UDC 631.9
IRSTI 06.71.07
https://doi.org/10.55452/1998-6688-2025-22-2-24-36

[1]***Orynbassar Y.B.,**
Master's degree, ORCID ID: 0009-0007-7156-1250,
*e-mail: y_orynbassar@kbtu.kz
[1]**Bissembayev A.S.,**
Associate Professor, ORCID ID: 0009-0001-3283-9826,
e-mail: a.bisembaev@kbtu.kz

[1]Kazakh-British Technical University, Almaty, Kazakhstan

AGRICULTURAL SUPPLY CHAIN RISK ANALYSIS: A RANKING METHOD APPROACH

Abstract

This paper proposes the Decision-Making and Trial Evaluation Laboratory (DEMATEL) method to assess the requirements of risk factors in the supply chain of agricultural products. It can be said that the supply chain of agricultural products is the most vulnerable to various risks. The risks may differ depending on the area (operational, economic, social, and environmental). Our objective in this paper is to determine the importance of each risk factor and their interrelationships to prioritize the most significant risks for further eliminate or mitigate them. To achieve this, we used the DEMATEL method on a specific dataset and compared our proposed method with fuzzy-DEMATEL. The results underscore that the central risk factor requirements revolve around Enhanced customer service and Controlling carbon emissions and pollution. Furthermore, we categorized the risk factors into two groups: cause and effect. Consequently, we noted slight variations between the outcomes of the methods, indicating the effective identification of critical risk factors by both approaches.

Keywords: DEMATEL, risk factors, supply chain, agricultural products, vulnerability, interrelationships, prioritization.

Introduction

More often, the agricultural supply chain is vulnerable to risks, starting with supply and demand risk that leads to price volatility [1]. Such risks can also result in supply chain disruptions. Additionally, the risks of pests and diseases can have a significant impact on agricultural production, especially if they are not detected and controlled at an early stage. Moreover, the use of pesticides and other chemicals in agriculture can pose risks to the environment and human health. Equally important are the operational risks, including transport risk. Since agricultural products decompose much further from consumers, it is crucial to deliver them carefully and in a timely manner, given their perishable nature. This requires choosing the right transport, equipped, if necessary, with refrigeration units. Environmental risks can also significantly impact agricultural products. Another aspect of operational risk includes weather events such as droughts, floods, and hurricanes, which can have a substantial effect on agricultural production. Financial risks in the agricultural supply chain can also impact business performance and sustainability. The volatility of raw material prices can significantly affect profits, and currency fluctuations can influence product costs and profits. All these main risks are summarized in Table 1. To facilitate the management of such risk sets, we propose using the DEMATEL method. This method simplifies risk management by ranking all types of risks, allowing a focus on the most important risks for elimination or mitigation. The main goals of this study can be condensed as follows:

1. Find the most important risks and evaluate the relationship between risks based on real data.
2. Conduct a comparative analysis between our proposed method and an alternative approach to identify distinctions.

Table 1 – The risks chosen from the literature

Risks	Description	Reference
1	2	3
Uncertainty of demand and supply	Unpredictability and fluctuations in both demand and supply of agricultural products.	[10]
Failure to select the right suppliers	This applies to scenarios where the selected suppliers do not meet the required quality standards, encounter problems with delivering products on time, or offer unreliable services.	[10] and [11]
Lack of sustainable technology	It refers to the risk associated with limited understanding or utilization of environmentally friendly and sustainable practices and technologies.	[12]
Volatility of price and cost	Challenges faced by farmers and agricultural businesses when dealing with the instability of prices in the market for their products, alongside unforeseen variations in input costs like labor, fertilizers, and fuel expenses	[10]
Inflation and currency exchange rates	Negative impact on the agricultural sector due to changes in the general level of prices for goods and services and fluctuations in exchange rates	[10]
Natural disasters	This risk refers to the potential damage caused by unforeseen and severe natural events such as floods, droughts, hurricanes, wildfires and similar events that can have a negative impact on agricultural production.	[13]
Environmental pollution	It relates to the potential dangers arising from the presence or contamination of detrimental substances in agricultural products, including crops, livestock, and other produce.	[13]
Inefficient use of resources	This risk occurs when resources are not utilized optimally, resulting in wastage, higher production expenses, and potential adverse effects on the environment.	[13]
Unexpected changes in policy or Governmental risks	This risk in agricultural supply chains shape incentives, decision-making, and the structure of the supply chain. They impact relationships, distribution of rewards and risks, and public-private dynamics.	[14]
Disruptions in transportation	Transportation disruptions can be a major threat to international markets, affecting both unfinished and finished products. The possibility of delays in delivery, particularly for perishable goods, can lead to crucial decisions on whether to wait for international delivery or sell locally at a reduced price. These strategic choices are made to prevent spoilage, reduce losses, and optimize the overall cost of the production system.	[15]

The risk management field in agricultural production has been developing well over the past decade, as the market competition is strong, and any mistake can lead to significant losses. Many people have proposed and offer their own methods, their application for managing various risks. As an illustration in the paper, a method for managing the supply chain of agricultural products is proposed, highlighting the importance of conducting risk assessment to improve the overall competitiveness of the agricultural supply chain [2]. To mitigate operational risk in logistics, the author proposes the following approach: 1) Enhance the enterprise's risk control capability by establishing a cooperation mechanism. 2) Create an information sharing platform for agricultural products.

