JPPIPA 11(10) (2025)
Jurnal Penelitian Pendidikan IPA
http://jppipa.unram.ac.id/index.php/jppipa/index

Fisheries Supply Chain Model Using Structural Equation Modeling (SEM) to Support the SDGs in the Fisheries Industry

Indra Jaya Kusuma Wardana[1], Arie Wahyu Prananta[1*], I Wayan Suyadnya[2], Iqbal Mahcfud Fauzi[1]

[1]Universitas Trunojoyo, Madura, Indonesia.
[2]Universitas Brawijaya Malang, Malang, Indonesia.

Received: July 27, 2025
Revised: September 20, 2025
Accepted: October 25, 2025
Published: October 31, 2025

Corresponding Author*:
Arie Wahyu Prananta
arie.prananta@trunojoyo.ac.id

DOI: 10.29303/jppipa.v11i10.12325

Abstract: The global fisheries supply chain faces challenges related to data integrity, product traceability, and distribution inequality, which impact the achievement of the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production). The main challenges are rooted in three critical pillars: data integrity, product traceability, and distribution inequality. The lack of accurate and transparent fishing data opens up opportunities for illegal, unreported, and unregulated (IUU) fishing, which is seriously depleting fish stocks. The global fisheries supply chain is a complex and vital network, providing a vital source of protein for billions of people worldwide. However, this complex system faces a series of fundamental challenges that threaten environmental sustainability and social equity, and hinder global efforts to achieve the Sustainable Development Goals (SDGs). Blockchain is a disruptive technology that offers transparency and accountability in the supply chain system. This study aims to examine the impact of blockchain technology adoption on food security through fisheries supply chain efficiency, using the Structural Equation Modeling (SEM) method. The results indicate that blockchain has a significant impact on improving logistics efficiency, product traceability, and consumer trust, which indirectly strengthens national food security. Recommendations are directed at synergy between industry players and the government to accelerate blockchain-based supply chain digitalization.

Keywords: Blockchain; Fisheries; Food security; SDGs; SEM; Supply chain

Introduction

The fisheries industry plays a vital role in maintaining global food security, particularly in archipelagic countries like Indonesia, which rely on this sector as a primary source of animal protein (Hidayat-ur-Rehman & Alsolamy, 2023). However, the fisheries supply chain faces significant challenges in the form of inefficiency, data manipulation, and detrimental illegal, unreported, and unregulated (IUU) fishing practices. The complexity of the distribution and transaction systems within this industry creates opportunities for misuse of information, which can negatively impact the sustainability of the fisheries sector (Delgado et al., 2025; Ahmed et al., 2024). In this context, achieving the Sustainable Development Goals (SDGs), particularly regarding food security and equitable distribution (Vågsholm et al., 2020; Henriksson et al., 2021), requires a more transparent, efficient system that avoids illegal practices. Blockchain technology has emerged as a potential solution, with its ability to transform conventional systems into more adaptive and responsive systems to global dynamics (Duan et al., 2023; Elsayed, 2025). This technology can provide greater transparency and accountability in the fisheries

How to Cite:
Wardana, I. J. K., Prananta, A. W., Suyadnya, I. W., & Fauzi, I. M. (2025). Fisheries Supply Chain Model Using Structural Equation Modeling (SEM) to Support the SDGs in the Fisheries Industry. *Jurnal Penelitian Pendidikan IPA*, *11*(10), 144–149. https://doi.org/10.29303/jppipa.v11i10.12325

supply chain (Rahman et al., 2021), enabling real-time product tracking from upstream to downstream (Quach et al., 2022; Iskamto & Juariyah, 2023).

The application of blockchain technology in the fisheries supply chain offers various benefits, such as increased operational efficiency and enhanced accountability (Sabat & Krishnamoorthy, 2020). Silvestri et al. (2025) and Zhang et al. (2025a) show that blockchain implementation can reduce operational costs and increase transparency, which in turn contributes to reduced waste and potential data manipulation. A more transparent and accountable supply chain can also reduce IUU fishing practices that damage fisheries ecosystems and the economy (Boumaiza, 2025; Guo & Liu, 2025). In the Indonesian context, the application of this technology can provide a solution to improve food security, especially in ensuring that fishery products produced meet sustainability and food safety standards (Ahmed, 2025; Yadav et al., 2021).

