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THE FUTURE OF SUPPLIER SELECTION: INTEGRATING BIBLIOMETRIC INTELLIGENCE AND MCDM IN THE PERISHABLE AGRO-INDUSTRY

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Abstract

Background: Supplier selection in the perishable agroindustry, such as for mushrooms, is a complex and strategic process. It significantly impacts supply chain performance owing to the perishability and quality sensitivity of the products involved. Traditionally, decision-making methods in this area often lack preliminary validation, resulting in suboptimal supplier choice.
Purpose: This study aims to integrate bibliometric analysis and multi-criteria decision-making (MCDM) approaches, particularly the Analytic Hierarchy Process (AHP), to develop a robust data-driven model for supplier selection in the mushroom agroindustry.
Design/methodology/approach: A systematic literature review using the PRISMA framework and bibliometric analysis of Scopus-indexed articles identified the most relevant MCDM methods. A case study approach involving expert judgment was used to evaluate mushroom suppliers based on the following five criteria: quality, price, delivery, service, and product suitability.
Findings/Result: A bibliometric review confirmed that AHP, TOPSIS, and fuzzy logic are the most frequently applied methods. AHP was selected for its strengths in handling both qualitative and quantitative data and validating decision consistency. The results showed that Supplier A had the highest overall score (0.389), followed by Supplier C (0.345) and Supplier B (0.266), with a consistency ratio (CR) below 0.10, validating the assessments.
Conclusion: Integrating bibliometric analysis with MCDM methods offers a more objective and evidence-based approach to supplier selection. The developed model enhances decision accuracy, supports strategic sourcing, and ensures quality and timeliness in highly perishable product supply chains.
Originality/value (State of the art): This study pioneers the direct integration of bibliometric insights into an MCDM-based decision-making framework applied in a real-world agroindustry context. The methodology is replicable and adaptable across various industries facing similar supplier evaluation challenges.

Keywords: supplier selection, multi-criteria decision making, analytic hierarchy process, bibliometrics

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INTRODUCTION

Supplier selection aims to identify suitable suppliers from among the alternatives offered. This is because suppliers are strategic partners for companies, and can provide products, services, and prices at the right time in a competitive environment (Parkouhi et al. 2019). On the other hand, supplier selection is considered a complex and crucial decision because it can affect the supply chain's quality, efficiency, and reliability. This view also agrees with Jiang et al. (2020) findings that there are a number of complex factors in choosing a supplier, especially if it provides important long-term items for use in long-term Revi et al. (2018). This view is supported because mistakes in raw material supplier selection affect the overall efficiency and effectiveness of a company's operations.

In the era of globalization, supplier selection is becoming even more challenging because of the interconnected nature of international supply chains. Companies are no longer sourcing solely from local or regional suppliers but are increasingly dependent on global partners to ensure consistent availability, cost efficiency, and quality. This global interdependence introduces various risks, such as geopolitical tensions, logistical disruptions, regulatory differences, and fluctuating currency rates (Basílio et al. 2022; Jiang et al. 2020). These risks are particularly critical in the context of perishable goods, where delivery delays or quality inconsistencies can result in substantial losses (Fallahpour et al. 2021). For agroindustry products such as mushrooms, which are highly sensitive to time and storage conditions, selecting the right global supplier is not only a strategic necessity but also a crucial factor in maintaining freshness, safety, and marketability. Therefore, a robust and data-driven approach to supplier selection is essential for effectively navigating these global challenges (Dania et al. 2023).

Given these global complexities and product sensitivities, a structured and objective supplier-selection process is essential. Thus, selecting the correct supplier is not only important but also necessary to ensure product quality, delivery reliability, and competitive prices (Mirmousa and Dehnavi, 2016). Therefore, a comprehensive assessment of suppliers is required, considering various specified criteria such as compliance with quality standards and the ability to provide competitive prices.(Xie et al. 2022). The supplier selection process not only reduces uncertainty in the supply chain, but also strengthens the long-term relationships between companies and suppliers, thereby supporting smooth business operations and increasing customer satisfaction.(Basílio et al. 2022). Therefore, supplier selection decision making must be supported by the accuracy of the comprehensive methods. This strategy aims to minimize potential disruptions to the supply chain. The accuracy of this method in determining suppliers is the key to achieving efficiency and reliability in supply chain operations (Dania et al. 2023).