3) Seek government support and guidance. 4) Foster specialized talents and promote the utilization of various techniques. 5) Strengthen employee management and provide incentives. 6)Establish a logistics insurance system. The study authors describe the need to improve the competitiveness of Indonesian agricultural products in international trade and the requirements for information on the origin and quality of products [3]. The paper proposes a model based on historical climate and productivity data that can help predict chilli production levels and estimate changes in response to climate conditions. The use of various technologies and tracking systems such as RFID tags and 2D barcodes to ensure product traceability and security is also considered. In this article, Hao Zhang et al. present a new model for risk assessment in refrigerated logistics of agricultural products [4]. They developed a quantitative method that allows an objective and accurate assessment of the status of the refrigeration logistics process for fresh agricultural products. The results of the study confirm the reliability of the model and its ability to reflect key risk factors. This model has practical value for refrigeration logistics managers and other process participants, helping them to assess risks scientifically and reasonably in refrigeration logistics of agricultural products. According to Abdullah Salamai et al. effective management of supply chain risks requires consideration of both internal and external risk factors [5]. A methodology has been developed for evaluating factors contributing to flood risk in various agricultural regions within the food supply chain [6]. To ensure the safety of wheat in Canada's supply chain, cost-effective strategies have been identified and tested [7]. In a separate study, the author identified numerous risks in the supply chain of goods with a limited shelf life, involving risks associated with the environment, organization, inventory, and equipment [8].

A review of recent literature has shown that all risk management work has almost no consideration of operational risk. The danger of all risks is also determined separately, meaning the interrelation between risks is not considered, as seen in the study, accounting for both internal strengths and external factors interacting among diverse risks [9]. Nevertheless, there are constraints in this study as well: the catalog of developmental risks is not comprehensive, and there may be additional risks to consider.

The purpose of this research is to rank risks in supply chain of agricultural products in order to focus on important risks for effective management. Also, the impact of one risk on others and their relationship with each other. To do this, we use the DEMATEL method. The result should show the most important risks in the case of a particular company, so that the decision makers can effectively allocate their resources to eliminate or mitigate the risk.

Materials and Methods

A. Risks in the agri-food supply chain

In this paper we will compare two methods: our proposed DEMATEL method and the fuzzy-DEMATEL method. To do this, we will use the risk factor requirements data. The data were obtained in the city of Alboraya, in the province of Valencia, Spain, since this region is known for its developed agricultural production and is recognized as one of the leading agricultural regions in Spain [17]. Our goal is to apply our proposed method to these data and then compare the two methods. In this section, we describe the main risks factor requirements that have been classified into six different categories were determined through a comprehensive analysis conducted by a group of three experts: R1: Cost reduction attitude, R2: Enhanced customer service, R3: Carbon emission and pollution control, R4: Efficient use of energy and resources, R5: Reduced impact on community, R6: Health and safety standards. These experts evaluated the importance of each factor based on several criteria, including price strategy, inventory management system, reverse logistics, and green image. Below, in table 2 each of these requirements is briefly defined:

Table 2 – The main risk factor requirements

Risk factors	Description
R1: Cost reduction attitude	Emphasizes the importance of adopting strategies aimed at reducing expenses across various aspects of the organization, enhancing financial efficiency without compromising on quality or service.
R2: Enhanced customer service	This requirement focuses on improving the interaction between the business and its customers, aiming to increase satisfaction through better service, responsiveness, and engagement practices.
R3: Carbon emission and pollution control	Implementing measures that significantly reduce the environmental impact of the organization's operations, particularly concerning carbon emissions and general pollution.
R4: Efficient use of energy and resources	This requirement addresses the need for more effective and sustainable use of energy and other resources, promoting conservation and optimization to reduce environmental footprint and operational costs.
R5: Reduced impact on community	This factor relates to minimizing the negative effects an organization's operations may have on the surrounding community, focusing on social responsibility and positive community relations.
R6: Health and safety standards	Ensures that stringent health and safety protocols are maintained within the organization to protect employees, customers, and the general public from hazards associated with the business's operations.

B. Proposed DEMATEL – method

The DEMATEL method is an effective tool for identifying components of a complex system and their interrelationships [16]. It is based on evaluating the interconnections between factors and finding critical components through a visual structural model. The DEMATEL method allows for the visualization of the structure of complex cause-and-effect relationships through matrices. It is particularly useful for analyzing the interrelationships between system components and determining their relative relationships. It can be used for investigating and solving complex problems. The method, also known as the Decision-Making Trial and Evaluation Laboratory method, comprises a series of steps used to examine the cause-and-effect connections between various factors. On figure 1 shows approach steps (DEMATEL steps). The following sections will describe all the steps of the method and formula [17].

