

Guest Editorial: Transforming Food Supply Chains: Harnessing the Potential of the Digital Era

Introduction: The Need for Digital Transformation in Food Supply Chains

In the face of global challenges such as the COVID-19 pandemic, climate change, supply chain disruptions, and shifting consumer preferences, the food supply chain (FSC) has emerged as a critical focus for innovation and resilience (Jagtap et al., 2024; Jagtap et al., 2022). The growing complexity and fragility of FSCs have highlighted the urgent need for adopting digital technologies to ensure efficiency, transparency, sustainability, and adaptability. In this context, digital transformation represents a fundamental shift in how food is produced, processed, distributed, and consumed. This Special Issue, *Transforming Food Supply Chains: Harnessing the Potential of the Digital Era*, brings together cutting-edge research and practical insights to explore the transformative power of digital solutions in FSCs.

This editorial provides a comprehensive review of the contributions in this Special Issue, synthesizing the key themes, challenges, and opportunities that emerge from the studies. We explore how digital technologies such as Industry 4.0, blockchain, mobile traceability platforms, artificial intelligence (AI), and digital logistics platforms are reshaping the landscape of food supply chains. Additionally, we reflect on the barriers, enablers, and future directions for achieving more resilient, sustainable, and equitable food systems through digital innovation.

The Transformative Power of Digital Technologies

Digital transformation in FSCs is driven by the integration of technologies such as the Internet of Things (IoT), blockchain, artificial intelligence, mobile platforms, and Industry 4.0 principles. These technologies offer unprecedented opportunities to enhance traceability, improve efficiency, foster resilience, and promote sustainability. Several papers in this Special Issue explore the different facets of this transformation, providing valuable insights for researchers, practitioners, and policymakers.

Sarkar et al. (2024) investigate the barriers to traceability in Industry 5.0-enabled digital FSCs. Their study identifies significant obstacles, such as limited digital and physical infrastructure, inadequate capital investment, and the complexity of supply chain frameworks. The authors adopt a mixed-method approach, combining exploratory factor analysis (EFA) and the fuzzy evidential reasoning approach (FERA), to prioritize these barriers. Their findings underscore the importance of addressing infrastructure gaps and investment challenges to achieve seamless traceability and sustainability in FSCs.

In a related study, Tortorella et al. (2024) explore the relationship between digital transformation and resilience development in the Australian food supply chain. Using a dynamic capabilities framework and a mixed-method approach, the authors demonstrate how digital technologies can enhance resilience by enabling firms to sense, seize, and transform strategies in response to disruptions. Their research highlights the differential impact of digital adoption across various tiers of the FSC, emphasizing the need for tailored strategies to maximize the benefits of digital transformation.

Mendoza Pardo and Fikar (2024) investigate the role of digital logistics platforms in facilitating regional food supply for the hospitality sector and communal catering. Their systems thinking approach reveals the critical influence of cooperation, trust, and digital solutions in enhancing regional food networks. By modelling these networks using causal loop diagrams (CLDs), the authors provide a holistic perspective on the feedback structures and key success factors that drive the adoption of regional food supplies. Their findings emphasize the potential of digital logistics platforms to reduce inefficiencies, improve communication, and promote sustainability goals.

Untal et al. (2024) focus on the adoption of mobile traceability platforms in the tuna supply chain in the Davao Region, Philippines. Their study identifies factors influencing fishers' preference for mobile traceability platforms and highlights the challenges associated with achieving digital traceability. Through logistic regression analysis, the authors find that organizational membership and educational attainment significantly influence fishers' willingness to adopt mobile platforms. The study also underscores the importance of enhancing digital literacy and providing infrastructure support to enable broader adoption of mobile traceability solutions.

Fernando et al. (2024) examine the implications of mobile phone literacy on sustainable smallholder agri-food supply chains in developing economies, specifically focusing on Sri Lanka's tea supply chain. Their study identifies four clusters of smallholder tea producers—Basic Tech Adopters, Digital Laggards, Skeptical Feature Phone Users, and Tech-savvy Adopters—based on mobile phone ownership and literacy. The findings highlight the need for targeted strategies to improve mobile literacy and facilitate digital transformation in smallholder farming. By addressing barriers such as affordability, access, and digital skills, stakeholders can enhance productivity, sustainability, and resilience in smallholder FSCs.

Blockchain Technology: Enhancing Transparency and Sustainability

Blockchain technology has emerged as a transformative solution for enhancing transparency, traceability, and trust in FSCs. Vern et al. (2024) investigate the impact of blockchain technology on agri-food supply chain performance and sustainability. Their research reveals that blockchain adoption leads to improvements in traceability, food safety, quality, and stakeholder collaboration. By leveraging blockchain's decentralized and immutable ledger, FSC stakeholders can achieve greater transparency and trust, thereby addressing critical challenges related to food safety, quality assurance, and sustainability.

