Management Strategies and Engineering Sciences 2025; 7(6):1-9

Identifying Sustainable Supply Chain Indicators in the Dairy Industry with a Foresight Approach

Meysam Abedini[1], Narges Mohammad Alipour[2*], Ashraf Shah Mansouri[3], Mahnaz Rabie[4]

[1] Department of Industrial Management, ST.C., Islamic Azad University, Tehran, Iran
[2] Department of Information Science and Epistemology, Ro.C., Islamic Azad University, Roudhen, Iran
[3] Department of Management, ST.C., Islamic Azad University, Tehran, Iran
[4] Department of Economics, ST.C., Islamic Azad University, Tehran, Iran

*** Corresponding author email address**: m.alipour@Riau.ac.ir

Received: 2025-02-03 **Reviewed:** 2025-04-09 **Revised:** 2025-04-16 **Accepted:** 2025-04-30 **Published:** 2025-11-28

Abstract

This study aimed to identify the key indicators of a sustainable supply chain in the Iranian dairy industry using a foresight-based qualitative approach. The research employed a qualitative methodology rooted in foresight thinking to explore the multidimensional aspects of sustainability in the dairy supply chain. Participants were selected through purposive and snowball sampling and included 11 individuals from three stakeholder groups: academic experts, industry professionals, and independent stakeholders such as consumers and researchers. Semi-structured in-depth interviews were conducted to gather insights into economic, social, environmental, legal, and ethical factors affecting sustainability. Data were analyzed using thematic analysis in MAXQDA software, following a six-step coding process: familiarization with data, initial coding, theme development, theme review, definition and naming of themes, and report generation. Theoretical saturation was reached after the ninth interview, and two additional interviews confirmed data saturation. Two overarching themes were extracted from the interviews: “Drivers” and “Dairy Supply Chain Sustainability.” The Drivers theme included five organizing categories—economic, social, environmental, legal, and ethical factors—each comprising several foundational indicators such as cost reduction, social responsibility, renewable energy use, regulatory compliance, and ethical leadership. The Dairy Supply Chain Sustainability theme featured six organizing themes: sustainable sourcing, sustainable management, sustainable culture, sustainable customer orientation, strategic sustainability planning, and dairy-specific sustainability practices. These themes encompassed a total of 62 basic indicators, providing a comprehensive framework for assessing and enhancing sustainability in the dairy industry. The findings highlight the need for an integrated, multi-dimensional strategy for achieving sustainability in the dairy supply chain, emphasizing foresight, stakeholder collaboration, ethical governance, and environmental responsibility. The proposed conceptual model can guide both strategic planning and policy formulation in dairy supply chain sustainability.

Keywords: *Sustainable supply chain, Dairy industry, Foresight approach, Thematic analysis, Iran, MAXQDA, Qualitative research, Stakeholder perspectives.*

How to cite this article:

Atri, R., Shafizadeh, H., & Soleimani, N. (2025). Identifying Sustainable Supply Chain Indicators in the Dairy Industry with a Foresight Approach. Management Strategies and Engineering Sciences, 7(6), 1-9.

1. Introduction

The global dairy industry is increasingly navigating a rapidly evolving landscape shaped by consumer expectations, sustainability demands, environmental regulations, and technological advancements. As one of the most resource-intensive segments within the agri-food sector, the dairy supply chain (DSC) plays a crucial role in food security, public health, economic stability, and environmental impact mitigation. With mounting pressures to transition toward sustainability-oriented practices, identifying and evaluating sustainable supply chain indicators within this industry has become an imperative task for researchers and practitioners alike. The sustainable transformation of the DSC requires an integrative

understanding of various interdependent factors ranging from economic enablers and environmental imperatives to ethical considerations and governance mechanisms [1, 2].

In recent years, researchers have emphasized the need to reimagine the dairy supply chain in light of emerging global trends, particularly those aligned with the United Nations Sustainable Development Goals (SDGs) [3, 4]. Sustainable supply chains in the dairy sector are characterized by efficient resource utilization, emission reduction strategies, ethical treatment of animals, waste minimization, equitable profit distribution, and resilience to environmental and economic shocks. The environmental challenges associated with traditional dairy operations—such as methane emissions, water usage, and land degradation—have prompted scholars and industry leaders to reassess and restructure supply chain processes [4, 5]. From raw milk production to consumer delivery, each stage of the DSC presents an opportunity to reduce ecological impact and enhance sustainability outcomes [6].

