

e-ISSN: 2502-1516

Research Article

Received: September 11, 2025  
Revised: July 31, 2026  
Accepted: August 12, 2026  
Available Online: September 2026

## MAPPING THE CAUSAL INTERRELATIONSHIPS AMONG BARRIERS TO SUSTAINABLE SUPPLY CHAIN IMPLEMENTATION IN THE BROILER CHICKEN INDUSTRY

**Keywords:**  
broiler chicken; Grey-DEMATEL; ISM; partnership farming; sustainable supply chain

**Ade Aisyah Arifna Putri<sup>\*1</sup>, Ratna Purwaningsih<sup>2</sup>, Alyssa Hayfa Zalsabila<sup>2</sup>, Singgih Saptadi<sup>2</sup>, Ary Arvianto<sup>2</sup>, Wiwik Budiawan<sup>2</sup>**

**Corresponding author(s):**  
e-mail:  
aisyaharifna@staff.uns.ac.id

1. Departemen Teknik Industri, Fakultas Teknik, Universitas Sebelas Maret  
2. Departemen Teknik Industri, Fakultas Teknik, Universitas Diponegoro

### Abstract

Broiler chicken production in Central Java is primarily carried out through a partnership system involving plasma farmers, partner slaughterhouses, and core companies. However, these stakeholders still face sustainability challenges. The implementation of sustainable practices in the broiler chicken supply chain is influenced by various factors, including barriers. Efforts are needed to address obstacles hindering the optimal implementation of sustainable supply chain strategies. This research aims to identify priority barriers, understand the relationship between inhibiting factors, and provide policy recommendations. To assess the influence and nature of each factor, a combination of the Grey Decision-Making Trial and Evaluation Laboratory (Grey-DEMATEL) and Interpretive Structural Model (ISM) methods was used. Six experts from government, practitioners, and academics participated in evaluating barriers to ensure a diverse range of perspectives. Fourteen barriers were identified through a literature review, and 10 were considered relevant to the research topic. Each valid factor is grouped based on influence group, influence size, and priority. The lack of company policy is identified as the highest-priority factor. This research also offers policy recommendations to address the top three priority barriers.

Copyright © 2026 by Authors,  
Published by Universitas Diponegoro Publishing  
Group.

This open access article is distributed under a Creative  
Commons Attribution 4.0 International license



### 1. Introduction

Central Java plays a significant role in Indonesia's broiler industry. According to the Directorate General of Livestock and Animal Health Services (2025), Central Java produced approximately 787,171 tonnes of broiler meat in 2025, making it the second-largest broiler meat-producing province in Indonesia after West Java. This production increased from 773,270 tonnes in 2024, highlighting Central Java's continued importance as a major source of broiler supply in Indonesia. 90% of broiler chicken production in Central Java is carried out in a partnership system between plasma farmers, partner slaughterhouses, and the nucleus company (Susanty et al., 2020). BPS Central Java (2022) recorded 70 poultry farming companies in Central Java that were engaged in hatching, breeding, fattening, and rearing female poultry for meat or egg production. Plasma farmers and slaughterhouses in Central Java still face problems in maintaining sustainability. Nurtini et al. (2017) conducted a study of 255 plasma farmers and found that some farmers still incurred losses of up to 12.5%. Hertanto et al. (2018), in a study of microbiological quality at slaughterhouses in Karanganyar, found *E. coli* and *Salmonella* contamination originating from equipment, unsanitary conditions, and

**Table 1.** Acceptable CVI Values

| Number of Experts | Acceptable CVI Value |
|-------------------|----------------------|
| 3-4               | Exactly 1            |
| 5                 | $\geq 0.80$          |
| 6                 | $\geq 0.83$          |
| 7                 | $\geq 0.86$          |
| 8                 | $\geq 0.88$          |
| >9                | $\geq 0.78$          |

substandard production processes. Such conditions generate economic losses for plasma farmers, pose social harm to consumers through unsafe products, and threaten the sustainability of the broiler chicken supply chain.

Susanty et al. (2020) and Susanty et al. (2021) quantified supply chain sustainability in Central Java using Multidimensional Scaling (MDS), assessing plasma farmers across three companies and a chicken slaughterhouse. All four were classified as moderately sustainable, with indices of 55.35, 60.91, and 51.83 for the companies and 61.99 for the slaughterhouse on a 1–100 scale.

The analysis and evaluation of factors affecting supply chains has been widely studied. Xia and Ruan (2020) examined the barriers to implementing sustainable agriculture, strategies for addressing these challenges, and the visualization of sustainable agriculture strategies in China using the Grey-DEMATEL method. Paul et al. (2023) developed a systematic approach to identify and analyze challenges to sustainability in Australia's food processing supply chain through the Best-Worst Method. While Grey-DEMATEL reveals cause–effect relationships and the Best-Worst Method establishes factor weights, neither approach produces a hierarchical structure showing how barriers drive one another across levels. Similar research has been conducted by Siebrecht (2020), Guimarães et al. (2022), Mohseni et al. (2022), and Yunita et al. (2022), focusing on the drivers of supply chain implementation. The present study addresses the broiler chicken supply chain by identifying priority factors and depicting their interrelationships in a diagram.