The study's findings have significant practical implications for managers, policymakers, and technology providers. By adopting blockchain technology, FSC actors can optimize information flow, reduce fraud, and improve supply chain efficiency. The authors' research framework, validated using partial least square structural equation modelling (PLS-SEM), provides a robust foundation for understanding the relationship between blockchain benefits and FSC performance.

Achieving Resilience and Agility Through Digitalization

In today's volatile and competitive environment, supply chain resilience and agility are essential for sustaining business performance. Sharma et al. (2024) explore the role of smart supply chains in enhancing resilience and agility through Industry 4.0 technologies. Their study employs

structural equation modelling (SEM) and artificial neural networks (ANNs) to analyse the impact of digitalization on sustainable business performance. The authors find that supply chain resilience, green practices, and Industry 4.0 technologies play a pivotal role in achieving agility and sustainability.

The findings highlight the need for integrated strategies that combine digital technologies with sustainable practices to build resilient and agile supply chains. By adopting Industry 4.0 technologies such as IoT, AI, and smart logistics, firms can improve supply chain responsiveness, adaptability, and overall performance. The study provides a valuable framework for firms seeking to enhance their resilience and agility in the face of disruptions.

Barriers to Digital Transformation and Pathways Forward

Despite the clear benefits of digital transformation, several barriers hinder the widespread adoption of digital technologies in FSCs. Saha et al. (2024) identify critical challenges to digital technology adoption in the agri-food supply chain. Using a mixed-method approach involving EFA, ISM, and DEMATEL, the authors categorize these challenges into technological, economic, environmental, and social dimensions. Key barriers include the lack of regulatory frameworks, security and privacy concerns, and limited digital literacy.

In addition, Vedapradha et al. (2024) address the evaluation criteria for IoT adoption in warehousing startups within the unorganized food sector. Their research uses analytic hierarchy process (AHP) and complex proportional assessment (COPRAS) techniques to rank warehousing startups based on IoT-driven performance indicators. The study highlights productivity, space utilization, data privacy, and cost as critical criteria. The findings offer practical implications for warehouse managers and policymakers, emphasizing the need for strategic IoT adoption to enhance food safety, storage efficiency, and resilience.

These studies emphasize the need for collaborative efforts among governments, policymakers, businesses, and researchers to address these challenges. By developing supportive policies, investing in infrastructure, and enhancing digital literacy, stakeholders can create an enabling environment for digital transformation. These efforts are crucial for achieving the United Nations Sustainable Development Goals (SDGs), particularly those related to zero hunger (SDG 2), responsible consumption and production (SDG 12), and climate action (SDG 13).

Societal and Environmental Impact of Digital Transformation

Digital transformation in FSCs holds significant potential to address societal and environmental challenges. Ajmera et al. (2024) examine the role of AI in enabling circular economy practices in the food and beverage sector. Their study identifies barriers to AI adoption and proposes strategies for overcoming these challenges. By leveraging AI-driven solutions, firms can optimize resource use, reduce waste, and promote sustainability. The study's findings contribute to the broader discourse on sustainable transformation and climate change mitigation.

Similarly, Sonar et al. (2024) highlight the importance of Industry 4.0 technologies in promoting sustainability in agri-food supply chains. Their research identifies sustainability assessment factors

and demonstrates how digital technologies can enhance market competitiveness, resource efficiency, and skill development. By adopting Industry 4.0 principles, FSC stakeholders can achieve long-term sustainability goals while improving operational efficiency and competitiveness.

Conclusion: A Call to Action for a Digital Future

The contributions in this Special Issue underscore the transformative potential of digital technologies in reshaping food supply chains. From enhancing traceability and resilience to promoting sustainability and transparency, digital solutions offer a pathway for addressing the complex challenges facing FSCs today. However, realizing this potential requires overcoming significant barriers related to infrastructure, investment, digital literacy, and policy support.

As Guest Editors, we believe that the insights and frameworks presented in this Special Issue provide a valuable resource for researchers, practitioners, and policymakers. By embracing digital transformation, stakeholders can build food supply chains that are not only efficient and resilient but also sustainable and equitable. The journey toward digital FSCs is not without challenges, but with collaborative efforts and innovative solutions, we can create a future where food systems are capable of meeting the needs of both present and future generations.

We hope this Special Issue inspires continued research, dialogue, and action in the field of digital food supply chains. The digital era holds immense promise, and it is up to all of us to harness its potential for the benefit of society and the planet.

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