However, previous research on supplier selection has often directly determined the method used without conducting an in-depth study or analysis. Erdebilli et al. (2023) used the multi-criteria decision-making (MCDM) methodology by combining the analytical hierarchy process (AHP) and Complex Proportional Assessment (COPRAS) methods with fuzzy interval-valued Pythagorean (IPF) logic without any preliminary studies regarding the suitability of this method for selecting suppliers. In addition to Tavakoli et al. (2023), who directly used the method of selecting suppliers using the Fuzzy Best-Worst Method (FBWM), Chen et al. (2023) proposed an MCDM model by combining fuzzy and rough numbers with the Stepwise Weight Assessment Ratio Analysis (SWARA) and Additive Ratio Assessment (ARAS) methods without investigating the potential and limitations of the chosen method.

In contrast, Khulud et al. (2023) and Pamucar et al. (2024) conducted studies on multi-criterion decision-making (MCDM) using a bibliometric approach for supplier selection. Both studies use a bibliometric approach to understand the most commonly used methods in the supplier selection process. However, Khulud et al. (2023) and Pamucar et al. (2024) did not apply the results of bibliometric studies to the case studies. Thus, although previous research has examined MCDM methods and bibliometric approaches to supplier selection, no study has directly integrated bibliometrics and MCDM into supplier selection. Generally, supplier selection research directly applies the MCDM method without conducting analysis as the first step in determining and implementing the most appropriate MCDM method for supplier selection.

To address this gap, the present study not only identifies the most frequently used MCDM methods through a systematic bibliometric review, but also applies the findings in a real-world context, specifically, supplier selection in the mushroom agroindustry. AHP, TOPSIS, fuzzy logic, DEMATEL, and VIKOR offer unique advantages depending on data structure and decision complexity. By basing method selection on bibliometric evidence rather than assumptions, this study provides a more objective evidence-driven foundation for selecting the most appropriate tool for supplier evaluation.

Therefore, this study integrates the bibliometric and MCDM methods when selecting suppliers. In particular, this study provides input to stakeholders and academics regarding MCDM methods that are popularly used for supplier selection and help the industry make supplier selection decisions that are more informed, effective, and in line with industry needs.

To ensure the accuracy and relevance of bibliometric analysis, this study uses a structured approach, such as Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA), in the selection stage of relevant articles regarding supplier selection in agro-industry supply chains (Syaifullah et al. 2022). PRISMA can be used to identify, collect, and filter relevant articles based on predetermined inclusion and exclusion criteria (Calandra et al. 2023). This ensured that the research selected for the bibliometric analysis had undergone a rigorous selection process and met the relevant criteria. The results of this study can be used in the mushroom agroindustry to improve supplier selection. The developed model can also be adapted to other industries that face similar supplier selection challenges.

This research consists of four parts: Part 1: Background and Research Objectives, which have previously discussed the context of the research problem and the objectives to be achieved. Part 2: Research Methods, which will explain the research steps, including the process of searching for articles in the Scopus database, conducting bibliometric analysis, and implementing supplier selection methods. Part 3: The results and discussion present findings from the bibliometric analysis of the application of the MCDM method in supplier selection, as well as discussing research findings and connecting them with relevant literature. Part 4: Conclusions from the research results and limitations that may arise during the research process.

METHODS

This study integrates bibliometric analysis and multi-criteria decision-making (MCDM) in the supplier selection process within the mushroom agroindustry. The integration of these two approaches provides a strong foundation for achieving accurate and objective decision making. Bibliometric analysis has been used to identify trends and dominant methods in previous literature, while MCDM, particularly the Analytic Hierarchy Process (AHP), has been applied to evaluate supplier alternatives based on expert-defined criteria (Alimardani et al. 2013).

Two types of data are used in this study. Secondary Data (Collected from the Scopus database through bibliometric analysis to identify the most frequently used MCDM methods in supplier selection). Primary Data (Collected via expert judgment using structured questionnaires or interviews. Experts were selected based on their experience, relevance, and credibility in the field of supplier selection. A case study was conducted in an agroindustrial supply chain with a focus on mushroom commodities).

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was used during the article selection stage to ensure systematic, objective, and transparent filtering of the relevant literature (Handayani et al. 2023). An initial search in Scopus using keywords such as “supplier”, “selection”, “MCDM”, and “supply chain” produced 686 records. After exclusion based on language (English), type (journal articles), relevance, language, and document type, 229 articles were retained for the bibliometric analysis. These articles form the basis for identifying the commonly used MCDM methods in supplier selection research.

The research methodology consisted of four phases.
Phase 1: PRISMA Diagram (This phase involves identifying and filtering relevant literature using the PRISMA approach, ensuring only qualified studies are included in the bibliometric analysis).
Phase 2: Bibliometric Analysis (The selected literature was analyzed using the VOSviewer software to visualize and identify the most frequently used MCDM methods in supplier selection).
Phase 3: Bibliometric and MCDM Integration Model (At this stage, a conceptual model was developed based on the bibliometric findings. The

AHP method was selected as the most suitable MCDM tool owing to its ability to handle both qualitative and quantitative data and validate decision consistency through the Consistency Ratio (CR). This integration offers a structured and data-driven approach to supplier selection).