1) Construction of the direct-relation matrix: Every expert is asked to indicate the extent of influence that each risk has on the others using a linguistic scale in table 3.

Table 3 – Terms for assessing direct relationships among risk factors

№	Linguistic term	Corresponding scores
1	Very High Influence (VH)	6
2	High Influence (H)	5
3	Medium High Influence (MH)	4
4	Medium Influence (M)	3
5	Medium Low Influence (ML)	2
6	Low Influence (L)	1
7	Very Low Influence (VL)	0

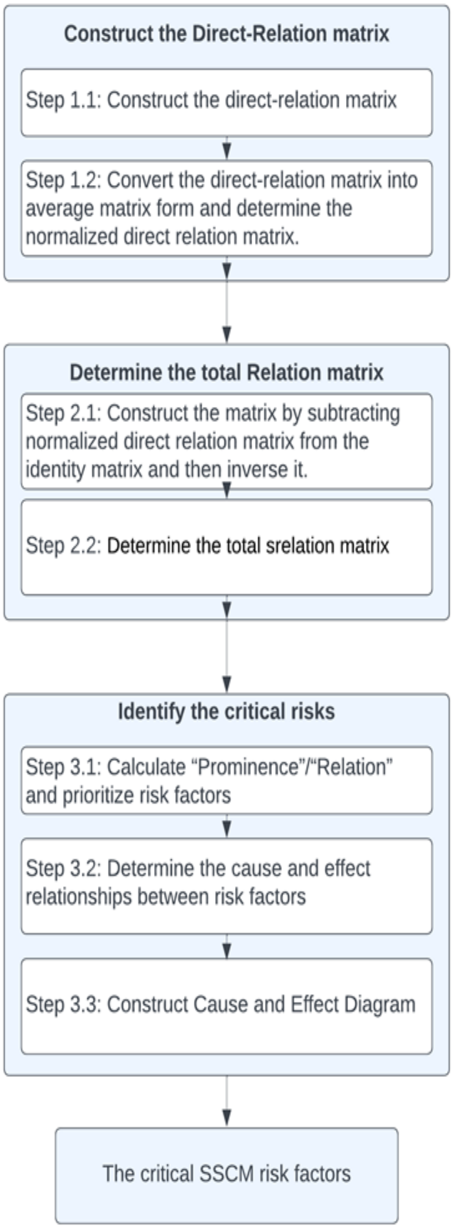

Figure 1 – The main steps of DEMATEL method

The matrix representing direct relationships with dimensions , is derived in the following manner:

$$M = \begin{bmatrix} 0 & r_{12} & \cdots & r_{1n} \\ r_{21} & 0 & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \ldots & 0 \end{bmatrix} \tag{1}$$

To normalize, the sum of each row and column in the matrix is computed directly. Let k represent the maximum sum of both rows and columns. Normalization requires dividing each element in the direct-relation matrix by k.

$$k = max\left\{max\sum_{j=1}^{n} r_{ij}, \sum_{i=1}^{n} r_{ij}\right\} \tag{2}$$

$$S = \frac{1}{k} * M \quad (3)$$

2) Determination the total Relation Matrix: Upon obtaining the normalized matrix, the total relation matrix is computed through a series of steps. Begin by creating an n × n identity matrix, subtract this identity matrix from the normalized matrix, and invert the resulting matrix. Finally, multiply the normalized matrix by the inverted matrix to derive the total relation matrix.

$$T = S \times (I - S)^{-1} \quad (4)$$

3) Identify the critical risks: After obtaining the total-relation matrix T, the sums of rows and columns, D and C respectively, are calculated. The significance of risk i impact on other risks is captured by the value of D_i, and the cumulative influence exerted by other risks on risk i is indicated by the sum of C_i.

The vector $P_i = D_i + C_i$ combines the interdependencies of risk directions and is determined by the collective influence and significance of the risk. A positive value of P_i indicates a higher overall importance of the risk. On the other hand, the vector $R_i = D_i - C_i$ classifies risks according to the impacts they exert and experience: a positive value denotes inclusion in the causal group, whereas a negative Ri value signifies membership in the effect group.

C. Fuzzy-DEMATEL – method

The following steps outline the process leading to the ultimate solution of the method [18]:

1) Embarking on the establishment of the initial direct-relation matrix, we incorporate the fuzzy type-2 number score denoted as x_{ij}^k, contributed by the k-th decision maker. This score vividly articulates the influential magnitude of each customer requirement (CR) i on the respective requirement j. The process marks a pivotal step in shaping the foundation for subsequent analytical assessments.

$$A_{ij} = \frac{1}{H} \sum_{k}^{H} x_{ij}^k \quad (5)$$

2) Moving forward, the subsequent step entails the identification of the normalized initial direct-relation matrix.

$$S = \max\left(max \sum_{j}^{n} A_{ij}, max \sum_{i}^{n} A_{ij}\right) \quad (6)$$

$$D = \frac{A}{S} \quad (7)$$

3) Next step is calculation total relation matrix.

$$\tilde{X}_{ij}^l = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{x}_{n1} & \tilde{x}_{n2} & \cdots & \tilde{x}_{nn} \end{bmatrix} \quad (8)$$

4) The conclusive phase involves the identification of critical requirements associated with risk factors. This is achieved by augmenting rows and columns to calculate matrices D and R, capturing dependencies and relationships. Subsequently, amalgamating these matrices facilitates the overall ranking of requirements. The final step entails a deductive approach, subtracting one from the other, to discern whether these requirements serve as causes or effects in the broader context of the analysis.