Assessing the barriers to Sustainable Supply Chain Management (SSCM) implementation is both theoretically and practically important. Although SSCM has developed rapidly over the past two decades, its adoption in practice remains constrained, particularly in developing countries, by limited resources, insufficient managerial commitment, weak regulatory frameworks, and low collaboration among supply chain actors (Jia et al., 2018).

This study aims to identify the barriers to sustainable supply chain implementation, examine their interrelationships, and provide recommendations based on their priority. The supply chain is delimited to the partnership between core companies and plasma farmers, and to chicken slaughterhouses. The barriers were identified through a literature review, while the relationships among them were established based on expert judgment.

The barriers are then ranked by priority to inform development strategies based on the highest-priority factors (Nazam et al., 2020). This study employs the Grey Decision-Making Trial and Evaluation Laboratory and Interpretive Structural Modeling (Grey-DEMATEL-ISM) methods to evaluate the barriers.

## 2. Methods

The variables were identified through a literature review of previous studies on sustainability in agricultural and livestock supply chains. The review was limited to peer-reviewed scientific articles published in English from 2018 onward. To validate the barriers, this study drew on the expert judgment of six experts representing government, practitioners, and academics.

### 2.1 Variables Validation

Validation focused on content validity, which aims to provide evidence of the extent to which the elements of an assessment instrument are relevant to and representative of the intended construct of the research objectives. This study used the Content Validity Index (CVI), which, according to Almanasreh et al. (2019), is the most widely used method for measuring an instrument's content validity. A four-point rating scale was used: 1 (not relevant and not representative of the research objectives), 2 (slightly relevant and slightly representative), 3 (fairly relevant and fairly representative), and 4 (highly relevant and highly representative). The CVI can be computed at the level of the entire scale or for each individual item, the latter being referred to as the item-level CVI (I-CVI).

The CVI is calculated as the proportion of respondents who assign a rating of 3 or 4, relative to the total number of respondents. If this proportion meets the accepted CVI value, the variable is retained for use in the study; if it falls below the required threshold, the variable is excluded. **Table 1** presents the acceptable CVI values (Polit et al., 2007).

### 2.2 Grey-DEMATEL

The Decision-Making Trial and Evaluation Laboratory (DEMATEL) is a structural modeling approach used to analyze cause-and-effect relationships among elements within complex systems (Thakkar, 2021). DEMATEL was first developed by the Battelle Memorial Institute at its Geneva Research Centre in 1973 (Chang et al., 2011; Si et al., 2018). The DEMATEL method has been widely used in supply chain studies, such as those on electronic products (Rajesh & Ravi, 2015), automotives (Govindan et al., 2015), food (Liu et al., 2021; Susanty, Puspitasari, et al., 2021), and

agriculture (Gardas et al., 2018). This method is used as a tool to identify important factors in the supply chain (Gardas et al., 2018; Wu and Chang, 2015), to evaluate supply chain sustainability (Lin, 2013), and to evaluate factors in sustainable supply chains (Gandhi et al., 2015; Kaur et al., 2017; Khan et al., 2020; Luthra et al., 2018).

The advantages of this method lie in its effectiveness in analyzing the mutual influence among factors, its capacity to capture complex cause-and-effect relationships, and its ability to identify critical evaluation criteria. However, DEMATEL has limitations in ranking alternatives, as it relies solely on interdependence relationships and does not account for relative weighting.

The limitations of DEMATEL, particularly its susceptibility to subjectivity and imprecision in expert input, necessitate integrating the method with other theories, such as grey theory (Khan et al., 2020). Grey set theory enables decisions that more closely approximate reality by constructing models based on numerical intervals. It is adopted because expert judgments can be expressed in linguistic terms rather than in crisp values (Han & Wang, 2018). Grey theory is incorporated into DEMATEL to address ambiguity arising from expert judgments, accommodate limited data or small expert samples, and improve the accuracy of observations (Haleem et al., 2019; Si et al., 2018). Data processing with the Grey-DEMATEL method follows the procedures applied in Bhatia & Srivastava (2018); de Campos et al. (2020); Xing et al. (2023).

### 2.3 Interpretive Structural Modeling (ISM)

ISM is a technique developed by Warfield (1974) and Sage (1977) that adopts a pairwise comparison approach. The technique helps identify relationships among the variables under study (Haleem et al., 2012). However, ISM can only indicate the order and direction of the complex relationships among variables; it does not assign weights to those variables (Kannan et al., 2008).

A study by Shahabaddkar et al. (2012) shows that ISM is widely used in research on supply chain management. Among the supply chain management topics covered in that study are supplier management, supply chain risk management, technology adoption, supply chain performance, reverse logistics, supply chain integration, the service industry, and green supply chain management. ISM has been widely applied to analyze issues within supply chains, depict barriers and drivers, and model the structure of relationships and interactions.