At the same time, economic sustainability remains a pivotal concern. Ensuring profitability for farmers, processors, and distributors while balancing environmental responsibilities necessitates innovations in supply chain governance, data integration, and risk management [7, 8]. Several studies have explored the economic levers that can drive more sustainable operations, including cold-chain optimization, forecasting precision, and logistics improvements [2, 9]. The increasing adoption of digital technologies—such as blockchain, IoT, and AI—in supply chain operations has further expanded the possibilities for enhancing transparency, traceability, and efficiency [10, 11]. These tools also enable producers to better anticipate market fluctuations and streamline resource allocations across the supply chain.

Social and ethical dimensions are equally critical in the dairy supply chain discourse. Consumer trust, animal welfare, community engagement, and labor conditions influence not only purchasing behaviors but also brand reputation and regulatory compliance [12, 13]. As consumers become more socially conscious, companies are increasingly held accountable for how their supply chains operate. Ethical supply chain management involves creating and enforcing codes of conduct, ensuring fair compensation and safe working conditions, and engaging in community-based programs that reflect corporate social responsibility [14, 15]. The integration of ethical values into organizational culture and leadership practices is instrumental in institutionalizing sustainability across operational levels.

Legal frameworks and regulatory standards also shape the boundaries within which sustainable supply chains can function. Compliance with food safety standards, environmental regulations, animal welfare laws, and labor rights is necessary to maintain operational licenses and secure market access, particularly in export-oriented sectors [11, 16]. In emerging economies, however, the lack of robust enforcement mechanisms often leads to inconsistencies in adherence and monitoring. Therefore, many scholars advocate for participatory and transparent models of governance that include multiple stakeholders—governments, corporations, communities, and consumers—in shaping the regulatory landscape [17, 18].

In parallel with these multidimensional pressures, the concept of foresight has gained prominence as a strategic approach in supply chain sustainability studies. Foresight research enables organizations to anticipate future challenges, identify strategic drivers, and develop adaptive strategies that align with long-term goals [19, 20]. It facilitates scenario planning and decision-making in the face of uncertainties such as climate change, market disruptions, and geopolitical tensions. In the context of the dairy industry, foresight allows for the identification of both macro-level trends (e.g., decarbonization, digital transformation) and micro-level indicators (e.g., supplier reliability, consumer expectations) that shape the trajectory of sustainability [4, 21].

Building upon this foundation, the current study aims to identify key indicators of a sustainable dairy supply chain in Iran using a foresight-oriented qualitative research design. The Iranian dairy industry, like many others in the Global South, faces a complex set of challenges including fragmented production systems, outdated infrastructure, economic sanctions, and increasing environmental constraints. Yet it also holds significant potential for transformation through integrated sustainability practices and stakeholder collaboration [19, 22]. By employing semi-structured interviews with academic experts, industry professionals, and independent stakeholders, this research explores the economic, social, environmental, legal, and ethical drivers of sustainable supply chains in the Iranian dairy sector. These interviews provide nuanced insights into stakeholder perceptions and strategic priorities, ultimately informing the design of a conceptual model for sustainable supply chain development.

This study contributes to the literature in several ways. First, it integrates cross-sectoral perspectives to provide a holistic understanding of sustainability indicators,

addressing the need for comprehensive models that bridge theory and practice [9, 23]. Second, it applies a thematic analysis approach using MAXQDA to systematically classify and interpret qualitative data, offering a replicable framework for future studies. Third, it emphasizes the value of foresight thinking in supply chain governance, a relatively underexplored area in dairy research. Lastly, the findings can inform policymakers, dairy producers, and supply chain managers about the core areas requiring attention to ensure the long-term viability and competitiveness of the industry.

The relevance of this research is further amplified by global trends in sustainability financing, green consumerism, and international trade regulations that increasingly prioritize ESG (Environmental, Social, and Governance) compliance [1, 24]. In this context, supply chains that are ill-equipped to adapt may face heightened risks of obsolescence or exclusion from emerging markets. Conversely, those that proactively engage with sustainable practices—through green procurement, waste reduction, renewable energy adoption, stakeholder transparency, and technological innovation—are more likely to thrive in the competitive global dairy landscape [25, 26].