Results and Discussion

In order to demonstrate the practicality and effectiveness of the proposed framework, we apply the DEMATEL method to the provided dataset. This practical implementation serves as a tangible illustration of how the suggested approach can be operationalized and its potential impact in a real-world context.

A. Table 4 represents the Initial Direct-Relation Matrix, sourced from evaluations provided by three distinct experts who assessed the interrelationships among various risks. This matrix serves as a valuable starting point, capturing the collective insights of multiple experts to establish a foundation for subsequent analyses.

Table 4 – Initial direct relation matrix with numbers

	R1	R2	R3	R4	R5	R6
DM1						
R1	-	1	0	4	1	1
R2	2	-	3	3	5	3
R3	3	5	-	1	3	4
R4	3	4	5	-	4	2
R5	1	3	3	1	-	1
R6	2	3	2	1	4	-
DM2						
R1	-	2	1	3	0	2
R2	3	-	3	3	4	2
R3	3	5	-	2	5	2
R4	4	2	3	-	3	1
R5	3	3	2	1	-	2
R6	0	3	3	3	1	-
DM3						
R1	-	3	0	4	3	1
R2	1	-	4	2	3	3
R3	3	5	-	3	1	4
R4	4	3	1	-	3	4
R5	3	4	2	1	-	3
R6	3	1	4	3	5	-

Next step the conversion of all these values into a Normalized Direct Relation Matrix is undertaken. In this process, the maximum sum of both rows and columns is identified, denoted as $k = 16.3$. The final into Normalized direct relation matrix we can see in table 5.

Table 5 – Normalized Direct Relation Matrix

Risk factors	R1	R2	R3	R4	R5	R6
R1	0	0.122451	0.02039	0.22451	0.08161	0.08161
R2	0.12245	0	0.20407	0.16329	0.28574	0.16329
R3	0.18368	0.30613	0	0.12245	0.18368	0.20407
R4	0.22451	0.18368	0.18368	0	0.20407	0.14284
R5	0.14284	0.20407	0.14284	0.06123	0	0.12245
R6	0.10206	0.14284	0.22451	0.14284	0.20407	0

In this particular stage, the initial action involves the generation of an n × n identity matrix. Subsequently, this identity matrix is subtracted from the normalized matrix, and the resultant matrix undergoes inversion. The multiplication of the normalized matrix by the resulting matrix yields the Total Relation Matrix. For a visual representation, Table 6 exhibits the finalized Total Relation Matrix.

Table 6 – Total Relation Matrix

Risk factor	R1	R2	R3	R4	R5	R6	
R1	0	0.122451	0.02039	0.22451	0.08161	0.08161	3.017899
R2	0.12245	0	0.20407	0.16329	0.28574	0.16329	4.981084
R3	0.18368	0.30613	0	0.12245	0.18368	0.20407	5.277472
R4	0.22451	0.18368	0.18368	0	0.20407	0.14284	4.900427
R5	0.14284	0.20407	0.14284	0.06123	0	0.12245	3.723474
R6	0.10206	0.14284	0.22451	0.14284	0.20407	0	4.480514
	4.172674	5.077388	4.219513	3.870712	5.116253	3.92433	4.172674

In the table and are the sums of rows and columns. In the next step the main requirements of the risk factors will be identified.

C. Utilizing the provided equations, the prioritization of risks involves conducting calculations. For and . The results of these computations are then presented in a table 7, offering a comprehensive overview of the prioritized risks and their corresponding values.

Table 7 – The Prominence, Relation and ranks of Risk factors

Risk factor	D_i	C_i	Prominence P_i	Relation R_i	Ranking	Identity
R1	3.017899	4.172674	7.190574	-1.15478	6	Effect
R2	4.981084	5.077388	10.05847	-0.0963	1	Effect
R3	5.277472	4.219513	9.496985	1.057959	2	Cause
R4	4.900427	3.870712	8.771139	1.029716	4	Cause
R5	3.723474	5.116253	8.839727	-1.39278	3	Effect
R6	4.480514	3.92433	8.404844	0.556184	5	Cause

Based on the values, the most important requirement for risk factor is identified as R2 (Enhanced customer service), followed by R3 (Carbon emission and pollution control). The subsequent ranking of other risk factors as follows: R5, R4, R6, and R1. This classification provides insights into the relative significance of each requirement, aiding in strategic decision-making and risk management.