The ISM method is carried out in several stages, including (Dixit et al., 2022; Xing et al., 2023):

1. Converting the total influence matrix into the initial reachability matrix
2. Checking for transitivity and constructing the final reachability matrix
3. Partitioning the reachability matrix
4. Developing the ISM model
5. MICMAC analysis

### 3. Results and Discussions

A total of 32 journal articles were screened as relevant to the topic, of which 8 were selected for the analysis of barriers to sustainable supply chain implementation. The remaining 24 were excluded because their focus differed from

Table 2. Barrier Factors

| No  | Barriers                            | Ghadge et al. (2020) | Kumar et al. (2022) | Srinivasan et al. (2022) | Paul et al. (2023) | Guimarães et al. (2022) | Liu et al. (2021) | Adams et al. (2023) | Mohseni et al. (2022) |
|-----|-------------------------------------|----------------------|---------------------|--------------------------|--------------------|-------------------------|-------------------|---------------------|-----------------------|
| B1  | Inadequate Technology               |                      | ✓                   | ✓                        |                    | ✓                       | ✓                 | ✓                   |                       |
| B2  | High Investment Cost                | ✓                    | ✓                   | ✓                        | ✓                  | ✓                       |                   | ✓                   | ✓                     |
| B3  | Lack of Knowledge                   | ✓                    |                     | ✓                        |                    | ✓                       | ✓                 |                     | ✓                     |
| B4  | Lack of Management Motivation       | ✓                    | ✓                   | ✓                        |                    | ✓                       |                   | ✓                   |                       |
| B5  | Lack of Regulation                  | ✓                    | ✓                   | ✓                        |                    |                         | ✓                 | ✓                   |                       |
| B6  | Lack of Expertise                   |                      |                     | ✓                        | ✓                  | ✓                       | ✓                 |                     | ✓                     |
| B7  | Increase in Operational Costs       |                      |                     | ✓                        | ✓                  |                         | ✓                 |                     | ✓                     |
| B8  | Lack of Government Guidance         | ✓                    |                     | ✓                        |                    |                         |                   |                     |                       |
| B9  | Lack of Government Control          |                      | ✓                   |                          |                    |                         | ✓                 |                     | ✓                     |
| B10 | Lack of Company Policy              | ✓                    | ✓                   | ✓                        |                    |                         |                   |                     |                       |
| B11 | Customer Concern for Sustainability | ✓                    |                     | ✓                        |                    |                         |                   |                     | ✓                     |
| B12 | Company Size                        | ✓                    |                     |                          |                    |                         |                   |                     |                       |
| B13 | Market Fluctuation                  | ✓                    |                     |                          | ✓                  |                         |                   |                     |                       |
| B14 | Product Price                       | ✓                    |                     |                          |                    |                         |                   |                     |                       |

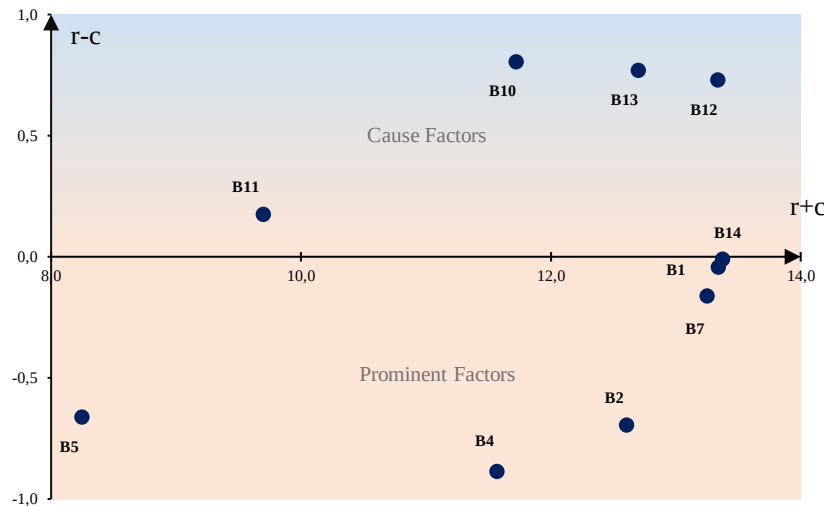


**Figure 1.** Cause-Effect Diagram

that of this study or because they were inaccessible. The selected studies are Ghadge et al. (2020), Srinivasan et al. (2022), Kumar et al. (2022), Paul et al. (2023), Guimarães et al. (2022), Liu et al. (2021), Adams et al. (2023), and Mohseni et al. (2022). 14 variables were derived from the literature review; 10 were successfully validated and retained as the selected barriers. The barriers are presented in **Table 2**.

### 3.1. Prominence and Causal Relations Based on Grey-DEMATEL

The prominence value ( $r+c$ ), the relation value ( $r-c$ ), and the depiction of interrelationships among factors form the basis of the Grey-DEMATEL analysis. The ( $r+c$ ) value indicates the magnitude of a factor's influence in relation to other factors. Factors with high ( $r+c$ ) values exert a substantial influence in impeding the implementation of a sustainable supply chain. The ( $r-c$ ) value indicates the nature of a factor, whether it acts as a cause factor that influences other barriers, or as an effect factor that is influenced by other barriers. If the ( $r-c$ ) value is greater than 0, the factor belongs to the cause group. If the ( $r-c$ ) value is less than 0, the factor belongs to the effect group. The lower the ( $r-c$ ) value, the more strongly the factor is influenced by others. **Figure 1** shows the position of each factor based on its ( $r+c$ ) and ( $r-c$ ) values.