In conclusion, the transition toward sustainable dairy supply chains is not a linear or isolated process but a systemic transformation influenced by a constellation of interconnected factors. Understanding these indicators through the lens of foresight provides a powerful tool for navigating uncertainty and complexity. The current study, by identifying and structuring the core drivers of sustainability in the Iranian dairy supply chain, lays the groundwork for actionable policy recommendations, strategic planning, and scholarly dialogue on the future of sustainable agri-food systems.

2. Methodology

This study adopted a qualitative foresight research design aimed at identifying the key indicators of a sustainable supply chain in Iran's dairy industry. The research population consisted of three primary stakeholder groups: academic experts with recognized scholarly contributions in supply chain and sustainability studies, industry professionals currently working in the dairy sector, and independent stakeholders including consumers and unaffiliated researchers. A purposive sampling method was employed, specifically using a chain-referral or snowball sampling technique. This approach was deemed appropriate given the absence of a formal sampling framework and the need to access individuals with specific and in-depth knowledge of the domain. Participants were selected based on their expertise, reputational credibility, and ability to provide meaningful insights into the topic. The sampling process began with identifying key individuals and conducting interviews with them, who in turn referred the researcher to additional experts. This iterative process continued until the point of theoretical saturation was reached. Notably, redundancy in the information collected emerged after the ninth interview, and two additional interviews were conducted to confirm saturation, resulting in a total of eleven participants in the study.

Data collection was carried out using semi-structured in-depth interviews. This method was chosen for its effectiveness in exploring complex phenomena and capturing nuanced perspectives from participants. The interviews focused on identifying influential factors and developing possible scenarios related to sustainable supply chains in the dairy sector. Interview questions were developed based on both existing literature and expert consultation to ensure content relevance and depth. Each interview followed a flexible protocol that included a set of open-ended, pre-designed questions, while also allowing the researcher to pose follow-up or newly emerged questions during the conversation. The use of in-depth interviewing allowed for the extraction of rich, experiential knowledge from individuals who had significant familiarity with the domain under investigation. Interviews primarily targeted those with deep involvement or insight into sustainable practices within the dairy industry, emphasizing both academic and practical dimensions. To establish content validity, the interview protocol was reviewed and confirmed by a panel of experts, and a pilot interview was conducted to refine the questions.

The data obtained from the interviews were analyzed using qualitative content analysis, specifically employing the thematic analysis method, supported by the MAXQDA software. This software, which is particularly compatible with Persian language content, enabled efficient and precise management of the qualitative data across multiple coding stages. Thematic analysis was conducted in six distinct phases. In the first phase, the researcher immersed themselves in the data through repeated and active reading of interview transcripts to gain a comprehensive understanding. During the second phase, initial codes were generated by identifying relevant features and organizing them accordingly. These codes reflected elements deemed significant by the researcher in relation to the study's

objective. The third phase involved searching for overarching themes by clustering related codes and consolidating overlapping or semantically similar ones. In the fourth phase, the themes were carefully reviewed and refined at two levels: first, at the level of coded extracts, and second, in relation to the entire data set to ensure coherence and consistency. The fifth phase involved defining and naming each finalized theme, ensuring that each one captured a unique and meaningful aspect of the participants' narratives. Finally, in the sixth phase, a comprehensive report was developed, integrating the themes into a coherent narrative that reflected the key findings of the study. This structured, multi-step analysis allowed the researcher to extract essential insights into the dynamics and foresight strategies of sustainable supply chain development in the dairy industry.

3. Findings and Results

The demographic characteristics of the participants in this study included a total of 11 individuals, comprising 7 men (63%) and 4 women (37%). In terms of age distribution, 2 participants (18%) were under 35 years old, 5 individuals (45%) were between 35 and 45 years old, and 4 participants (37%) were aged 45 and above. Regarding educational attainment, the majority held doctoral degrees (8 participants, 73%), while 3 participants (27%) had obtained a master's degree. As for professional experience, 7 individuals (63%) had between 10 to 20 years of work experience, and the remaining 4 participants (37%) had over 20 years of experience.