Based on the conceptual model developed in this study, the following hypothesis is proposed. Hypothesis: The integration of bibliometric analysis with multi-criteria decision-making (MCDM), particularly the Analytic Hierarchy Process (AHP), improves the accuracy and objectivity of supplier selection in the agroindustry. This hypothesis is derived from the gap identified in previous studies, which often apply MCDM methods directly without evaluating their relevance or suitability. By selecting a method based on bibliometric evidence, the decision-making process becomes more robust, data-driven, and aligned with actual trends in academic and practical applications.

In the final phase, supplier selection was performed using an integrated model. Experts evaluated each supplier alternative based on five main criteria: quality, price, delivery, service, and product suitability. These criteria were derived from the literature and industry practice. AHP is then used to calculate priority weights and rank suppliers accordingly. Consistency of expert judgments was assessed to ensure the validity and reliability of the results.

RESULTS

Bibliometric Analysis

Bibliometric analysis results are used to understand the multi-criteria decision-making (MCDM) method, which helps in making decisions in situations where many methods are being considered. This method allows decision makers to organize, model, and analyze relevant methods in supplier selection. Figure 1 shows the results from VosViewer, which explains that the AHP (Analytic Hierarchy Process (AHP), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Fuzzy Logic methods are the dominant methods and are often combined with other methods to increase the effectiveness of decision-making. The use of fuzzy methods is also prominent, indicating the importance of dealing with uncertainty in data and decision makers. preference (Wang et al. 2020). The TOPSIS method is the most connected to other methods, demonstrating its popularity in research and application in the field of MCDM. AHP and DEMATEL also exhibit multiple connections, indicating that these methods are often used in combination with other methods(Gökler and Boran, 2023). Likewise, Fuzzy Logic and its variants (such as Fuzzy AHP and Fuzzy TOPSIS) play an important role in overcoming uncertainty and subjectivity in decision making (Nazim et al. 2022). ELECTRE and PROMETHEE tend to be connected to each other and VIKOR, indicating that these methods are often used in similar or complementary contexts (Azhar et al. 2021).

The findings of this bibliometric analysis confirm the trends observed in previous studies such as Khulud et al. (2023) and Demir, Chatterjee, and Pamucar (2024), who also identified AHP, TOPSIS, and fuzzy-based methods as the most commonly used methods in supplier selection. Similar to this study, Khulud et al. (2023) used VOSviewer to visualize keyword relationships and method frequencies. The key distinction lies in the integration of bibliometric insights into real-world applications. While previous research has focused solely on mapping literature trends, this study not only confirms the dominance of AHP, TOPSIS, and Fuzzy Logic through bibliometric mapping but also applies these findings to the selection of suppliers in the mushroom agroindustry. This dual approach enhances both the theoretical contribution and practical relevance of this research.

The frequencies of using various multi-criterion decision-making (MCDM) methods are shown in Figure 2. This shows how often each MCDM method is used in research studies and publications and can be an indicator of the popularity or trend of certain methods in supplier selection or decision-making research. AHP has been widely used and recognized in various fields, including supply chain management, for supplier selection. This method has a strong theoretical basis and many case studies have demonstrated its success. In addition, TOPSIS can evaluate alternatives by comparing them with an ideal solution (Menon and Ravi, 2022). Fuzzy logic demonstrates the importance of this approach in dealing with uncertainty and subjectivity in decision making. Fuzzy logic provides a framework for processing unclear and uncertain information.(Afrasiabi et al. 2022).