Several barriers stand out in terms of prominence ( $r+c$ ), which reflects the extent to which a factor is embedded in the system as both an influencing and an influenced element. Inadequate technology (B1), increase in operational costs (B7), and product price (B14) record the highest ( $r+c$ ) values, yet their ( $r-c$ ) values lie close to zero. This positions them as linkage factors that transmit influence within the system rather than originate it, indicating that they are closely tied to the other barriers and represent the most visible manifestations of the constraints on sustainable supply chain implementation.

Conversely, company size (B12), market fluctuation (B13), and lack of company policy (B10) combine high prominence with clearly positive ( $r-c$ ) values, placing them in the cause group. These barriers exert substantial influence on the others while being only slightly influenced in return, which establishes them as the priority factors for intervention. Consumer concern for sustainability (B11) also falls within the cause group, but its weak net causal effect and low prominence suggest a limited role in the system observed.

Lack of company policy (B10) and market fluctuation (B13) emerge as strong barriers in this study; market structure was likewise identified by Habib et al. (2024) as a strong barrier to sustainability in agribusiness. Company size, in turn, was found to be a barrier in the studies of Wang et al. (2018) and Baig et al. (2020). These three factors are regarded as strong barriers because they not only affect a single dimension of sustainability but also serve as driving barriers that shape an organization's capacity to implement sustainability practices throughout the supply chain. This finding is consistent with Seuring and Müller (2008), who emphasize that implementing sustainability depends on the focal company's capacity to set standards and communicate the corresponding requirements to all partners across the supply chain.

The ( $r+c$ ) values indicate that several factors fall into the medium and weak categories. High investment cost (B2) and lack of management motivation (B4) have medium ( $r+c$ ) values, placing them among factors of moderate impact; both are influenced more by other factors than they influence, given their negative ( $r-c$ ) values. The factors with the lowest ( $r-c$ ) values are B4 and B5, which are therefore the weakest of the effect factors. Another weak factor is consumer concern for sustainability (B11), which belongs to the cause group.

### 3.2. Hierarchical Structure Based on ISM

The ISM model of the relationships among the barriers to sustainable supply chain implementation comprises four levels. For ease of discussion, levels 1 and 2 are hereafter referred to as surface factors and levels 3 and 4 as

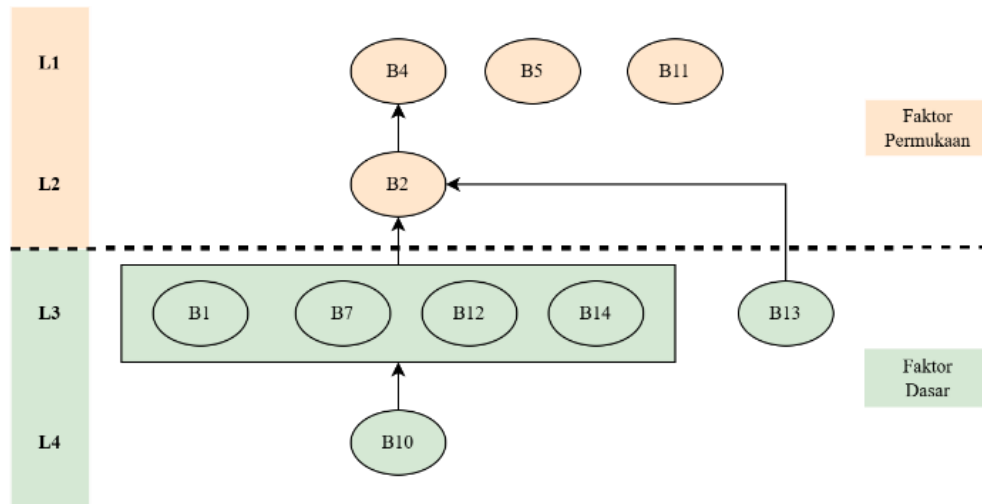


Figure 2. ISM Diagram

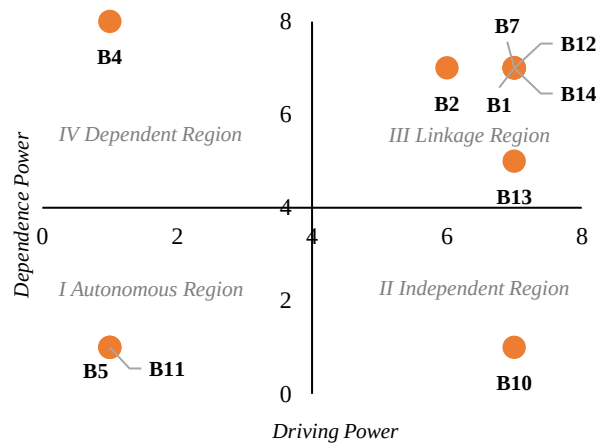


Figure 3. Classification of Barriers

fundamental factors; this grouping is a simplification adopted in the present study. **Figure 2** shows the position of each factor within the hierarchy. The deeper a factor is positioned in the hierarchy, the greater its driving power over the factors above it, making factors at levels 3 and 4 the priorities for intervention.