Table 1. Main and Sub-Themes of the Study

Global Themes	Organizing Themes	Basic Themes
Drivers	Economic Factors	1. Supply chain cost reduction
		2. Increased market share
		3. International market presence
		4. Increased sales and revenues
		5. Improved return on investment
		6. Enhanced company profitability
	Social Factors	7. Public trust in dairy companies
		8. Participation in charitable activities
		9. Sponsorship of social events
		10. Support for public welfare initiatives
		11. Active presence in community events
		12. Responsiveness to social demands
	Environmental Factors	13. Support for clean dairy production
		14. Use of renewable energy
		15. Emissions and pollution reduction
		16. Reduction of harmful substances
		17. Increased product shelf life
	Legal Factors	18. Compliance with government regulations
		19. Clear ethical standards
		20. Addressing illegal/unethical practices
		21. Ethical discipline within companies
		22. Ongoing ethical compliance monitoring
	Ethical Factors	23. Company code of ethics
		24. Ethical leadership
		25. Employee ethical conduct
		26. Staff ethical evaluation
		27. Institutionalizing ethical culture
Dairy Supply Chain Sustainability	Sustainable Sourcing	28. Identifying sustainable suppliers
		29. Long-term supplier relations
		30. Eco-friendly raw materials
		31. Funding green suppliers
		32. Flexible supplier relationship management
	Sustainable Management	33. Managerial support for sustainability
		34. Strategic sustainability planning
		35. Adaptive organizational structure
		36. Reengineering based on sustainability
		37. Continuous monitoring of sustainability issues

	38. Adequate budgeting for sustainability
Sustainable Culture	39. Institutionalizing sustainability culture
	40. Strengthening sustainability values
	41. Employee sustainability training
	42. Staff awareness and accountability
	43. Sustainability-supportive atmosphere
Sustainable Customers	44. Responding to customer needs
	45. Two-way customer engagement
	46. Long-term customer relationships
	47. Customer complaint systems
	48. Ongoing monitoring of customer needs
Sustainability Strategy	49. Clear supply chain sustainability vision
	50. Defined sustainability missions
	51. Long-term sustainability goals
	52. Strategic alignment with long-term goals
	53. Short-term sustainability objectives
	54. Actionable policies for short-term objectives
	55. Operational procedures for supply chain sustainability
Dairy-Specific Sustainability	56. Minimizing dairy product waste
	57. Mechanisms for waste absorption
	58. Dairy supply chain optimization
	59. Production of organic dairy products
	60. High-quality dairy products
	61. Fast access to raw material suppliers
	62. Fast delivery of dairy products to customers

The analysis of qualitative data collected through in-depth interviews led to the identification of two overarching global themes, each encompassing several organizing themes and basic subthemes. The first global theme, titled "Drivers," includes five key organizing dimensions: economic, social, environmental, legal, and ethical drivers. These dimensions reflect the primary motivating forces influencing the transition toward sustainability in the dairy supply chain. Economic drivers comprise factors such as cost reduction in the supply chain, increased market share for the dairy industry, international market presence, growth in sales and revenues, improved return on investment, and enhanced profitability. Social drivers refer to the level of public trust in dairy companies, corporate participation in charitable and public welfare activities, sponsorship of social events, and responsiveness to social expectations. Environmental drivers emphasize support for the production of clean dairy products, use of renewable energy sources, pollution and emissions reduction, minimization of harmful substances, and increased product shelf life. Legal drivers highlight compliance with governmental regulations, adherence to clear ethical standards, addressing unlawful or unethical conduct, enforcement of moral discipline within firms, and continuous ethical supervision. Finally, ethical drivers underscore the importance of the company's code of ethics, moral leadership, employee adherence to ethical conduct, ethical evaluation systems, and the institutionalization of ethical culture within organizations.