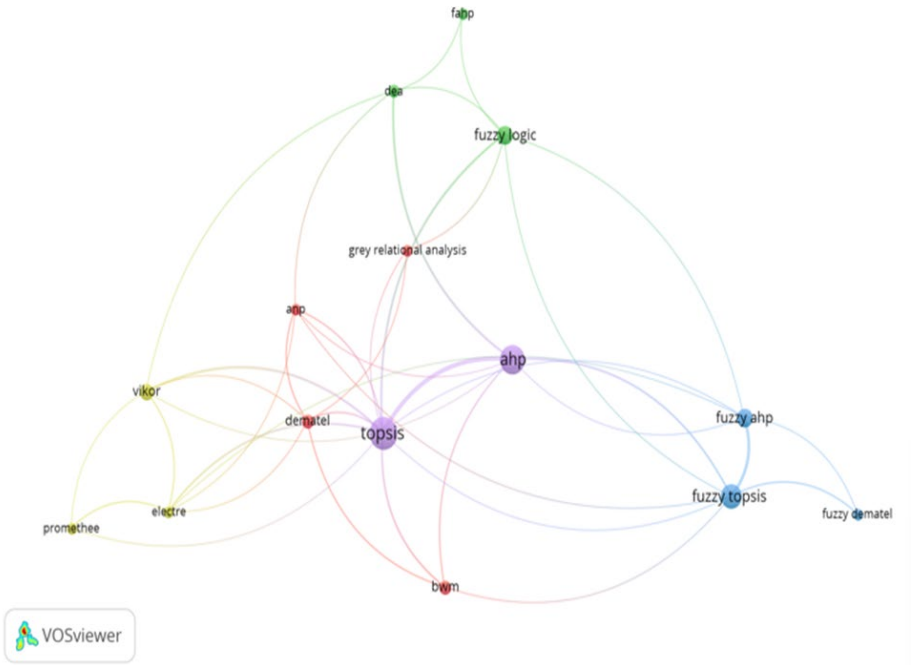

Figure 1. Bibliometric Results of Supplier Selection Using MCDM

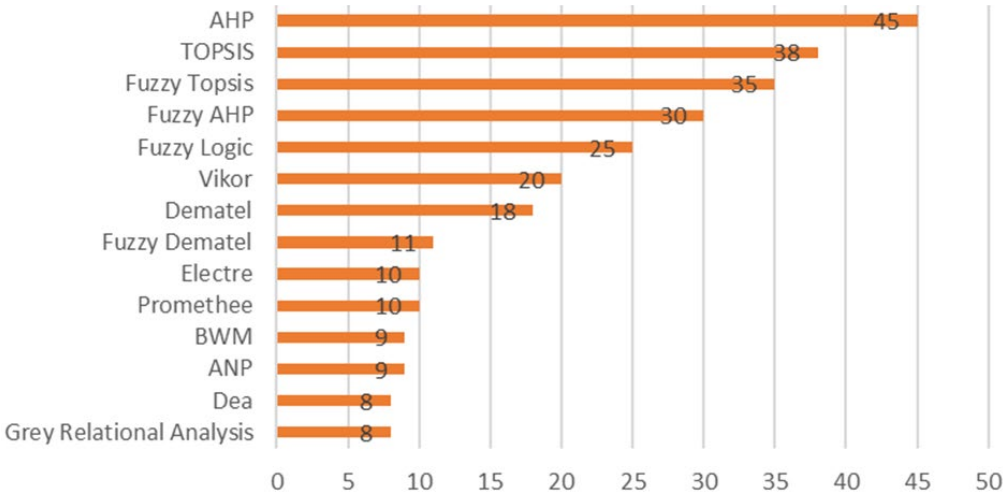

Figure 2. MCDM Method in Supplier Selection

Although the total number of articles included in the bibliometric analysis was substantial, the dominance of only a few methods such as AHP, TOPSIS, and Fuzzy Logic was due to two key factors. First, keyword co-occurrence analysis using VOSviewer was filtered based on a minimum threshold to ensure clarity and interpretability of the visualization. This means that only the methods with the highest frequency of occurrence across the dataset were visualized on the maps. Second, many other MCDM methods appeared in the dataset but were used far less frequently and therefore did not meet the inclusion threshold for the final visualization. This is consistent with previous bibliometric studies, such as Khulud et al. (2023), where similar dominant patterns were observed despite a broad article base. The purpose of this filtering is not to exclude relevant methods but to highlight those that are most impactful and widely adopted in the field of supplier selection.

VIKOR is used to find compromise solutions, whereas DEMATEL helps map and understand the cause-effect relationships in the system (Ciptomulyono et al. 2022). Both methods are useful for assessing various factors involved in supplier selection. Other methods such as ELECTRE, PROMETHEE, BWM, ANP, DEA, and grey relational analysis are also frequently used,

although at lower frequencies (Kumar et al. 2017). This method helps with subjective judgment, addressing complex decisions, assessing efficiency, and dealing with uncertainty in the data.

Review Why Choose AHP is better than TOPSIS

The Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are popular methods in multiple-criteria decision-making (MCDM). The AHP has several advantages that make it superior in certain situations. Comparison of AHP and Topsis in Table 1.

AHP is suitable for complex problems that require detailed analysis and consideration of many qualitative and quantitative methods (Salomon and Gomes, 2024). The primary advantage of TOPSIS is its ability to break down problems into smaller components and check the consistency of judgments. In addition, TOPSIS is simpler and faster to apply, particularly when the data are quantitative (Bai and Sarkis, 2018). This method is effective for direct comparison between alternatives and ideal solutions. However, this is less detailed and does not check for consistency.