This study aims to empirically test this relationship, using the Structural Equation Modeling (SEM) method to evaluate the impact of blockchain technology on efficiency, transparency, and accountability in the Indonesian fisheries supply chain, as well as its implications for national food security.

Method

This study adopted a quantitative explanatory approach using survey techniques to collect data from fisheries industry players in Indonesia, such as fishermen (Sari et al., 2024; Umroh et al., 2020), logistics managers, distributors, and exporters. The primary objective of the study was to explain the relationship between blockchain technology adoption, supply chain efficiency, transparency, consumer trust, and food security. The instrument used to measure these variables included a 1-5 Likert scale tested for validity and reliability, allowing for accurate and consistent measurement of each construct. The variables measured included blockchain adoption (AB), supply chain efficiency (ERP), consumer transparency and trust (TTK), and food security (KP), each measured by relevant indicators.

The collected data were analyzed using Partial Least Squares-based SEM (PLS-SEM) using SmartPLS 4 software. This analysis involved two main models: a measurement model (outer model) that connects latent variables to their indicators, and a structural model (inner model) that describes the relationships between the latent variables. A goodness-of-fit (GoF) test was conducted to evaluate the model's fit to the data. The results show that blockchain adoption significantly improves supply chain efficiency, which in turn positively impacts transparency and consumer trust. Supply chain efficiency and transparency significantly contribute to improved food security, with transparency and consumer trust having the strongest influence on food security ($\beta = 0.69$; $p < 0.001$).

The SEM analysis also shows that blockchain adoption has a significant direct effect on food security ($\beta = 0.33$; $p < 0.05$), although the effect is smaller than the effect through supply chain efficiency and transparency. The proposed SEM model has a good fit to the data, with SRMR = 0.062 and NFI = 0.89, indicating a good overall fit. This study provides insights into how blockchain implementation can improve fisheries distribution efficiency and enhance food security, particularly by increasing transparency and consumer trust in sustainable fishery products.

Instruments and Variables

This study measures several key variables influencing food security in the context of blockchain implementation in the fisheries sector, including: Blockchain Adoption (AB): This variable measures the extent to which blockchain technology has been adopted in the fisheries supply chain, including by fishermen, logistics managers, distributors, and exporters; Supply Chain Efficiency (ERP): Measures operational efficiency in the fisheries supply chain influenced by blockchain technology, including reduced costs, transaction times, and logistics management; Transparency and Consumer Trust (TTK): Measures the level of transparency in the fisheries supply chain and how this impacts consumer trust in the resulting fishery products; Food Security (KP): Measures the impact of blockchain technology on improving food security, particularly in terms of food availability, accessibility, and stability. Each variable is measured using a 1-5 Likert scale, which measures respondents' level of agreement or disagreement with a series of statements related to that variable. Prior to use, the research instrument was tested for validity and reliability. Validity measures the extent to which the instrument accurately measures the intended concept, while reliability measures the consistency of the measurement.

Analysis Techniques

The data collected from the survey will be analyzed using Partial Least Squares-based SEM (PLS-SEM) using SmartPLS 4 software. SEM is a statistical method that allows for testing complex causal relationship models between latent variables and relevant indicators. The analysis process consists of two main models: Measurement Model (Outer Model): This model connects the latent variables with their measurement indicators. The measurement model assesses the validity and reliability of the indicators used to measure each latent variable; Structural Model (Inner Model): This model describes the relationships between latent variables. Here, we will examine the relationships between blockchain adoption (AB), supply chain efficiency (ERP), consumer transparency and trust (TTK), and food security (KP). This structural model will identify the direct and indirect influences between variables. In addition, a Goodness-of-Fit (GoF) test was conducted to measure the extent to which the proposed model fits the collected data. This test involves calculating several model fit indices, such as SRMR (Standardized Root Mean Square Residual) and NFI (Normed Fit Index), which will provide an idea of the overall model quality.

Results and Discussion

Descriptive Statistics

A total of 157 valid respondents participated in this study, the majority of whom were medium-scale fisheries industry players located in the coastal areas of East Java and South Sulawesi. Respondents comprised various actors in the fisheries supply chain, including fishermen, logistics managers, distributors, and exporters. This data provides a fairly representative picture of the practices and perceptions of industry players regarding the adoption of blockchain technology.

Validity and Reliability

The validity and reliability testing of the research instrument showed good results. All measurement indicators had outer loading values > 0.7, indicating that each indicator was sufficiently strong in measuring the intended latent variables. Furthermore, the composite reliability value was greater than 0.8, indicating that the research instrument had a high level of reliability. The Average Variance Extracted (AVE) for each variable was also greater than 0.50, indicating that the latent variables could be adequately explained by their indicators.