The second global theme, "Dairy Supply Chain Sustainability," captures the structural, strategic, and cultural dimensions that contribute to long-term supply chain sustainability. This theme encompasses six organizing themes: sustainable sourcing, sustainable management, sustainable culture, sustainable customers, supply chain sustainability strategy, and dairy-specific sustainability practices. Sustainable sourcing involves identifying environmentally responsible suppliers, building long-term supplier relationships, procuring eco-friendly raw materials, allocating funding to green suppliers, and maintaining flexibility in supplier relationship management. Sustainable management includes managerial support for sustainability, strategic planning aligned with sustainability goals, adaptive organizational structures, business process reengineering based on sustainability principles, ongoing monitoring of sustainability issues, and proper budgeting for sustainability initiatives. Sustainable culture covers institutionalization of sustainability values within the organization, reinforcing beliefs and values related to sustainability, staff training, promoting awareness and accountability, and fostering a supportive organizational atmosphere. The sustainable customers theme emphasizes responsiveness to consumer demands, strengthening reciprocal engagement with customers, maintaining long-term customer relationships,

effective customer complaint systems, and ongoing monitoring of customer needs. The strategic planning theme outlines a clear sustainability vision, defined mission statements, long-term and short-term goal setting, actionable policies, and operational procedures aligned with sustainability objectives. Lastly, dairy-specific sustainability practices include minimizing waste in dairy production, implementing systems to absorb production waste, optimizing the dairy supply chain, producing organic dairy goods, ensuring high product quality, and improving both the speed of raw material acquisition and product distribution.

4. Discussion and Conclusion

The findings of this study, rooted in a foresight-based qualitative framework, led to the identification of two overarching themes—Drivers and Dairy Supply Chain Sustainability—with a total of seven organizing themes and sixty-two foundational subthemes. The theme of *Drivers* encapsulates economic, social, environmental, legal, and ethical dimensions, illustrating the multifaceted nature of sustainability in the dairy supply chain. The second theme, *Dairy Supply Chain Sustainability*, encompassed subdimensions such as sustainable sourcing, sustainable management, sustainable culture, sustainable customer relations, and strategic approaches tailored to the specific characteristics of the dairy industry. These insights collectively provide a comprehensive picture of how sustainability is conceptualized, enacted, and institutionalized in the context of the Iranian dairy sector.

Economically driven factors were highlighted as dominant forces influencing sustainable supply chain transitions. Participants repeatedly referred to goals such as cost reduction, revenue increase, improved profitability, and enhanced market share. These findings align with the growing body of research emphasizing economic sustainability as a primary motivator for firms to adopt green and resilient supply chain practices. For instance, studies have noted that the integration of cost optimization strategies, such as improved logistics and predictive analytics, not only boosts supply chain efficiency but also contributes to sustainability goals [2, 9]. Furthermore, enhanced return on investment and increased presence in international markets, both mentioned by participants, are echoed in the global literature as significant enablers of sustainable supply chain innovation in the dairy industry [7, 8]. This economic imperative creates an environment in which sustainability becomes a vehicle for competitiveness rather than merely a regulatory obligation.

Social drivers also emerged as vital elements, with participants referring to public trust, participation in philanthropic activities, social responsiveness, and stakeholder engagement. The integration of social responsibility into supply chain strategy is increasingly acknowledged as essential, not only for ethical reasons but also for long-term brand resilience and customer loyalty [12, 15]. In this regard, our findings are consistent with those of Hu et al. (2021), who found that consumer expectations and perceptions play a critical role in shaping firm behavior in the dairy sector, particularly in regions where transparency and social accountability are becoming non-negotiable [13]. The alignment of corporate values with community needs, along with investments in social cohesion, enhances the perceived legitimacy of dairy firms and cultivates supportive stakeholder ecosystems.

Environmental considerations such as emissions reduction, energy efficiency, waste minimization, and the production of environmentally friendly dairy products were extensively emphasized by interviewees. These findings are directly supported by existing research demonstrating that sustainable environmental practices are increasingly being institutionalized as central pillars in dairy operations worldwide [4, 6]. The integration of renewable energy sources and reduction of toxic waste have been identified as key components of resilient dairy supply chains in both developed and developing contexts [3, 5]. Our study echoes the argument made by Fei (2021) that environmental performance in the dairy supply chain is tightly connected to both long-term profitability and risk mitigation strategies [22]. Additionally, the focus on product shelf-life enhancement is a noteworthy contribution, highlighting how environmental and economic goals can intersect through technological and packaging innovations.