The table reveals a distinctive categorization of requirements of risk factors into two distinct groups. The first group comprises R3, R4 and R6. These risk factors form causal relationships characterized by positive correlations . Meanwhile, the second group encompasses, R1, R2 and R5. These risks exhibit negative relations and are accordingly classified into the effect group of risks. This classification highlights the interplay and interdependence among the identified risks.

In our final analysis, a comparison of our findings with a study utilizing the fuzzy-DEMATEL method reveals slight variations, as shown in Table 8. Notably, when ranking requirements related to risk factors, our results indicate R2 > R3 > R5 > R4 > R6 > R1 [18]. In contrast, the fuzzy-DEMATEL method yielded a slightly different ranking: R2 > R3 > R4 > R5 > R6 > R1.

Table 8 – Comparison table

Proposed method	Risk factor	Prominence	Relation	Ranking	Identity
	R1	7.190574	-1.15478	6	Effect
	R2	10.05847	-0.0963	1	Effect
	R3	9.496985	1.057959	2	Cause
	R4	8.771139	1.029716	4	Cause
	R5	8.839727	-1.39278	3	Effect
	R6	8.404844	0.556184	5	Cause
Alternative method	Risk factor	Prominence	Relation	Ranking	Identity
	R1	3.195	-0,5125	6	Effect
	R2	4.36	-0.1051	1	Effect
	R3	4.15	0.4715	2	Cause
	R4	3.88	0.4761	3	Cause
	R5	3.785	-0.5503	4	Effect
	R6	3.652	0.2203	5	Cause

Checking the table, the only difference is that risk factors R4 and R5 switched places, leading to two different results. But we can overlook the variation between and since it's a natural difference due to the different calculations in the two methods. Also, the risk factor's identity remains the same in both cases. The figure 2 displays the DEMATEL Cause and Effect Diagram, clearly separating the risk factors into causes and effects.

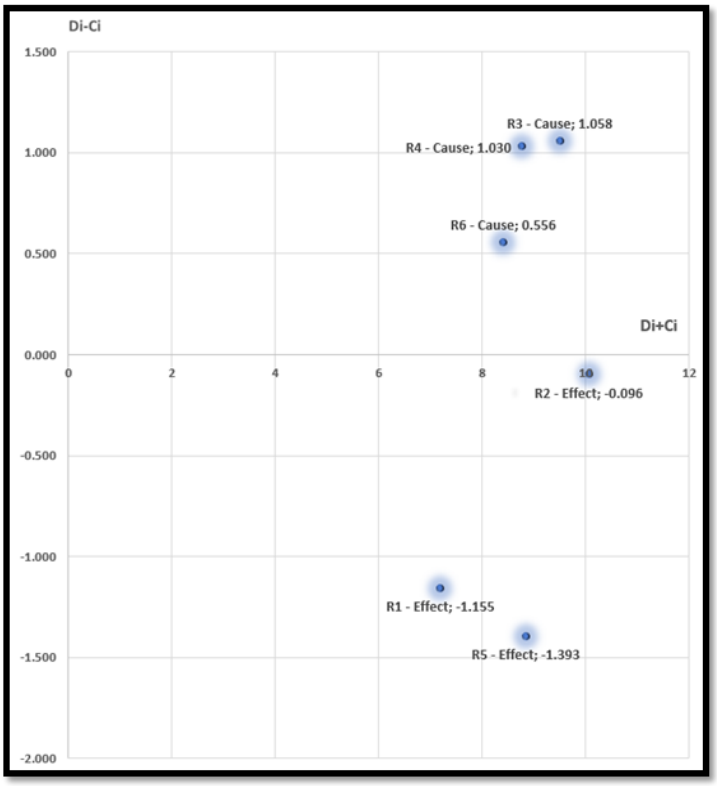

Figure 2 – Cause and Effect Diagram

As can be seen from Figure 2, risk factors for which the relation value is less than 0 belong to the Effect group. Conversely, those for which is greater than 0 are identified as belonging to the Cause group.

Conclusion

This study aims to evaluate the significance of risk factors in the agricultural supply chain. The approach adopted for this assessment is the DEMATEL method, which considers external interactions among diverse risks while incorporating the subjective judgments of various decision-makers. To accomplish this, we applied the method to a real dataset and compared our proposed approach with fuzzy-DEMATEL. The findings highlight that the key risk factor requirements revolve around "Enhanced customer service" and "Controlling carbon emissions and pollution." We also identified the risk factors into two groups: cause and effect. The first group, consisting of R3, R4, and R6, is the causal group, while risks R1, R2, and R5 belong to the effect group. Consequently, we observed minor variations between the results of methods, suggesting that both approaches effectively identify critical risk factors. The choice between them hinges individual preferences.