In ISM, the reachability matrix is used in the MICMAC analysis to clarify the role of each factor within the system based on its driving power and dependence power. The results of the MICMAC analysis are presented in a four-quadrant diagram. **Figure 3** shows the category of each barrier.

The ISM method depicts the relationships among factors through the ISM diagram and the MICMAC quadrants. The ISM diagram groups the factors into four levels, with level 1 comprising the most dependent factors and level 4 the most influential. Level 1 consists of a lack of management motivation (B4), a lack of government policy (B5), and a lack of consumer concern for sustainability (B11). Level 2 consists of high investment cost (B2). Level 3 comprises inadequate technology (B1), increase in operational costs (B7), company size (B12), market fluctuation (B13), and product price (B14). Level 4 consists of lack of company policy (B10).

The MICMAC quadrants classify the factors as autonomous, independent, linkage, and dependent. Autonomous factors are relatively disconnected from the system, with few links to the other barriers; these include a lack of government policy (B5) and a lack of consumer concern for sustainability (B11). The independent factor is only weakly influenced by others yet exerts a strong effect on them, namely, the lack of company policy (B10). Linkage factors act as connectors within the system and comprise inadequate technology (B1), high investment costs (B2), increase in operational costs (B7), company size (B12), market fluctuations (B13), and product prices (B14). The dependent factor has low driving power and is strongly influenced by the others, namely, lack of management motivation (B4).

### 3.3. Integrated Grey-DEMATEL–ISM Analysis

The barriers to sustainable supply chain implementation identified in this study are treated as a self-contained system. The interactions and relationships among the factors were analyzed through a combination of the Grey-DEMATEL method, the ISM model, and MICMAC analysis. Based on these results, the factors are divided into surface factors and fundamental factors.

Surface factors are those most visible in practice, emerging as consequences of the more fundamental factors within the system. In this study, the surface factors comprise high investment cost (B2), lack of management motivation (B4), lack of government policy (B5), and lack of consumer concern for sustainability (B11).

Lack of management motivation (B4) is not a priority factor, as it combines low driving power with high dependence, thus falling into the dependent quadrant. It nonetheless warrants examination, since its presence signals other barriers with greater driving power.

High investment cost (B2) occupies a different position relative to the other surface factors. Its prominence ( $r+c$ ) is above average, and the MICMAC analysis places it in the linkage quadrant, indicating that it not only receives influence but also transmits it to other factors. Altering this factor, therefore, requires identifying its root causes rather than addressing it directly.

Lack of government policy (B5) and lack of consumer concern for sustainability (B11) are relatively disconnected from the system, as both exhibit low driving power and low dependence, placing them in the autonomous quadrant. The position of B5 is consistent with its being the least prominent among all factors in the Grey-DEMATEL analysis.

Fundamental factors are the drivers that operate at the deepest level of the hierarchy and substantially shape the system. This study identifies six fundamental factors that occupy levels 3 and 4 of the ISM hierarchy: inadequate technology (B1), increase in operational costs (B7), lack of company policy (B10), company size (B12), market fluctuation (B13), and product price (B14).

Among these, only lack of company policy (B10) stands alone at level 4 and occupies the independent quadrant, combining high driving power with low dependence. B10 is therefore the sole factor that can be regarded as the root cause within the system and the highest priority for resolution. Company policy determines the availability of technology, operational costs, and product pricing across the partnership chain.

The five remaining fundamental factors fall within the linkage quadrant. Market fluctuation (B13) and company size (B12) exhibit positive net causal effects and thus act as secondary drivers that transmit pressure to the factors above them. Inadequate technology (B1), increase in operational costs (B7), and product price (B14), by contrast, have net causal effects close to zero, functioning as conduits of influence and as the most visible manifestations of the more fundamental barriers.

Market fluctuation (B13) differs in nature from the other fundamental factors, as it lies beyond the control of both the core company and the plasma farmers. Addressing it is therefore better directed at strengthening adaptive capacity than at eliminating the factor itself.

This study identifies six fundamental factors: inadequate technology (B1), increase in operational costs (B7), lack of company policy (B10), company size (B12), market fluctuation (B13), and product price (B14). Among these six, lack of company policy (B10) is the most influential factor. Company policy is judged to affect the availability of technology, operational costs, company size, and product price.

The ISM analysis identifies six important factors: inadequate technology (B1), increase in operational costs (B7), lack of company policy (B10), company size (B12), market fluctuation (B13), and product price (B14). Among these, the lack of company policy (B10) is a priority factor, as it ranks lowest on the ISM diagram. In addition, inadequate technology (B1) and company size (B12) are identified as priority factors owing to the magnitude of their influence and their tendency toward low dependence values. This study therefore identifies three priority factors: lack of company policy (B10), inadequate technology (B1), and company size (B12).

Recommendations for addressing barriers to sustainable supply chain implementation focus on three priority factors: lack of company policy (B10), inadequate technology (B1), and company size (B12). The recommendations for addressing the lack of company policy (B10) are the establishment of a sustainability committee, the development of a sustainability policy, and the conduct of sustainability audits. The recommendations for addressing inadequate technology (B1) include identifying potential areas for improvement, such as emissions and energy use, upgrading the technology, and monitoring its effectiveness. The recommendation for addressing company size (B12) is to strengthen collaboration and cooperation among small enterprises, large companies, government, and academia.