Legal and ethical drivers were also consistently underscored by participants, including adherence to regulatory frameworks, organizational discipline, and ethical leadership. These findings corroborate the work of Khanna et al. (2022), who identified legal compliance and traceability as foundational pillars of trustworthy and sustainable dairy operations [11]. The emphasis on ethical conduct—both from leadership and employees—resonates with recent scholarship exploring the institutionalization of ethical norms within supply chain networks [14, 17]. Furthermore, the centrality of ethics in our findings supports the position of Nikoličić et al. (2021), who argue that

integrating ethical principles in supply chain practices leads to more socially acceptable and environmentally friendly outcomes, especially when embedded across managerial and operational levels [26].

The second overarching theme—Dairy Supply Chain Sustainability—provides a structural framework that details how sustainability is implemented across operational domains. Sustainable sourcing, for instance, was characterized by long-term partnerships with eco-conscious suppliers, procurement of green materials, and financial flexibility in managing supplier relationships. These findings strongly parallel previous studies on green procurement and ethical supplier engagement, especially in the context of resource-intensive sectors such as dairy [7, 25]. Sustainable management practices—including leadership commitment, process reengineering, and continuous monitoring—also mirror the emphasis placed in the literature on organizational adaptability and dynamic capability building for sustainable transformation [8, 10]. In particular, the importance of managerial support echoes the findings of Mirsaeedi et al. (2024), who demonstrated that leadership involvement significantly enhances reliability and risk resilience in the dairy supply chain [19].

Cultural aspects of sustainability, such as employee training, values alignment, and awareness-building, were found to be foundational to embedding sustainability within organizational DNA. This internal culture-building is often underemphasized in operational frameworks but has been validated by recent research as a decisive factor in long-term sustainability success [15, 17]. Our findings substantiate the argument by Theunissen and Bernhardt (2023), who highlighted that cultural shifts are essential for energy efficiency strategies to succeed in the dairy sector [18]. Moreover, sustainability-driven customer relations—built on trust, responsiveness, and feedback mechanisms—reflect a growing consensus in the literature that customer-centric sustainability not only enhances loyalty but also drives market differentiation [12, 23].

The strategic dimension of sustainability, as captured in vision setting, long- and short-term goal articulation, and the formulation of actionable policies, suggests that foresight and scenario planning are becoming indispensable. This insight supports the foresight-based models proposed by Mwirigi et al. (2024), who emphasized the need for forward-looking strategies in navigating complexity and aligning with the SDGs [20]. Scenario thinking, a cornerstone of the current study's methodological design, allows firms to prepare for multiple futures rather than rely on reactive decision-making. This capacity for adaptive strategy development is critical in addressing shocks such as climate change, regulatory reforms, and market disruptions [16, 21].

Finally, several dairy-specific sustainability practices were also identified, such as waste minimization, organic product development, and enhanced distribution speed. These factors reflect the unique operational pressures in the dairy industry—particularly regarding perishability and food safety. The focus on organic production also aligns with consumer trends and emerging regulatory incentives across global markets [25]. The inclusion of logistical efficiency and speed as sustainability indicators corresponds with research from Kashyap et al. (2023), who demonstrated that cold-chain optimization directly influences both environmental impact and consumer satisfaction [2].

Despite its significant contributions, this study is not without limitations. The research was conducted using a qualitative methodology with a relatively small sample size (n=11), which, although appropriate for in-depth thematic exploration, may limit the generalizability of findings. The snowball sampling technique, while effective in reaching domain experts, may have introduced a degree of homogeneity among participants, potentially excluding dissenting or divergent perspectives. Additionally, the study is context-specific to Iran's dairy industry, and while the findings may be relevant to other similar economies, their applicability to different socio-economic or regulatory contexts should be considered cautiously.

Future research could benefit from expanding the participant base to include a broader range of stakeholders, such as policy-makers, farmers, and supply chain intermediaries, to gain a more holistic view. Comparative studies across different countries or regions could also yield valuable insights into how sustainability drivers vary based on local governance structures, consumer behavior, and resource availability. Quantitative validation of the indicators identified in this study through survey-based or modeling approaches would further strengthen the robustness of the conceptual model. Additionally, longitudinal studies could explore how these sustainability indicators evolve over time in response to technological advancements or policy shifts.