Future research on applying the DEMATEL method to the agricultural supply chain should focus on expanding its scope to diverse agricultural scenarios, considering climatic, environmental, and social factors. Additionally, exploring the integration of DEMATEL with other decision-making methods can provide a more nuanced analysis of risks. Refining the list of risks by incorporating temporal factors and changes in agricultural practices is crucial for data optimization. Empirical testing in practical agricultural settings is necessary to evaluate the method's effectiveness across different enterprises. Lastly, considering dynamic factors such as seasonal variations, technological shifts, and industry trends will enhance the understanding of risks in the agricultural supply chain. This research can optimize the DEMATEL method and tailor its application to specific conditions and preferences.

REFERENCES

1 Yang J. and Liu H. Research of vulnerability for fresh agricultural-food supply chain based on bayesian network // Mathematical Problems in Engineering. – vol. 2018. – P. 1–17. https://doi.org/10.1155/2018/6874013.

2 Huang Y. Based on the supply chain of agricultural products logistics operational risk assessment and avoid : In 2015 Seventh International Conference on Measuring Technology and Mechatronics Automation, 2015. – P. 246–254. https://doi.org/10.1109/ICMTMA.2015.67.

3 Septiawan R., Komaruddin A., Sulistya B., Alfi N. and Shanmuganathan S. Prediction model for chilli productivity based on climate and productivity data : In 2012 Sixth UKSim/AMSS European Symposium on Computer Modeling and Simulation IEEE, 2012. – P. 54–59. https://doi.org/10.1109/EMS.2012.67.

4 Zhang H., Qiu B., and Zhang K. A new risk assessment model for agricultural products cold chain logistics // Industrial management & data systems. 2017. – Vol. 117. – No. 9. – P. 1800–1816. https://doi.org/10.1108/IMDS-03-2016-0098.

5 Salamai A., Hussain O.K., Saberi M., Chang E., and Hussain F.K. Highlighting the importance of considering the impacts of both external and internal risk factors on operational parameters to improve supply chain risk management // IEEE Access. – 2019. – Vol. 7. – P. 49297–49315. https://doi.org/10.1109/ACCESS.2019.2902191.

6 Yazdani M., Gonzalez E.D., and Chatterjee P. A multi-criteria decision-making framework for agriculture supply chain risk management under a circular economy context // Management Decision. – 2021. – Vol. 59. – No. 8. – P. 1801–1826. https:// doi.org/10.1108/MD-10-2018-1088.

7 Ge H., Nolan J., Gray R., Goetz S. and Han Y. Supply chain complexity and risk mitigation – A hybrid optimization–simulation model // International Journal of Production Economics. – 2016. – Vol. 179. – P. 228–238. https://doi.org/ 10.1016/j.ijpe.2016.06.014.

8 Deng X., Yang X., Zhang Y., Li Y. and Lu Z. Risk propagation mechanisms and risk management strategies for a sustainable perishable products supply chain // Computers & Industrial Engineering. – 2019. – Vol. 135. – P. 1175–1187. https:// doi.org/10.1016/j.cie.2019.01.014.

9 Benabdallah C., El-Amraoui A., Delmotte F. and Frikha A. An integrated rough-dematel method for sustainability risk assessment in agro-food supply chain. In 2020 5th International Conference on Logistics Operations Management (GOL). IEEE, 2020. – P. 1–9. https://doi.org/10.1109/GOL49479.2020.9314712.

10 Song W., Ming X. and Liu H.C. Identifying critical risk factors of sustainable supply chain management: A rough strength-relation analysis method // Journal of Cleaner Production. – 2017. – Vol. 143. – P. 100–115. https://doi.org/10.1016/j. jclepro.2016.12.145

11 Rostamzadeh R., Ghorabaee M. K., Govindan K., Esmaeili A. and Nobar H.B.K. Evaluation of sustainable supply chain risk management using an integrated fuzzy topsis-critic approach // Journal of Cleaner Production. – 2018. – Vol. 175. – P. 651–669. https://doi.org/10.1016/j.jclepro.2017.12.071.

12 Tomchek M. Sustainable technology impact on agricultural production // Decent Work and Economic Growth. – 2021. – P. 1024–1037.

13 De Oliveira U.R., Marins F.A.S., Rocha H.M. and Salomon V.A. P. The iso 31000 standard in supply chain risk management // Journal of Cleaner Production. – 2017. – Vol. 151. – P. 616–633. https://doi.org/10.1016/j.jclepro.2017.03.054.

14 Jaffee S., Siegel P. and Andrews C. Rapid agricultural supply chain risk assessment: A conceptual framework // Agriculture and rural development discussion paper. – 2010. – Vol. 47. – No. 1. – P. 1–64.

15 Behzadi G., O'Sullivan M.J., Olsen T.L. and Zhang A. Agribusiness supply chain risk management: A review of quantitative decision models // Omega. – 2018. – Vol. 79. – P. 21–42. https://doi.org/10.1016/j.omega.2017.07.005.

16 Si S.L., You X.Y., Liu H. C., and Zhang P. Dematel technique: A systematic review of the state-of-the-art literature on methodologies and applications // Mathematical Problems in Engineering. – 2018. – Vol. 2018. – P. 1–33. https://doi.org/10.1155/2018/3696457.

