S. Rawat, S. Kumar, Critical review on processing technologies and economic aspect of bio-coal briquette production. Preparative Biochemistry & Biotechnology. 52, 8, 855-871 (2022). https://doi.org/10.1080/10826068.2021.2001754
7. S. N. Onyegirim, E. I. Nwankwo, K. C. Owuama, H. A. Madukasi, Advances in Charcoal Briquetting Machines: A Comprehensive Review of Technologies, Performance, and Sustainable Applications. International Journal of Applied and Natural Sciences. 3, 2, 35-49 (2025). https://doi.org/10.61424/ijans.v3i2.325
8. J. Yirijor, A. A. T. Bere, Production and characterization of coconut shell charcoal-based bio-briquettes as an alternative energy source for rural communities. Heliyon. 10, 16 (2024). https://doi.org/10.1016/j.heliyon.2024.e35717
9. N. V. Kuthe, P. B. Ingle, V. G. Gore, Biomass briquettes as an alternative energy source compare to wood charcoal in boilers. International Journal of Scientific Research in Mechanical and Materials Engineering. 5, 4, 16-40 (2021). https://ijsrmme.com/paper/IJSRMME215317.pdf
10. P. C. Ntare, I. R. Shau, E. Ojwang, Effects of Enterprise Risk Management Practices on Performance of Small and Medium Scale Enterprises. A case of Dar es Salaam City, Tanzania. African Journal of Applied Research. 8, 1, 182-199 (2022). https://www.ajol.info/index.php/ajapres/article/view/229287
11. I. A. Hanifah and W. Retnowati, The Role of Corporate Governance in Enterprise Risk Management (ERM) Disclosure. American Journal of Economic and Management Business (AJEMB). 3, 5, 1-20 (2024). https://doi.org/10.58631/ajemb.v3i5.84
12. J. Aoun, The impact of risk management on the performance of small medium enterprises amid the crisis: the case of Lebanon. Dutch journal of finance and management. 6, 2, 25718 (2023). https://doi.org/10.55267/djfm/14180
13. C. Chairani, S. V. Siregar, The effect of enterprise risk management on financial performance and firm value: the role of environmental, social and governance performance. Meditari Accountancy Research. 29, 3, 647–670 (2021). https://doi.org/https://doi.org/10.1108/MEDAR-09-2019-0549
14. O. A. Thompson, A. L. Imoize, T. T. Amos, Climate change risk management strategies: the case of small and medium scale enterprises in Southwest Nigeria. Highlights Sustain. 2, 35-49 (2023). https://doi.org/10.54175/hsustain2010004
15. C. Saranza *et al.,* Enterprise risk management on business performance: A quantitative analysis of local businesses in Surigao del Norte, Philippines. IJBTSR International Journal of Business and Technology Studies and Research. 5, 2, 15-pages. (2024). https://doi.org/10.5281/zenodo.10526702

16. B. Oyewo, Enterprise risk management and sustainability of banks performance. Journal of Accounting in Emerging Economies. 12, 2, 318-344 (2022). https://doi.org/10.1108/JAEE-10-2020-0278
17. C. Pérez-Cornejo and E. de Quevedo-Puente, How corporate social responsibility mediates the relationship between corporate reputation and enterprise risk management: evidence from Spain. Eurasian Business Review. 13, 2, 363–383 (2023). https://doi.org/10.1007/s40821-022-00223-2
18. P. Lisdiono, J. Said, H. Yusoff, and A. A. Hermawan, Risk management practice, alliance management capability, and enterprise resilience: Findings from Indonesian state-owned enterprises. Problems and Perspectives in Management. 20, 1, 190–202 (2022). https://doi.org/10.21511/ppm.20(1).2022.17
19. D. S. Driya, Y. Augustine, B. S. Bambang, Determinants of Enterprise Risk Management (ERM) Effectiveness. Jurnal Akuntansi Trisakti. 9, 2, 179–204 (2022). https://doi.org/10.25105/jat.v9i2.14905
20. Z. Virglerová *et al.,* Selected factors of internationalisation and their impact on the SME perception of the market risk. Oeconomia Copernicana. (2021). https://doi.org/10.24136/oc.2021.033
21. S. N. Agustin, U. M. D. Fadli, Risk Management Analysis with Enterprise Risk Management (ERM) at UMKM Maestro Gelato in Karawang Regency. Research in Management of Technology and Business. 5, 2, 976-986 (2024). https://doi.org/10.30880/rmtb.2024.05.02.081
22. R. V. Singh, D. Jena, Role of 4PS in Marketing Mix. World Journal of Pharmaceutical Research. 14, 7, 1525-1543 (2024). https://wjpr.s3.ap-south-1.amazonaws.com/article_issue/51a912752081b1226affb0b0daa5de76.pdf
23. M. Shadaei *et al.*, Enterprise Risk Management and Firm Operations: Evidence from Inventory Management. SSRN 4429714. (2023). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4429714
24. C. Peace, The risk matrix: Uncertain results?. Policy and Practice in Health and Safety. 15. 1-14 (2017). https://doi.org/10.1080/14773996.2017.1348571.
25. L. S. Rivaldi, M. M. Rachmadhani, A. Z. Tosofu, I. I. Supriatna, Analisa Risiko Menggunakan Metode Likelihood Dan Consequence Risk Matriks. Industrial Engineering Journal–System. 2, 2, 67-77 (2024). https://doi.org/10.33506/system.v2i02.3573