Practitioners in the dairy industry should prioritize the integration of sustainability indicators into their strategic planning and operational frameworks. Building strong partnerships with green suppliers and investing in renewable technologies can improve both environmental outcomes and operational efficiency. Developing a culture of sustainability

within organizations through training, value alignment, and leadership commitment is essential for embedding long-term change. Supply chain managers should adopt foresight methods, such as scenario planning, to remain agile in the face of future uncertainties. Finally, enhancing transparency and ethical governance will not only build consumer trust but also help organizations align with emerging regulatory and market expectations.

Authors' Contributions

Authors equally contributed to this article.

Acknowledgments

Authors thank all participants who participate in this study.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

References

[1] N. Slavinskaitė, K. Čižiūnienė, and V. Bundonytė, "Assessment of the Sustainable Supply Chain Finance Factors," *Sustainability*, vol. 17, no. 3, p. 1002, 2025, doi: 10.3390/su17031002.

[2] A. Kashyap, O. J. Shukla, B. K. Jha, B. Ramtiyal, and G. Soni, "Enhancing Sustainable Dairy Industry Growth Through Cold-Supply-Chain-Integrated Production Forecasting," *Sustainability*, vol. 15, no. 22, p. 16102, 2023, doi: 10.3390/su152216102.

[3] D. Mwirigi, "From Cow to Climate—Tracing the Path of Dairy Sustainability: Unveiling the Impact on Sustainable Development Goals Through Bibliometric and Literature Analyses," *Animals*, vol. 15, no. 7, p. 931, 2025, doi: 10.3390/ani15070931.

[4] H. Ni, "Towards Decarbonizing the Supply Chain of Dairy Industry: Current Practice and Emerging Strategies," *Carbon Neutrality*, vol. 4, no. 1, 2025, doi: 10.1007/s43979-025-00124-z.

[5] F. T. M. Kilima, G. Msalya, and A. O. Omore, "Enhancing Capacity to Comply With Sustainability Standards in the Milk Value Chain in East Africa: Challenges, Prospects, and Policy Implications," *Sustainability*, vol. 16, no. 18, p. 8100, 2024, doi: 10.3390/su16188100.

[6] C. L. Beber, G. Langer, and J. Meyer, "Strategic Actions for a Sustainable Internationalization of Agri-Food Supply Chains: The Case of the Dairy Industries From Brazil and Germany," *Sustainability*, vol. 13, no. 19, p. 10873, 2021, doi: 10.3390/su131910873.

[7] M. Asif, M. Sarim, W. Khan, and S. Khan, "ISM- And MICMAC-based Modelling of Dairy Supply Chain: A study of Enablers in Indian Economy Perspective," *British Food Journal*, vol. 126, no. 2, pp. 578-594, 2023, doi: 10.1108/bfj-04-2023-0307.

[8] D. Milić, T. Novaković, D. Tekić, B. Matkovski, D. Đokić, and S. Zekić, "Economic Sustainability of the Milk and Dairy Supply Chain: Evidence From Serbia," *Sustainability*, vol. 15, no. 21, p. 15234, 2023, doi: 10.3390/su152115234.

[9] F. Gu, "Research on Cost Optimization of Supply Chain Network in Dairy Industry," *BCP Business & Management*, vol. 23, pp. 591-596, 2022, doi: 10.54691/bcpbm.v23i.1408.

[10] R. Kumar and D. Kumar, "Blockchain-Based Smart Dairy Supply Chain: Catching The momentum for Digital Transformation," *Journal of Agribusiness in Developing and Emerging Economies*, 2023, doi: 10.1108/jadee-07-2022-0141.

[11] A. Khanna, S. Jain, A. Burgio, V. Bolshev, and B. Панченко, "Blockchain-Enabled Supply Chain Platform for Indian Dairy Industry: Safety and Traceability," *Foods*, vol. 11, no. 17, p. 2716, 2022, doi: 10.3390/foods11172716.

[12] M. Shamsuddoha, T. Nasir, and N. U. I. Hossain, "A Sustainable Supply Chain Framework for Dairy Farming Operations: A System Dynamics Approach," *Sustainability*, vol. 15, no. 10, p. 8417, 2023, doi: 10.3390/su15108417.