SEM Results

The SEM analysis results showed a significant relationship between the tested variables. The following are the main results of the structural model testing: Blockchain Adoption → Supply Chain Efficiency (ERP): $\beta = 0.61$, beta = 0.61, $\beta = 0.61$, $p < 0.001$. The adoption of blockchain technology has a significant impact on improving supply chain efficiency; Supply Chain Efficiency → Transparency and Consumer Trust (TTK): $\beta = 0.54$, beta = 0.54, $\beta = 0.54$, $p < 0.01$. Efficiency in the supply chain contributes to increased transparency and consumer trust in fishery products; Transparency and Consumer Trust → Food Security (KP): $\beta = 0.69$, beta = 0.69, $\beta = 0.69$, $p < 0.001$. Transparency and consumer trust have a significant impact on improving food security; Blockchain Adoption → Food Security (KP): $\beta = 0.33$\beta = 0.33 $\beta = 0.33$, $p < 0.05$. Although the effect is smaller, blockchain adoption still contributes directly to improved food security.

These results indicate that the adoption of blockchain technology not only improves efficiency in the supply chain but also increases transparency and consumer trust, ultimately contributing to better food security. The Goodness-of-Fit (GoF) test showed that this SEM model fit the data obtained, with SRMR = 0.062 and NFI = 0.89, indicating a good fit between the model and the data.

Discussion

Fisheries supply chain models analyzed using Structural Equation Modeling (SEM) are a sophisticated approach to understanding how various factors influence each other in achieving the Sustainable Development Goals (SDGs) in the fisheries industry (Osei et al., 2023; Huang et al., 2023; Sari et al., 2021). This type of research seeks to map complex causal relationships, going beyond simple descriptive statistical or regression analysis, to ensure simultaneous economic, social, and environmental sustainability (Tundys & Wiśniewski, 2023).

Purpose and Context of SEM Use

The primary purpose of using SEM in this context is to validate theoretical models of efficient and sustainable supply chains (Jamil et al., 2024; Mastos et al., 2024). SEM allows researchers to simultaneously test a series of hypotheses about the relationships between latent (unobserved) and observed variables, or between one latent variable and another. In the fisheries industry, latent variables that are often of focus include (Aksu & Başaran, 2025): Environmental Sustainability (measured by responsible fishing practices, fish stock monitoring, or waste management) (Braña et al., 2021; Hirokawa & Thompson, 2023); Economic Efficiency (measured by reduced logistics costs, increased fisher income, or return on investment); Social Welfare (measured by working conditions, fairness of profit sharing, or compliance with labor standards); Supply Chain Quality (measured by transparency, traceability, or technology adoption). The SEM model will examine how improving Supply Chain Quality affects Economic Efficiency, which can then indirectly support Environmental Sustainability and Social Welfare, aligning with SDGs such as Goal 8 (Decent Work and Economic Growth) and Goal 14 (Life Below Water).

Benefits of SEM Analysis for SDG Support

The application of SEM provides two critical benefits for policymakers and industry players in supporting the SDGs:

Identifying Key Drivers

SEM helps identify the most effective intervention points along the supply chain. For example, if SEM results indicate that Catch Data Transparency (an observed variable) has the strongest causal influence on Environmental Sustainability (a latent variable), then regulatory efforts should prioritize improving reporting and auditing systems. This ensures that resources are invested in factors that have the greatest multiplier effect on sustainability.

Testing Complex Relationships (Mediation and Moderation)

The fisheries industry is characterized by interdependent relationships (Zhang et al., 2025b; Abideen et al., 2023). SEM excels at testing complex mechanisms such as mediation. For example, a study could test whether the Adoption of Cold Chain Technology (the independent variable) indirectly affects Fisherman Welfare (the dependent variable) through improving Fish Product Quality and Safety (the mediator variable). By validating this pathway, SEM provides strong evidence regarding the most holistic investment strategy—one that focuses not only on economic outcomes but also on integrated social and environmental outcomes (Sun et al., 2022). Thus, modeling fisheries supply chains using SEM is not merely a statistical exercise, but a strategic blueprint for striking a balance between industry profitability and global commitments to sustainability. These results support the theory that blockchain improves operational efficiency (Bai et al., 2024; Balcıoğlu et al., 2024; Hübschke et al., 2025) and increases consumer trust in seafood (Khairunnisa et al., 2024; Kukman & Gričar, 2025; Putri et al., 2025). The implications for food security are significant, as a transparent distribution system can reduce waste, speed up logistical response, and increase the competitiveness of local products (Yang, 2025; Akinbamini et al., 2025; Masa'deh et al., 2024).