#### **4. Conclusion**

Using the Grey-DEMATEL and ISM methods, three priority factors were identified: lack of company policy (B10), inadequate technology (B1), and company size (B12). The Grey-DEMATEL analysis identifies the type and magnitude of influence of each factor. The barriers in the cause group are lack of company policy (B10), market fluctuations (B13), company size (B12), and lack of consumer concern for sustainability (B11). The barriers in the effect group are lack of management motivation (B4), high investment costs (B2), lack of government policy (B5), increase in operational costs (B7), inadequate technology (B1), and product price (B14). The factors with the highest prominence are product price (B14), increase in operational cost (B7), and company size (B12), whereas those with the lowest prominence are lack of government policy (B5), lack of consumer concern for sustainability (B11), and lack of management motivation (B4). The recommendations for addressing the three priority barriers are to establish a sustainability committee, identify potential areas for improvement, such as emissions and energy use, and strengthen collaboration among small enterprises, large companies, government, and academics.

## AI Use Declaration

The authors declare that we used artificial intelligence (AI) tools in the preparation of this manuscript. The AI tool used was ChatGPT (OpenAI, GPT-5.6), which was utilized for language editing, grammar improvement, enhancement of the manuscript's structure and readability, and assistance with the initial literature search. All sources used were independently verified by the authors. All ideas, interpretations, figures, data analyses, discussions, and conclusions presented in this manuscript were developed and determined by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the entire content of the manuscript.

## 5. References

- Adams, D., Donovan, J., & Topple, C. (2023). Sustainability in large food and beverage companies and their supply chains: An investigation into key drivers and barriers affecting sustainability strategies. *Business Strategy and the Environment*, 32(4), 1451–1463. <https://doi.org/10.1002/BSE.3198>
- Almanasreh, E., Moles, R., & Chen, T. F. (2019). Evaluation of methods used for estimating content validity. *Research in Social and Administrative Pharmacy*, 15(2), 214–221. <https://doi.org/10.1016/J.SAPHARM.2018.03.066>
- Baig, S. A., Abrar, M., Batool, A., Hashim, M., & Shabbir, R. (2020). Barriers to the adoption of sustainable supply chain management practices: Moderating role of firm size. *Cogent Business & Management*, 7(1), 1841525. <https://doi.org/10.1080/23311975.2020.1841525>
- Bhatia, M. S., & Srivastava, R. K. (2018). Analysis of external barriers to remanufacturing using grey-DEMATEL approach: An Indian perspective. *Resources, Conservation and Recycling*, 136, 79–87. <https://doi.org/10.1016/J.RESCONREC.2018.03.021>
- BPS Jawa Tengah. (2022). *Direktori Perusahaan Pertanian Jawa Tengah 2022*.
- Chang, B., Chang, C. W., & Wu, C. H. (2011). Fuzzy DEMATEL method for developing supplier selection criteria. *Expert Systems with Applications*, 38(3), 1850–1858. <https://doi.org/10.1016/J.ESWA.2010.07.114>
- de Campos, E. A. R., Tavana, M., ten Caten, C. S., Bouzon, M., & de Paula, I. C. (2020). A grey-DEMATEL approach for analyzing factors critical to the implementation of reverse logistics in the pharmaceutical care process. *Environmental Science and Pollution Research*, 28(11), 14156–14176. <https://doi.org/10.1007/S11356-020-11138-8>
- Dixit, A., Suvadarshini, P., & Pagare, D. V. (2022). Analysis of barriers to organic farming adoption in developing countries: a grey-DEMATEL and ISM approach. *Journal of Agribusiness in Developing and Emerging Economies*, <https://doi.org/10.1108/JADEE-06-2022-0111>
- Gandhi, S., Mangla, S. K., Kumar, P., & Kumar, D. (2015). Evaluating factors in implementation of successful green supply chain management using DEMATEL: A case study. *International Strategic Management Review*, 3(1–2), 96–109. <https://doi.org/10.1016/J.ISM.2015.05.001>
- Gardas, B. B., Raut, R. D., & Narkhede, B. (2018). Evaluating critical causal factors for post-harvest losses (PHL) in the fruit and vegetables supply chain in India using the DEMATEL approach. *Journal of Cleaner Production*, 199, 47–61. <https://doi.org/10.1016/J.JCLEPRO.2018.07.153>
- Ghadge, A., Er Kara, M., Mogale, D. G., Choudhary, S., & Dani, S. (2020). Sustainability implementation challenges in food supply chains: a case of UK artisan cheese producers. —, 32(14), 1191–1206. <https://doi.org/10.1080/09537287.2020.1796140>
- Govindan, K., Khodaverdi, R., & Vafadarnikjoo, A. (2015). Intuitionistic fuzzy-based DEMATEL method for developing green practices and performances in a green supply chain. *Expert Systems with Applications*, 42(20), 7207–7220. <https://doi.org/10.1016/J.ESWA.2015.04.030>
- Guimarães, Y. M., Eustachio, J. H. P. P., Leal Filho, W., Martinez, L. F., do Valle, M. R., & Caldana, A. C. F. (2022). Drivers and barriers in sustainable supply chains: The case of the Brazilian coffee industry. *Sustainable Production and Consumption*, 34, 42–54. <https://doi.org/10.1016/J.SPC.2022.08.031>
- Habib, A. M., Ren, J., Matellini, B., Jenkinson, I., & Paraskevadakis, D. (2024). Critical factors to adopt sustainable agrifood supply chain management in developing countries: The case of Ethiopian coffee industry. *Business Strategy & Development*, 7(4), e70032. <https://doi.org/10.1002/bsd2.70032>
- Haleem, A., Sushil, Qadri, M. A., & Kumar, S. (2012). Analysis of critical success factors of world-class manufacturing practices: an application of interpretative structural modelling and interpretative ranking process. —, 23(10–11), 722–734. <https://doi.org/10.1080/09537287.2011.642134>
- Haleem, A., Khan, S., & Khan, M. I. (2019). Traceability implementation in food supply chain: A grey-DEMATEL approach. *Information Processing in Agriculture*, 6(3), 335–348. <https://doi.org/10.1016/J.INPA.2019.01.003>
- Han, Y., & Wang, L. (2018). Identifying barriers to off-site construction using grey-DEMATEL approach: case of China. *Journal of Civil Engineering and Management*, 24(5), 364–377. <https://doi.org/10.3846/JCEM.2018.5181>
- Hertanto, B. S., Nirmalasari, C. D. A., Nuhriawangsa, A. M. P., Cahyadi, M., & Kartikasari, L. R. (2018). The physical and microbiological quality of chicken meat in the different type of enterprise poultry slaughterhouse: a case study in Karanganyar District. *IOP Conference Series: Earth and Environmental Science*, 102(1), 012051. <https://doi.org/10.1088/1755-1315/102/1/012051>