17 Shieh J.I., Wu H.H. and Huang K.K. A DEMATEL method in identifying key success factors of hospital service quality // Knowledge-Based Systems. – 2010. – Vol. 23.3, P. 277–282. https://doi.org/10.1016/j.knosys.2010.01.013.

18 Yazdani M., Wang Z.X., Chan F. T. S. A decision support model based on the combined structure of DEMATEL, QFD and fuzzy values // Soft Computing. – 2020. – Vol. 24. – P. 12449–12468. https://doi.org/10.1007/s00500-020-04685-2.

REFERENCES

1 Yang J. and Liu H. Research of vulnerability for fresh agricultural-food supply chain based on bayesian network. Mathematical Problems in Engineering, 2018, 1–17, https://doi.org/10.1155/2018/6874013.

2 Huang Y. Based on the supply chain of agricultural products logistics operational risk assessment and avoid. In 2015 Seventh International Conference on Measuring Technology and Mechatronics Automation, 2015, pp. 246–254, https://doi.org/10.1109/ICMTMA.2015.67.

3 Septiawan R., Komaruddin A., Sulistya B., Alfi N. and Shanmuganathan S. Prediction model for chilli productivity based on climate and productivity data. In 2012 Sixth UKSim/AMSS European Symposium on Computer Modeling and Simulation IEEE, 2012, pp. 54–59, https://doi.org/10.1109/EMS.2012.67.

4 Zhang H., Qiu B., and Zhang K. A new risk assessment model for agricultural products cold chain logistics. Industrial management & data systems, 117 (9), 1800–1816 (2017). https://doi.org/10.1108/IMDS-03-2016-0098.

5 Salamai A., Hussain O.K., Saberi M., Chang E., and Hussain F.K. Highlighting the importance of considering the impacts of both external and internal risk factors on operational parameters to improve supply chain risk management. IEEE Access., 7, 49297–49315 (2019). https://doi.org/10.1109/ACCESS.2019.2902191.

6 Yazdani M., Gonzalez E.D., and Chatterjee P.A multi-criteria decision-making framework for agriculture supply chain risk management under a circular economy context. Management Decision, 59 (8), 1801–1826 (2021). https:// doi.org/10.1108/MD-10-2018-1088.

7 Ge H., Nolan J., Gray R., Goetz S. and Han Y. Supply chain complexity and risk mitigation – A hybrid optimization–simulation model. International Journal of Production Economics, 179, 228–238 (2016). https://doi.org/ 10.1016/j.ijpe.2016.06.014.

8 Deng X., Yang X., Zhang Y., Li Y. and Lu Z. Risk propagation mechanisms and risk management strategies for a sustainable perishable products supply chain. Computers & Industrial Engineering, 135, 1175–1187 (2019). https:// doi.org/10.1016/j.cie.2019.01.014

9 Benabdallah C., El-Amraoui A., Delmotte F. and Frikha A. An integrated rough-dematel method for sustainability risk assessment in agro-food supply chain. In 2020 5th International Conference on Logistics Operations Management (GOL). IEEE, 2020, pp. 1–9, https://doi.org/10.1109/GOL49479.2020.9314712.

10 Song W., Ming X. and Liu H.C. Identifying critical risk factors of sustainable supply chain management: A rough strength-relation analysis method. Journal of Cleaner Production, 143, 100–115 (2017). https://doi.org/10.1016/j. jclepro.2016.12.145

11 Rostamzadeh R., Ghorabaee M. K., Govindan K., Esmaeili A. and Nobar H.B.K. Evaluation of sustainable supply chain risk management using an integrated fuzzy topsis-critic approach. Journal of Cleaner Production, 175, 651–669 (2018). https://doi.org/10.1016/j.jclepro.2017.12.071.

12 Tomchek M. Sustainable technology impact on agricultural production. Decent Work and Economic Growth, 1024–1037 (2021).

13 De Oliveira U.R., Marins F. A. S., Rocha H. M. and Salomon V. A. P. The iso 31000 standard in supply chain risk management. Journal of Cleaner Production, 151, 616–633 (2017). https://doi.org/10.1016/j.jclepro.2017.03.054.

14 Jaffee S., Siegel P. and Andrews C. Rapid agricultural supply chain risk assessment: A conceptual framework. Agriculture and rural development discussion paper, 47 (1), 1–64 (2010).

15 Behzadi G., O'Sullivan M.J., Olsen T.L. and Zhang A. Agribusiness supply chain risk management: A review of quantitative decision models. Omega, 79, 21–42 (2018). https://doi.org/10.1016/j.omega.2017.07.005.

16 Si S. L., You X. Y., Liu H. C., and Zhang P. Dematel technique: A systematic review of the state-of-the-art literature on methodologies and applications. Mathematical Problems in Engineering, 2018, 1–33 (2018). https://doi.org/10.1155/2018/3696457.