Conclusion

This research demonstrates that blockchain strategies can be a crucial catalyst in supporting the achievement of the SDGs and strengthening food security by improving the efficiency and transparency of the fisheries supply chain. Blockchain implementation significantly impacts logistics efficiency and consumer trust, further strengthening national food security. The government and industry need to foster a collaborative digitalization ecosystem to expand blockchain adoption in the marine and fisheries sector. A transparent distribution system is not only about technology, but also the foundation for a more efficient, equitable and sustainable food supply chain, directly and significantly supporting all key dimensions of global and local food security.

Acknowledgments

Thanks to all parties who have supported the implementation of this research. I hope this research can be useful.

Author Contributions

Conceptualization, methodology, validation, formal analysis, A.W.P.; investigation, resources, data curation, I.J.K.W.; writing—original draft preparation, writing—review and editing, I.W.S.; visualization, I.M.F. All authors have read and approved the published version of the manuscript.

Funding

The researchers funded this research independently.

Conflicts of Interest

The researchers funded this research independently.

References

Abideen, A. Z., Sorooshian, S., Sundram, V. P. K., & Mohammed, A. (2023). Collaborative Insights on Horizontal Logistics to Integrate Supply Chain Planning and Transportation Logistics Planning – A Systematic Review and Thematic Mapping. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(2), 100066. https://doi.org/10.1016/j.joitmc.2023.100066

Ahmed, H. F., Hosseinian-Far, A., Sarwar, D., & Khandan, R. (2024). Supply Chain Complexity and Its Impact on Knowledge Transfer: Incorporating Sustainable Supply Chain Practices in Food Supply Chain Networks. *Logistics*, *8*(1), 5. https://doi.org/10.3390/logistics8010005

Ahmed, I. E. (2025). Analyzing the Impact of Blockchain Technology on Banking Transaction Costs Using the Random Forest Method. *Frontiers in Blockchain*, *8*, 1551970. https://doi.org/10.3389/fbloc.2025.1551970

Akinbamini, E., Vargas, A., Traill, A., Boza, A., & Cuenca, L. (2025). Critical Analysis of Technologies Enhancing Supply Chain Collaboration in the Food Industry: A Nigerian Survey. *Logistics*, *9*(1), 8. https://doi.org/10.3390/logistics9010008

Aksu, C., & Başaran, I. M. (2025). Development and Validation of a Scale for Sustainable Practices and Their Performance Effects in Logistics Centres.

Discover Sustainability, *6*(1), 922. https://doi.org/10.1007/s43621-025-01848-9

Bai, C. A., Sarkis, J., & Xue, W. (2024). Improving Operational Efficiency and Effectiveness Through Blockchain Technology. *Production Planning & Control*, *35*(9), 857–865. https://doi.org/10.1080/09537287.2024.2329182

Balcıoğlu, Y. S., Çelik, A. A., & Altındağ, E. (2024). Integrating Blockchain Technology in Supply Chain Management: A Bibliometric Analysis of Theme Extraction via Text Mining. *Sustainability*, *16*(22), 10032. https://doi.org/10.3390/su162210032

Boumaiza, A. (2025). Advancing Sustainable Investment Efficiency and Transparency Through Blockchain-Driven Optimization. *Sustainability*, *17*(5), 2000. https://doi.org/10.3390/su17052000

Braña, C., Brais, C., Cerbule, K., Senff, P., & Stolz, I. K. (2021). Towards Environmental Sustainability in Marine Finfish Aquaculture. *Frontiers in Marine Science*, *8*, 666662. https://doi.org/10.3389/fmars.2021.666662

Delgado, F., Garrido, S., & Bezerra, B. S. (2025). Barriers to Visibility in Supply Chains: Challenges and Opportunities of Artificial Intelligence Driven by Industry 4.0 Technologies. *Sustainability*, *17*(7), 2998. https://doi.org/10.3390/su17072998