- Jia, F., Zuluaga-Cardona, L., Bailey, A., & Rueda, X. (2018). Sustainable supply chain management in developing countries: An analysis of the literature. *Journal of Cleaner Production*, 189, 263–278. <https://doi.org/10.1016/j.jclepro.2018.03.248>
- Kannan, G., Noorul, A., Sasikumar, P., & Subramaniam, A. (2008). Analysis and selection of green suppliers using interpretative structural modelling and analytic hierarchy process. *International Journal of Management and Decision Making*, 9(1), 163–182. <https://doi.org/10.1504/IJMDM.2008.017198>
- Kaur, J., Sidhu, R., Awasthi, A., Chauhan, S., & Goyal, S. (2017). A DEMATEL based approach for investigating barriers in green supply chain management in Canadian manufacturing firms. 56(1–2), 312–332. <https://doi.org/10.1080/00207543.2017.1395522>
- Kementerian Pertanian Republik Indonesia. Ministry of Agriculture of the Republic of Indonesia (2022). *Buku Statistik Peternakan dan Kesehatan Hewan Tahun 2022*. <https://ditjenpkh.pertanian.go.id/berita/1609-buku-statistik-peternakan-dan-kesehatan-hewan-tahun-2022>
- Khan, S., Haleem, A., & Khan, M. I. (2020). Enablers to implement circular initiatives in the supply chain: A grey-DEMATEL method. *Global Business Review*, 25(1), <https://doi.org/10.1177/0972150920929484>
- Kumar, M., Raut, R. D., Jagtap, S., & Choubey, V. K. (2023). Circular economy adoption challenges in the food supply chain for sustainable development. *Business Strategy and the Environment*, 32(4), 1334–1356. <https://doi.org/10.1002/bse.3191>
- Lin, R. J. (2013). Using fuzzy DEMATEL to evaluate the green supply chain management practices. *Journal of Cleaner Production*, 40, 32–39. <https://doi.org/10.1016/J.JCLEPRO.2011.06.010>
- Liu, Y., Wood, L. C., Venkatesh, V. G., Zhang, A., & Farooque, M. (2021). Barriers to sustainable food consumption and production in China: A fuzzy DEMATEL analysis from a circular economy perspective. *Sustainable Production and Consumption*, 28, 1114–1129. <https://doi.org/10.1016/J.SPC.2021.07.028>
- Luthra, S., Mangla, S. K., Shankar, R., Prakash Garg, C., & Jakhar, S. (2018). Modelling critical success factors for sustainability initiatives in supply chains in Indian context using Grey-DEMATEL., 29(9), 705–728. <https://doi.org/10.1080/09537287.2018.1448126>
- Mohseni, S., Baghizadeh, K., & Pahl, J. (2022). Evaluating barriers and drivers to sustainable food supply chains. *Mathematical Problems in Engineering*, 2022(1), 4486132. <https://doi.org/10.1155/2022/4486132>
- Nazam, M., Hashim, M., Baig, S. A., Abrar, M., & Shabbir, R. (2020). Modeling the key barriers of knowledge management adoption in sustainable supply chain. *Journal of Enterprise Information Management*, 33(5), 1077–1109. <https://doi.org/10.1108/JEIM-09-2019-0271>
- Nurtini, S., Muzayyanah, M. A. U., Haryadi, F. T., & Hakim, A. (2017). Performance of broiler farmer in partnerships system at Surakarta, Indonesia. *Journal of Advanced Agricultural Technologies*, 4(2), 196–199. <https://doi.org/10.18178/JOAAT.4.2.196-199>
- Paul, A., Shukla, N., & Trianni, A. (2023). Modelling supply chain sustainability challenges in the food processing sector amid the COVID-19 outbreak. *Socio-Economic Planning Sciences*, 87, 101535. <https://doi.org/10.1016/J.SEPS.2023.101535>
- Polit, D. F., Beck, C. T., & Owen, S. V. (2007). Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Research in Nursing & Health*, 30(4), 459–467. <https://doi.org/10.1002/NUR.20199>
- Rajesh, R., & Ravi, V. (2015). Modeling enablers of supply chain risk mitigation in electronic supply chains: A Grey-DEMATEL approach. *Computers & Industrial Engineering*, 87, 126–139. <https://doi.org/10.1016/J.CIE.2015.04.028>
- Sage, A. P. (1977). *Methodology for large-scale systems*. McGraw-Hill College.
- Shahabaddar, P., Hebbal, S. S., & Prashant, S. (2012). Deployment of interpretive structural modeling methodology in supply chain management—An overview. *International Journal of Industrial Engineering & Production Research*, 23(3), 195–205.
- Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16(15), 1699–1710. <https://doi.org/10.1016/j.jclepro.2008.04.020>
- Si, S. L., You, X. Y., Liu, H. C., & Zhang, P. (2018). DEMATEL technique: A systematic review of the state-of-the-art literature on methodologies and applications. *Mathematical Problems in Engineering*, 2018, —. <https://doi.org/10.1155/2018/3696457>
- Siebrecht, N. (2020). Sustainable agriculture and its implementation gap—Overcoming obstacles to implementation. *Sustainability*, 12(9), 3853. <https://doi.org/10.3390/su12093853>
- Srinivasan, K., Yadav, V. K., Kumar, A., Margabandu, B., Selvaraj, J., & Kumar, A. (2022). Prioritizing the mitigation strategies to lean and green barriers using fuzzy BWM-FTOPSIS method in the food supply chain: an empirical case study. *International Journal of Lean Six Sigma*, <https://doi.org/10.1108/IJLSS-10-2021-0171>
- Susanty, A., Puspitasari, N. B., Prastawa, H., & Renaldi, S. V. (2021a). Exploring the best policy scenario plan for the dairy supply chain: a DEMATEL approach. *Journal of Modelling in Management*, 16(1), 240–266. <https://doi.org/10.1108/JM2-08-2019-0185>
- Susanty, A., Puspitasari, N. B., Purwaningsih, R., & Siregar, A. R. R. (2020). Sustainability assessment of contract farming broiler chicken supply chain using RAP-Poultry. *IEEE International Conference on Industrial*