Conceptual Model of Bibliometric Integration and MCDM

Based on Figure 3, a bibliometric analysis and literature review were conducted to identify relevant supplier criteria and determine the frequency of the MCDM methods used in the literature. Below is an explanation of each component in the diagram:

- **Database (Scopus):** The primary data source was the Scopus. Scopus is a bibliographic database that provides information on scientific journal articles, conferences, and other publications.
- **Bibliometric analysis:** Bibliometric analysis is used to evaluate various scientific publications related to supplier selection methods (Handayani et al. 2022). In this step, the most frequently used method was identified.
- **Literature Review:** In addition to bibliometric analysis, a literature review was conducted to gain a deeper understanding of supplier selection methods, including the criteria used and best practices identified in previous research.
- **Frequency of MCDM Methods:** In the bibliometric analysis, the frequency of Multi-Criteria Decision Making (MCDM) methods used in supplier selection is identified. This helps determine the most relevant and frequently used MCDM methods in previous studies.
- **Method Determination:** The most suitable method for this research was selected based on the frequency analysis of MCDM methods. This method was used for supplier selection.
- **Supplier Criteria:** The relevant criteria for supplier selection were identified based on the literature review. These criteria include quality, price, delivery, and service. These criteria are used as the basis for the supplier selection process based on the MCDM methodology.
- **Best Practice:** The result of the above process is supplier selection based on the identified criteria and chosen MCDM method. These best practices in supplier selection can then be implemented in relevant industries.

Based on Figure 3, the conceptual model illustrates a systematic approach to supplier selection by integrating bibliometric analysis and multi-criteria decision-making (MCDM) methods. The process begins with data collection from the Scopus database, which is then analyzed using bibliometric techniques to identify the most relevant supplier selection methods. Subsequently, a literature review was conducted to strengthen the findings and ensure that the selected methods aligned with the industry's best practices. This analysis also includes the identification of MCDM method usage frequency, leading to the determination of the optimal method for supplier evaluation, such as AHP, TOPSIS, or Fuzzy Logic. Once the method is determined, the next stage involves the identification of supplier criteria, where key factors such as quality, price, delivery time, service, and product suitability are selected as assessment parameters. The results of these stages are then implemented in the supplier selection process, which is a part of the best practices in the supply chain. Using this data-driven and systematic analysis approach, the model enables companies to make more objective and transparent supplier selection decisions, thereby optimizing supply chain efficiency and reducing supplier selection risk.

Implementation of the MCDM Method Based on Bibliometric Study Results

The Analytic Hierarchy Process (AHP) method was used for supplier selection in this study. This method is often used for supplier selection because it provides a structured framework for describing and evaluating the complex aspects of the selection process. AHP facilitates more objective and logical assessments (Abdullah and Zulkifli, 2015). This approach is highly effective for handling qualitative and quantitative data, incorporating subjective preferences, and verifying assessment consistency. AHP is also known for its ease of use, flexibility in adapting the model to changing needs, and ability to provide clear documentation for the decision-making process(Chen et al. 2023). This allows the AHP to support complex supplier selection decision-making.

Supplier Criteria

The results of identifying the supplier criteria for the mushroom agroindustry are shown in Figure 4. The definition and explanations of each supplier's criteria are presented in Table 2.

Table 1. Comparison of AHP and Topsis

Indicator	Method		Typical Application Goal
	AHP	Topsis	
Hierarchical and Structured Approach:	Breaks down complex problems into a hierarchy of objectives, criteria, sub-criteria, and alternatives, thereby facilitating understanding and evaluation.	Focus on the direct comparison of alternatives to the ideal solution without hierarchy.	AHP: Strategic, structured analysis; TOPSIS: Fast operational ranking
Detailed Pairwise Comparisons	Pairwise comparisons are used for an in-depth evaluation of 3 each criterion and alternative.	Do not use pairwise comparisons, and may lack detail.	AHP: Suitable for subjective expert judgment; TOPSIS: More objective and metric-driven
Ability to Handle Qualitative and Quantitative Data:	Integrates qualitative and quantitative data, enabling comprehensive evaluation.	More suitable for quantitative data, less effective in handling qualitative data.	AHP: Combines subjective and objective views; TOPSIS: Optimized for numerical scoring
Validation of Assessment Consistency	The consistency of the assessment was checked using the consistency ration (CR) Index.	No built-in mechanism to check scoring consistency.	AHP: Critical for decisions needing justification; TOPSIS: Suited for fast, low-risk selections