17 Shieh J.I., Wu H.H. and Huang K.K. A DEMATEL method in identifying key success factors of hospital service quality. Knowledge-Based Systems, 23.3, 277–282 (2010). https://doi.org/10.1016/j.knosys.2010.01.013.

18 Yazdani M., Wang Z.X., Chan F.T.S.A decision support model based on the combined structure of DEMATEL, QFD and fuzzy values. Soft Computing, 24, 12449–12468 (2020). https://doi.org/10.1007/s00500-020-04685-2.

[1]*Орынбасар Е.Б.,
магистр, ORCID ID: 0009-0007-7156-1250,
e-mail: y_orynbassar@kbtu.kz
[1]Бисембаев А.С.,
доцент, профессор, ORCID ID: 0009-0001-3283-9826,
e-mail: a.bisembaev@kbtu.kz

[1]Қазақстан-Британ техникалық университеті, Алматы қ., Қазақстан

АУЫЛ ШАРУАШЫЛЫҒЫ ЖЕТКІЗІЛІМ ТІЗБЕГІНДЕГІ ҚАУІП-ҚАТЕРДІ ТАЛДАУ: РЕЙТИНГТІК ӘДІС АРҚЫЛЫ БАҒАЛАУ

Аңдатпа

Бұл мақала ауыл шаруашылығы өнімдерін жеткізу тізбегіндегі қауіп-қатер факторларының талаптарын бағалау үшін Decision-Making and Trial Evaluation Laboratory (DEMATEL) әдісін ұсынады. Ауыл шаруашылығы өнімдерін жеткізу тізбегі түрлі қауіп-қатерге барынша осал деп айтуға болады. Қауіп-қатер аумаққа байланысты әртүрлі болуы мүмкін (операциялық, экономикалық, әлеуметтік және экологиялық). Бұл мақаладағы біздің басты мақсатымыз – әрбір қауіп-қатер факторының маңыздылығын және олардың өзара байланысын анықтап, оларды жою немесе әсерін азайту үшін ең маңызды қауіп-қатерге басымдық беру. Осы мақсатқа жету үшін біз белгілі бір деректер жиынына DEMATEL әдісін қолдандық және оны fuzzy-DEMATEL әдісімен салыстырдық. Зерттеу нәтижелері орталық қауіп-қатер факторының тұтынушыларға қызмет көрсетуді жақсарту, көміртегі шығарындыларын және қоршаған ортаның ластануын бақылау мәселелерімен тығыз байланысты екенін көрсетті. Сонымен қатар, қауіп-қатер факторлары себептік және салдарлық болып екі топқа бөлінді. Зерттеу барысында біз екі әдістің нәтижелері арасында аздаған айырмашылықтардың бар екенін байқадық. Соған қарамастан, екі әдіс те маңызды қауіп-қатер факторларын тиімді анықтауға мүмкіндік беретіні анықталды.

Тірек сөздер: DEMATEL, тәуекел факторлары, жеткізу тізбегі, ауылшаруашылық өнімдері, осалдық, өзара байланыстар, басымдылық.

[1]*Орынбасар Е.Б.,
магистр, ORCID ID: 0009-0007-7156-1250,
e-mail: y_orynbassar@kbtu.kz
[1]Бисембаев А.С.,
ассоц. профессор, ORCID ID: 0009-0001-3283-9826,
e-mail: a.bisembaev@kbtu.kz

[1]Казахстанско-Британский технический университет, г. Алматы, Казахстан

АНАЛИЗ РИСКОВ В СЕЛЬСКОХОЗЯЙСТВЕННОЙ СНАБЖЕНЧЕСКОЙ ЦЕПИ: МЕТОДИКА ОЦЕНКИ ПО РАНЖИРОВАНИЮ

Аннотация

В данной статье предлагается метод Decision-Making and Trial Evaluation Laboratory (DEMATEL) для оценки требований к факторам риска в цепочке поставок сельскохозяйственной продукции. Можно сказать, что цепочка поставок сельскохозяйственной продукции наиболее уязвима к различным рискам. Риски могут различаться в зависимости от региона (эксплуатационный, экономический, социальный и экологический). Наша цель в этой статье – определить важность каждого фактора риска и их взаимосвязей, чтобы расставить приоритеты наиболее значимых рисков для их дальнейшего устранения или смягчения. Для этого мы использовали метод DEMATEL на конкретном наборе данных и сравнили предложенный нами метод с fuzzy-DEMATEL. Результаты подчеркивают, что основные требования к факторам риска связаны с улучшением обслуживания клиентов и контролем выбросов углекислого газа и загрязнения. Кроме того, мы разделили факторы риска на две группы: причины и следствия. Следовательно, мы отметили небольшие различия между результатами методов, что указывает на эффективную идентификацию критических факторов риска с помощью обоих подходов.

Ключевые слова: DEMATEL, факторы риска, цепочка поставок, сельскохозяйственная продукция, уязвимость, взаимосвязи, расстановка приоритетов.

Article submission date: 13.04.2024