- Engineering and Engineering Management*, 2020-December, 756–760.  
<https://doi.org/10.1109/IEEM45057.2020.9309842>
- Susanty, A., Sutrimo, W. H. W. M., & Saptadi, S. (2021b). Measuring the sustainability of broiler chicken supply chain using rapid appraisal for poultry method: A comparison between one-tier and two-tier contract farming system. *2021 IEEE 8th International Conference on Industrial Engineering and Applications (ICIEA)*, 226–230.  
<https://doi.org/10.1109/ICIEA52957.2021.9436709>
- Thakkar, J. J. (2021). *Multi-criteria decision making* (Vol. 336). Springer Singapore. <https://doi.org/10.1007/978-981-33-4745-8>
- Wang, J., Zhang, Y., & Goh, M. (2018). Moderating the role of firm size in sustainable performance improvement through sustainable supply chain management. *Sustainability*, 10(5), 1654. <https://doi.org/10.3390/su10051654>
- Warfield, J. N. (1974). Developing interconnection matrices in structural modeling. *IEEE Transactions on Systems, Man, and Cybernetics*, SMC-4(1), 81–87. <https://doi.org/10.1109/TSMC.1974.5408524>
- Wu, H. H., & Chang, S. Y. (2015). A case study of using DEMATEL method to identify critical factors in green supply chain management. *Applied Mathematics and Computation*, 256, 394–403.  
<https://doi.org/10.1016/J.AMC.2015.01.041>
- Xia, X., & Ruan, J. (2020). Analyzing barriers for developing a sustainable circular economy in agriculture in China using Grey-DEMATEL approach. *Sustainability*, 12(16), 6358. <https://doi.org/10.3390/SU12166358>
- Xing, M., Luo, X., Zan, Y., Yang, L., Jin, H., & Luo, J. (2023). Identification of factors affecting hoisting quality of large offshore structures and analysis of their coupling relationship based on grey-DEMATEL-ISM-MICMAC. *Ocean Engineering*, 280, 114805. <https://doi.org/10.1016/J.OCEANENG.2023.114805>
- Yunita, I., Hasibuan, S., & Thaheer, H. (2022). Identification of key agility variables to improve poultry supply chain sustainability: Indonesian case. *Industria: Jurnal Teknologi dan Manajemen Agroindustri*, 11(2), 117–127.  
<https://doi.org/10.21776/UB.INDUSTRIA.2022.011.02.3>