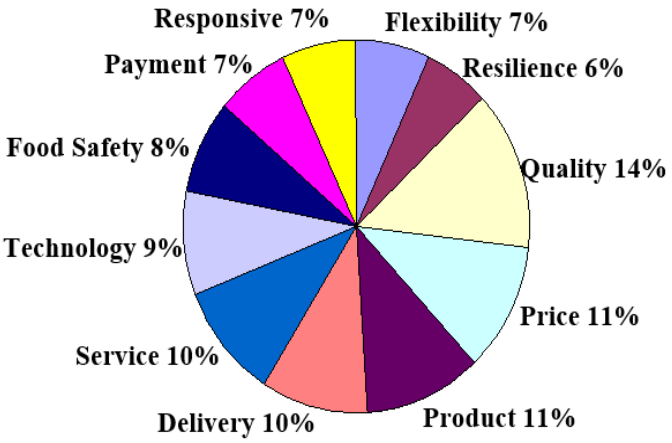

Figure 4. Supplier criteria for the mushroom agro-industry

Table 2. Supplier Criteria

Criteria	Definition of criteria	References
Quality	It is the supplier's ability to provide products or services that meet established quality standards.	(Taherdoost and Brard, 2019)
Price	Price competitiveness offered by suppliers, including price structures, discounts and economies of scale.	(R. Rajesh and Ravi, 2015)
Product	Conform to specifications, and are compatible with other products or existing services.	(Rasmussen et al., 2023)
Delivery	The product delivery process, including the speed, timeliness, and condition of the product when delivered.	(Rasmussen et al., 2023)
Service	Quality of service provided by the supplier.	(Yu and Tsai, 2008)
Technology	Utilization of the latest technology by suppliers.	(R. Rajesh and Ravi, 2015)
Food safety	Practices that ensure that food produced does not cause injury or poisoning quality control processes.	(Imran Khan (2021): Bux (2022)
Payment	Payment methods offered by suppliers, including credit terms, discounts, and payment transaction efficiency.	(Rasmussen et al., 2023)
Responsive	Speed and effectiveness of suppliers in responding to customer needs and changing requests.	(Rasmussen et al., 2023)
Flexibility	Ability to quickly adapt processor and systems to meet changing demands or market conditions.	(Rasmussen et al., 2023)
Resilience	Ability of a system to withstand or recover quickly from adversity, disruption, damage, or failure.	(Valipour Parkouhi and Safaei Ghadikolaei, 2017)

Analysis of Criteria Selection in Mushroom Supplier Selection

By selecting the criteria for delivery, product, service, price, and quality, companies can ensure that suppliers can provide fresh mushrooms with the right specifications, competitive prices, and satisfactory services. This enhances customer satisfaction, maintains a company's reputation, and supports long-term business sustainability. The following is an analysis of the criteria for supplier selection:

a. Delivery: In the mushroom industry, speed and timeliness of delivery are crucial because mushroom products are highly perishable. Timely delivery ensures that mushrooms remain fresh and of the highest quality when they reach the consumer's point of purchase. Delays or poor delivery conditions can cause significant losses because of quick spoilage of the product.
b. Product Criteria: This important because the quality and specifications of mushrooms must meet certain standards to be accepted by the market. Mushrooms must conform to specified standards for size, color, and freshness to ensure consumer satisfaction and compliance with industry standards.
c. Service: Good service from suppliers includes responsiveness to customer needs and inquiries, ability to handle complaints, and quick solutions to problems. Good service improves the long-term relationship between suppliers and buyers, which is crucial in a competitive industry such as mushrooms.
d. Price Criteria: Price is an important factor for maintaining profit margins. Competitive pricing enables companies to offer products at competitive prices. In addition, a clear pricing structure and discount can improve cost efficiency and competitiveness.
e. Quality Criteria: Quality is the main criterion for supplier selection because high-quality products ensure customer satisfaction and a good market reputation. In the mushroom industry, quality includes freshness, cleanliness, and adherence to the health standards. Good quality also reduces products and consumer complaints.

Application of the AHP Method to the Supplier Selection Process

The hierarchical structure comprises goals, criteria, and alternatives. The goal of this hierarchy is supplier selection, and the criteria consist of delivery, service, product quality, and price. Alternative suppliers include suppliers A, B, and C. These criteria and alternatives were obtained from the identification results of the literature review. The hierarchical structure of the Analytical Hierarchy Process (AHP) in Figure 5.