Duan, K., Pang, G., & Lin, Y. (2023). Exploring the Current Status and Future Opportunities of Blockchain Technology Adoption and Application in Supply Chain Management. *Journal of Digital Economy*, *2*, 244–288. https://doi.org/10.1016/j.jdec.2024.01.005

Elsayed, R. A. A. (2025). Unveiling the Black Box: Understanding Digital Assets' Complexity. *Future Business Journal*, *11*(1), 31. https://doi.org/10.1186/s43093-025-00456-3

Guo, H., & Liu, X. (2025). Exploring Trust Dynamics in Finance: The Impact of Blockchain Technology and Smart Contracts. *Humanities and Social Sciences Communications*, *12*(1), 1235. https://doi.org/10.1057/s41599-025-05473-9

Henriksson, P. J. G., Troell, M., Banks, L. K., Belton, B., Beveridge, M. C. M., Klinger, D. H., Pelletier, N., Phillips, M. J., & Tran, N. (2021). Interventions for Improving the Productivity and Environmental Performance of Global Aquaculture for Future Food Security. *One Earth*, *4*(9), 1220–1232. https://doi.org/10.1016/j.oneear.2021.08.009

Hidayat-ur-Rehman, I., & Alsolamy, M. (2023). A SEM-ANN Analysis to Examine Sustainable Performance in SMEs: The Moderating Role of Transformational Leadership. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(4), 100166. https://doi.org/10.1016/j.joitmc.2023.100166

Hirokawa, T., & Thompson, B. S. (2023). The Influence of New Sustainable Fisheries Policies on Seafood Company Practices and Consumer Awareness in Japan. *Marine Policy*, *157*, 105819. https://doi.org/10.1016/j.marpol.2023.105819

Huang, J-F., Chen, C-T. A., Chen, M-H., Huang, S-L., & Hsu, P-Y. (2023). Structural Equation Modeling of the Marine Ecological System in Nanwan Bay Using SPSS Amos. *Sustainability*, *15*(14), 11435. https://doi.org/10.3390/su151411435

Hübschke, M., Buss, E., Holschbach, E., & Lier, S. (2025). Blockchain in Supply Chain Management: A Comprehensive Review of Success Measurement Methods. *Management Review Quarterly*. https://doi.org/10.1007/s11301-025-00546-0

Iskamto, D., & Juariyah, L. (2023). Blockchain Technology Challenge in the Future: Data Security and Efficiency. *International Journal of Law, Policy, and Governance*, *2*(2), 65–76. https://doi.org/10.54099/ijlpg.v2i2.708

Jamil, M. A., Mustofa, R., Hossain, N. U. I., Rahman, S. M. A., & Chowdhury, S. (2024). A Structural Equation Modeling Framework for Exploring the Industry 5.0 and Sustainable Supply Chain Determinants. *Supply Chain Analytics*, *6*, 100060. https://doi.org/10.1016/j.sca.2024.100060

Khairunnisa, N., Christiani, F., & Prawiyogi, A. G. (2024). Supply Chain Transparency: Exploring Blockchain Solutions for Enhanced Traceability and Efficiency. *Blockchain Frontier Technology*, *4*(1), 15–22. https://doi.org/10.34306/bfront.v4i1.569

Kukman, T., & Gričar, S. (2025). Blockchain for Quality: Advancing Security, Efficiency, and Transparency in Financial Systems. *FinTech*, *4*(1), 7. https://doi.org/10.3390/fintech4010007

Masa'deh, R., Jaber, M., Sharabati, A-A. A., Nasereddin, A. Y., & Marei, A. (2024). The Blockchain Effect on Courier Supply Chains Digitalization and Its Contribution to Industry 4.0 within the Circular Economy. *Sustainability*, *16*(16), 7218. https://doi.org/10.3390/su16167218

Mastos, T. D., Gotzamani, K., Ieromonachou, P., & Tsiotras, G. (2024). A Structural Equation Model for Sustainable Supply Chain Management in the Food Industry. *Foods*, *13*(23), 3713. https://doi.org/10.3390/foods13233713

Osei, M. B., Papadopoulos, T., Acquaye, A., & Stamati, T. (2023). Improving Sustainable Supply Chain Performance through Organisational Culture: A Competing Values Framework Approach. *Journal of Purchasing and Supply Management*, *29*(2), 100821. https://doi.org/10.1016/j.pursup.2023.100821

Putri, M. W., Chandini, A., Putri, F. F. E., Andriadi, J., & Zefriyenni, Z. (2025). Blockchain and Supply Chain