[13] F. Hu *et al.*, "Does the Price Support Policy Drive a Balanced Distribution of Profits in the Chinese Dairy Supply Chain? Implications for Supplier and Consumer Psychology," *Frontiers in Psychology*, vol. 12, 2021, doi: 10.3389/fpsyg.2021.632355.

[14] A. Hassan *et al.*, "Safety Failure Factors Affecting Dairy Supply Chain: Insights From a Developing Economy," *Sustainability*, vol. 13, no. 17, p. 9500, 2021, doi: 10.3390/su13179500.

[15] S. Hristova and K. Efremov, "Managing Supply Chain and Organizational Performance: An Evidence From the Macedonian Dairy Industry," *Timisoara Journal of Economics and Business*, vol. 15, no. 2, pp. 127-150, 2022, doi: 10.2478/tjeb-2022-0008.

[16] Y. Shimizuike, Y. Takeru, and R. Dai, "The Impact of Earthquake Disasters on Milk Supply Chain and Review of Existing Measures," *Journal of Food System Research*, vol. 28, no. 1, pp. 16-28, 2021, doi: 10.5874/jfsr.28.1_16.

[17] H. v. d. Ven, "Can Digital Activism Change Sustainable Supply Chain Practices in the Agricultural Bioeconomy? Evidence From #Buttergate," *Applied Sciences*, vol. 14, no. 24, p. 11893, 2024, doi: 10.3390/app142411893.

[18] T. Theunissen and H. Bernhardt, "Scenario Analysis Indicates Revenue Increase for German Dairy Farmers Through Supply Chain Energy Management," *Journal of the Asabe*, vol. 66, no. 3, pp. 667-675, 2023, doi: 10.13031/ja.15379.

[19] F. Mirsaeedi, A. Mollajan, S. H. Iranmanesh, and M. Sheikhalishahi, "Evaluation of Dairy Supply Chain Performance: A Fuzzy Inference System-Based Reliability Analysis," 2024, doi: 10.20944/preprints202407.0547.v1.

[20] D. Mwirigi, M. Fekete-Farkas, and B. Csaba, "From Cow to Climate: Tracing the Path of Dairy Sustainability: Unveiling the Impact on Sustainable Development Goals Through Bibliometric and Literature Analysis," 2024, doi: 10.20944/preprints202406.1054.v1.

[21] G. K. Sinha and S. Mishra, "Sustainable Supply Chain Management Practices in the Dairy Industry: A Comparative Study of Leading Dairy Firms and Future Research Directives," *Asian Journal of Dairy and Food Research*, no. Of, 2023, doi: 10.18805/ajdfr.dr-2120.

[22] C. L. T. Fei, "Research on Profit Distribution Between Dairy Farmers and Manufacturing Enterprises in Dairy Supply Chain Based on Qualified Rate," *Converter*, pp. 607-625, 2021, doi: 10.17762/converter.90.

[23] Z. Li, A. Zuo, and C. Li, "Predicting Raw Milk Price Based on Depth Time Series Features for Consumer Behavior Analysis," *Sustainability*, vol. 15, no. 8, p. 6647, 2023, doi: 10.3390/su15086647.

[24] I. B. S and A. Vasumathi, "Supply Chain Management on Technology Adoption," *International Research Journal of Multidisciplinary Scope*, vol. 05, no. 03, pp. 11-27, 2024, doi: 10.47857/irjms.2024.v05i03.0371.

[25] E. Vargas-Bello-Pérez, O. R. Espinoza-Sandoval, S. Rodríguez-Piñeros, and N. Ghavipanje, "Supply and Value Chain of the Dairy Industry in Mexico," *Ijanr*, vol. 51, no. 3, 2024, doi: 10.7764/ijanr.v51i3.2643.

[26] S. Nikoličić, M. Kilibarda, M. Maslarić, D. Mirčetić, and S. Bojić, "Reducing Food Waste in the Retail Supply Chains by Improving Efficiency of Logistics Operations," *Sustainability*, vol. 13, no. 12, p. 6511, 2021, doi: 10.3390/su13126511.