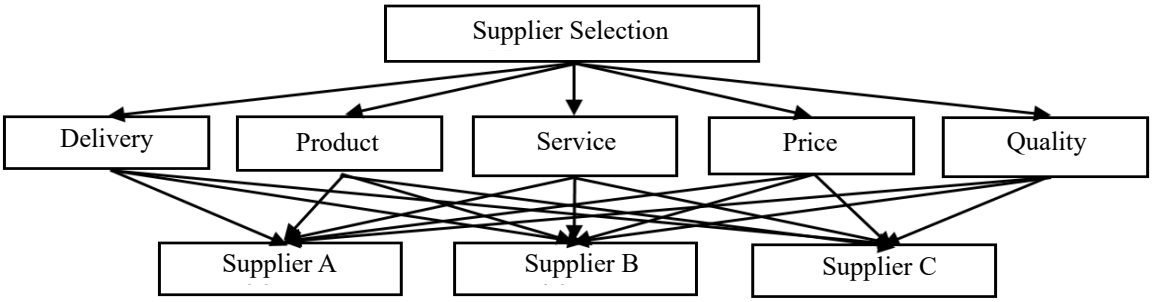

Figure 5. Supplier Selection Hierarchy Structure

Comparison between Criteria

After determining the criteria, weights were assigned to the relationship between the criteria and criteria. The assessment was conducted by two experts from the company and one academic person who completed the questionnaire. The questionnaire results for each respondent were inputted into the expert choice, and the results are shown in Table 3.

The normalization matrix calculation between the criteria determines the weights between the criteria (vector priority), as shown in Table 4. The results of the Consistency Ratio calculation are consistent with the parameter CR = 0.01 => 0.01.

Supplier Assessment Based on Five Criteria

Supplier assessment based on five criteria, namely, quality, cost, product, delivery, and service, is a comprehensive approach for evaluating and selecting the best suppliers in the supply chain. The most important quality criteria demonstrate that the company pays close attention to the quality of the products or services provided by suppliers. Chang and Wu (2011)focus on quality as it can help ensure customer satisfaction and a good reputation. Cost criteria are an important consideration when selecting suppliers because companies want to ensure that suppliers offer competitive prices and provide good value in the relationship between costs and benefits (Ada, 2022).

Based on Table 5, Supplier C has a greater weight than the other two suppliers. Regarding the price criteria, supplier B offers the most economical price, whereas supplier C offers the most expensive price. Supplier A is superior in terms of product criteria, meaning that it has the best product quality. On the other hand, the delivery criteria for supplier B have the lowest quality, which means that supplier B often experiences delays, in contrast to supplier A in terms of delivery, which is at the highest rank. Regarding the service criteria, supplier A offers the most superior service, as can be seen in the value weight of supplier A, which dominates suppliers B and C, which require improved service.

Overall, supplier A offers the best service and good products, Supplier C is superior in quality, and Supplier B offers competitive prices. The final decision on which supplier to choose depends on the priorities of the company that conducts the assessment. Supplier C may be the best choice if the quality is the top priority. If the price is the determining factor, Supplier B may be preferred. If overall balance and strong service are considered the most important, then Supplier A may be the most attractive choice.

Test Consistency

The results of the consistency test demonstrated that all the criteria had a CR value below the threshold of 0.10. This indicates that the paired assessments for each criterion have an acceptable level of consistency and can be used in the AHP decision-making process (Ramos et al. 2020). Based on Table 6, the high level of consistency shows that decision-makers' assessments are logical and coherent in the context of the relative importance of various criteria.

Supplier Ratings

Supplier A ranked the highest (37.2%). This score indicates that Supplier A may have performed better on the measured criteria than the other two suppliers. These relatively high scores may reflect excellence in terms of product quality, delivery reliability, price, customer service, or a combination of these (Fallahpour et al. 2021).

Table 3. Pairwise comparison between criteria

Criteria	Delivery	Product	Service	Price	Quality
Delivery		2.28943	2.62074	1.81712	2.28943
Product			3.0	1.10064	1.44225
Service				3.68403	5.27763
Price					1.25992
Quality	Incon:0,05				

Table 4. Weights between criteria

Criteria	Weight
Delivery	0.198
Product	0.172
Service	0.062
Price	0.273
Quality	0.295

Inconsistency = 0.05
With 0 missing judgement

Table 5. Criteria weight table for suppliers

Criteria	Supplier A	Supplier B	Supplier C
Quality	0.361	0.178	0.461
Price	0.302	0.430	0.268
Product	0.395	0.239	0.366
Delivery	0.395	0.239	0.366
Service	0.643	0.198	0.159

Table 6. Criteria consistency test for suppliers

Criteria	Consistency Index (CI)	Random Consistency Index (IR), n = 3	Consistency Ratio (CR)=CI/IR	
Quality	0.01	0.58	0.02	Consistent
Price	0.013	0.58	0.02	Consistent
Product	0.02	0.58	0.03	Consistent
Delivery	0.009	0.58	0.02	Consistent
Service	0.007	0.58	0.01	Consistent

Supplier C was in second place, with a score of 35.9%, slightly below that of Supplier A. This score shows that Supplier C also has a strong performance in the assessment criteria, which is almost comparable to that of Supplier A, but some aspects still need to be improved to reach the top ranking. Supplier B received the lowest score (26.9%). This indicates that in some or all of the scoring criteria, Supplier B may not be as competitive as Suppliers A and C. This low score can be attributed to several factors such as low quality, low competitive prices, and unsatisfactory service.