Efficiency: Implications for Managerial Economics. *Amkop Management Accounting Review (AMAR)*, *5*(1), 39–48. https://doi.org/10.37531/amar.v5i1.2404

Quach, S., Thaichon, P., Martin, K. D., Weaven, S., & Palmatier, R. W. (2022). Digital Technologies: Tensions in Privacy and Data. *Journal of the Academy of Marketing Science*, *50*(6), 1299–1323. https://doi.org/10.1007/s11747-022-00845-y

Rahman, L. F., Alam, L., Marufuzzaman, M., & Sumaila, U. R. (2021). Traceability of Sustainability and Safety in Fishery Supply Chain Management Systems Using Radio Frequency Identification Technology. *Foods*, *10*(10), 2265. https://doi.org/10.3390/foods10102265

Sabat, K. C., & Krishnamoorthy, B. (2020). Sustainable Supply Chain Management Practices and Their Mediation Effect on Economic Returns. *Corporate Governance and Sustainability Review*, *4*(1), 8–20. https://doi.org/10.22495/cgsrv4i1p1

Sari, D. K., Koestiono, D., & Shinta, A. (2021). Analysis Influence Relationship of Internal and External on Strategy and Sustainable Supply Chains Management on Operational Performance of Food and Beverages Agro-Industries. *Agricultural Social Economic Journal*, *21*(3), 241–250. https://doi.org/10.21776/ub.agrise.2021.021.3.9

Sari, D. W., Islamiya, H. A. T., Sylviana, W., Fawait, M., Amelia, B. S., Hidayanti, I., & Alias, N. S. (2024). The Behavior of Fishermen in Handling Post-Harvest Fish and Its Quality in East Java Province. *Aquaculture and Fisheries*, S2468550X24001205. https://doi.org/10.1016/j.aaf.2024.08.003

Silvestri, R., Carloni, E., Morrone, D., & Santovito, S. (2025). The Role of Blockchain Technology in Supply Chain Relationships: Balancing Efficiency and Relational Dynamics. *Journal of Purchasing and Supply Management*, *31*(1), 100967. https://doi.org/10.1016/j.pursup.2024.100967

Sun, X., Yu, H., Solvang, W. D., Wang, Y., & Wang, K. (2022). The Application of Industry 4.0 Technologies in Sustainable Logistics: A Systematic Literature Review (2012–2020) to Explore Future Research Opportunities. *Environmental Science and Pollution Research*, *29*(7), 9560–9591. https://doi.org/10.1007/s11356-021-17693-y

Tundys, B., & Wiśniewski, T. (2023). Triple Bottom Line Aspects and Sustainable Supply Chain Resilience: A Structural Equation Modelling Approach. *Frontiers in Environmental Science*, *11*, 1161437. https://doi.rg/10.3389/fenvs.2023.1161437

Umroh, E. A., Maulita, W., Pangestu, M. D. A., Islami, N. N., & Sukidin, S. (2020). Analysis of Fisheries Export Commodities in Banyuwangi Regency, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *485*(1), 012127. https://doi.org/10.1088/1755-1315/485/1/012127

Vågsholm, I., Arzoomand, N. S., & Boqvist, S. (2020). Food Security, Safety, and Sustainability—Getting the Trade-Offs Right. *Frontiers in Sustainable Food Systems*, *4*, 16. https://doi.org/10.3389/fsufs.2020.00016

Yadav, D., Dutta, G., & Kumar, S. (2021). Food Safety Standards Adoption and Its Impact on Firms' Export Performance: A Systematic Literature Review. *Journal of Cleaner Production*, *329*, 129708. https://doi.org/10.1016/j.jclepro.2021.129708

Yang, H. (2025). Can Blockchain Smart Contracts Improve the Operational Efficiency of Green Supply Chain Emission Reduction Technologies? *Finance Research Letters*, *85*, 108163. https://doi.org/10.1016/j.frl.2025.108163

Zhang, T., Jia, F., & Chen, L. (2025a). Blockchain Adoption in Supply Chains: Implications for Sustainability. *Production Planning & Control*, *36*(5), 699–722. https://doi.org/10.1080/09537287.2023.2296669

Zhang, Y., Lin, Y., & Esfahbodi, A. (2025b). Digital Transformations of Supply Chain Management via RFID Technology: A Systematic Literature Review. *Journal of Digital Economy*, S2773067025000196. https://doi.org/10.1016/j.jdec.2025.06.001