The distribution of assessment weights shows clear differences in the performance of the three suppliers. Supplier A seems to be the best choice based on the assessment criteria, whereas supplier C shows good and competitive performance. By contrast, supplier B should review and improve several aspects of its operations and offerings to improve its position. According to Parkouhi et al. (2019) stated that when making a final decision, it is important to consider the specific criteria on which this assessment is based and how those criteria align with the needs and priorities of the organization conducting the assessment.

Managerial Implications

This study provides significant managerial implications for improving the effectiveness of supplier selection by integrating bibliometric and multi-criteria decision-making (MCDM) methods. Using this approach, procurement and supply chain managers can make data-driven decisions when evaluating suppliers, thereby reducing subjectivity and increasing the selection accuracy. The AHP (Analytic Hierarchy Process) method, chosen in this study, enables supplier evaluation based on a combination of quantitative and qualitative data, considering five key criteria: quality, price, delivery time, service, and product suitability. By applying this model, companies can optimize their operational efficiency, avoid suppliers who do not meet standards, and enhance transparency and objectivity in the supplier selection process.

Furthermore, the supplier selection model developed in this study can be applied not only to the agroindustry but also to other sectors such as manufacturing, pharmaceuticals, and the food industry. The bibliometric MCDM-based approach provides a flexible framework that can be tailored to industry-specific needs, allowing companies to select suppliers that best align with their business strategies. Implementing this method can help companies mitigate supply chain risks, strengthen long-term relationships with reliable suppliers, and enhance competitiveness in increasingly complex markets. Thus, this study provides strong guidelines for managers to develop more objective and efficient supplier selection strategies.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study successfully integrated bibliometric and multi-criteria decision-making (MCDM) approaches into the supplier selection process. This approach allows the identification of relevant and effective MCDM methods based on a literature analysis. The integration model of bibliometrics and the MCDM provides objective and informed guidance for supplier selection. This helps companies to make decisions that are more effective and suit their needs. The analytic hierarchy process (AHP) method was chosen as the most suitable MCDM method for supplier selection based on the results of the bibliometric analysis. AHP allows for more structured and logical modeling, particularly when dealing with qualitative and quantitative data and subjective preferences. Based on the AHP method, supplier A is the priority raw-material supplier. Supplier A received the highest total weight score of 0.389, followed by Supplier C (0.345), and Supplier B (0.266). These results indicate that Supplier A outperformed the other suppliers, particularly in terms of quality and delivery time, which were assigned the highest importance weights in the hierarchy. The consistency ratio (CR) of the pairwise comparisons was below 0.10, confirming the validity of expert judgments. This study provides not only a replicable methodology but also actionable recommendations for supplier prioritization in the mushroom agroindustry context.

Recommendations

Future research should test the integrated bibliometric MCDM model in different industrial contexts to examine its adaptability and scalability. Exploring alternative MCDM methods, such as BWM, DEMATEL, or VIKOR, in combination with bibliometric screening, could offer comparative insights. From a practical perspective, companies in the agro-industry sector are encouraged to use bibliometric evidence as a foundation for selecting the appropriate decision-making tools. This helps ensure that the chosen methods are not only theoretically sound, but also aligned with industry-specific needs, improving supplier selection effectiveness, and reducing supply chain risks.

Despite its contributions, this study had several limitations. First, the case study focused exclusively on the mushroom agroindustry, which may limit the generalizability of the findings to other sectors and product types. Second, the AHP evaluation involved a limited number of expert respondents, which may have introduced subjective bias. Additionally, bibliometric analysis relies solely on the Scopus database; thus, relevant studies indexed in other databases, such as Web of Science or Google Scholar, may have been omitted. Future studies should consider broader databases and more diverse expert panels to increase their robustness.

DECLARATION OF GENERATIVE AI STATEMENT: During the preparation of this manuscript, the authors used ChatGPT solely to improve grammar, refine the sentence structure, and assist with language clarity. The authors did not use this tool to

generate scientific content, data analysis, or conceptual development of the manuscript. After utilizing this tool, the authors carefully reviewed, edited, and verified all the content to ensure its accuracy, originality, and academic integrity. The authors take full responsibility for the contents of this manuscript.

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