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Nourish resilience in digital food supply chain in post COVID landscape: literature swill for past insights and future roadmap

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Abstract

Purpose – The paper aims to enhance the understanding of robust food supply chains (FSC) by exploring the capabilities of various digital technologies and examining their interactions.
Findings – This study finding shows that digital technology enhances the resilience of the FSC by improving visibility, traceability and adaptability. This resilience provides a competitive advantage, ultimately enhancing the overall business performance.
Research limitations/implications – In developing countries, inadequate infrastructure, poor Internet connectivity and diverse stakeholder systems pose challenges to implementing advanced digital solutions in the FSC.
Originality/value – This paper is among the first to investigate the impact of digital technology on FSC resilience, exploring visibility, flexibility and collaboration.

Keywords Digital technologies, Food supply chain, Resilience, IoT, Blockchain technology
Paper type Literature review

1. Introduction

The influences of climate change push for sustainable development goals, and unpredicted disruptions from COVID-19 have introduced additional stress on the traditional FSC and

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alterations in consumer habits (Burgos and Ivanov, 2021; Marusak *et al.*, 2021) Supply chains are complex networks that are vulnerable to global disturbances (Njomane and Telukdarie, 2022). A FSC is a series of steps, starting from farmers growing crops, processing, packaging, transporting, and finally reaching the consumers (Ali *et al.*, 2023). So, there are several challenges that the traditional FSC has to deal with, including a lack of transparency, inefficiency, limited traceability, quality concerns, transportation issues, and environmental impacts like unexpected weather changes or sudden changes in demand (Nabipour and Ülkü, 2021). The disruption in FSC due to COVID-19 has taught everyone that if the supply chain is disrupted, backup should always be ready so that the supply chain is not disturbed (Sharma *et al.*, 2021). Companies manage their FSC properly to be resilient to disruptions and adapt to rapidly changing circumstances (Kazancoglu *et al.*, 2023). Therefore, it is important to know how well a company can handle disruptions and adapt quickly which determines its strength. Furthermore, FSC systems noticed the unique challenges posed by COVID-19 pandemic individuals, and organisational leaders. Also, researchers are continuously exploring ways to improve the resilience of the FSC to efficiently manage unpredicted disturbances (Michel-Villarreal *et al.*, 2021). In this context present time, resilience in the FSC is a necessity. Resilience in the FSC is decisive for confirming a stable and safe food supply, especially in the face of various risks like as pandemics, economic crises, natural disasters and geopolitical events (Kazancoglu *et al.*, 2023). FSC's resilience is quite complex as it involves perishable goods which require cold storage for quality maintenance (Feng *et al.*, 2020). The main challenge is long-distance transportation of perishable goods, which leads to chances of food contamination (Qian *et al.*, 2022). Supply chains are expected to come back to their original shape shortly after any natural disaster like as floods, droughts, and pandemics, as well as occurrences of deliberate disturbances like strikes, acts of terrorism, or sabotage (Alabi and Ngwenyama, 2023). To succeed in this, endeavour the capability to anticipate and plan for restoration after such disturbances appears fundamental. Implementation of digital technologies for achieving this, is one of the recommended approach (Hassoun *et al.*, 2023).

Digital technologies are helping companies be open to new ideas, be more eco-friendly, stay flexible in disruptions, and alter their operations faster when new situations/challenges occur (Michel-Villarreal *et al.*, 2021). In simple terms, resilience in FSC's is adding smart, digital tools to each stage of the food journey, which will ensure a quick response to changes and challenges, ultimately making the entire FSC more efficient and resilient (Burgos and Ivanov, 2021). Improving the resilience of the FSC involves embracing digital technologies to enhance visibility, make the right decisions and foster reliance among supply chain stakeholders (Al-Talib *et al.*, 2020). So, informed decision-making can be achieved through the implementation of digital technologies which is advantageous for all stakeholders involved (Joshi *et al.*, 2023). Generally, IoT, Blockchain and cloud computing, Artificial intelligence (AI) and machine learning (ML) type of digital technologies are used in FSC (Njomane and Telukdarie, 2022; Vanderroost *et al.*, 2017; Ivanov and Dolgui, 2019). By incorporating these technologies into each step of the FSC, the entire system becomes more adaptable (Hassini *et al.*, 2023; Ali and Govindan, 2023).

Traditionally, monitoring crops and keeping track of weather and soil health has been time-consuming and challenging. However, with digital technologies, farmers can now easily watch and manage their crops using real-time data on weather conditions and soil health and consumers can better evaluate the quality of food and spoilage, ultimately enabling them to be healthier. By digital technologies suppliers can know where and in what condition products are in during transit (Masudin *et al.*, 2021). Real-time data collected with the help of digital platforms may enable retailers to adjust their inventory according to consumers' choices. In this context, one of the digital technologies is blockchain which provides flexibility, stability, traceability and risk reduction (Sharma *et al.*, 2021). As a result, blockchain is a critical tool for creating systems that bounce back from accidents and continue to operate even with challenges

(Prashar *et al.*, 2020). With the help of many participants involved a ledger is created using blockchain. Once data is written, all replicas are updated simultaneously and the original value of that data cannot be changed (Sharma *et al.*, 2021). Updated archives avoid the need to verify things at an intermediate level, which in turn leads to conviction between partners. This conviction results in reduced cost as efficiency is increased by removing redundancy. Blockchain technology, with its decentralised nature, makes it suitable to be used on supply chains where it can help prevent bogus goods from entering the system (Vasanthraj *et al.*, 2023). As we enter an era of digital technology, the Internet of Things (IoT) is a good candidate for enhancing visibility into products, it provides details such as where the product was made, what environmental conditions are like around that product and product quality based on its condition at the time (Tsang *et al.*, 2018). RFID is most common system that is used for data exchange between IoT devices, ensuring food safety (Bouzembrak *et al.*, 2019; Masudin *et al.*, 2021). It evolves as a powerful tool in the situation against counterfeiting and theft, uplifting supply chain transparency. Several researches highlighted application of RFID's in the food cold chain, in which it monitors transport temperatures, estimates shelf life, and safeguards against counterfeit food products. This technology is invaluable in confirming the integrity and quality of goods throughout FSC journey (Masudin *et al.*, 2021). Next technology is Cloud computing which makes computation of services, creating storage, processing power, and applications, with the help of Internet. The collaborative utilisation of IoT and cloud computing enables diverse devices to produce and exchange significant data in a centralised fashion (Wamba *et al.*, 2017).

Food companies need to combine their FSC with digital technology networks to see the whole process from start to finish, connect farms and food goods through real-time data monitoring, and then formulate decisions based on that information (Alabi and Ngwenyama, 2023). FSC must enhance their resilience to withstand disruptions, given their susceptibility due to a vulnerable structure. It is always very important for FSC to use digital technologies (Ali *et al.*, 2023). However, digital technologies should be adopted more during disruptive times to avoid issues in FSC. This paper provides evidence that digital technologies can support resilience within FSC. To fulfil the objectives of this study, two specific research questions have been formulated:

RQ1. What is the role of digital technology in the FSC after the COVID era?

RQ2. How are digital technologies going to shape the FSC toward resilience?

Hence, this study employed an SLR with bibliometric analysis to investigate the following research enquiries. The bibliometric analysis was carried out on 77 articles chosen from the Scopus and WOS databases. Relevant keywords related to digital technologies were used to identify articles that contribute to the resiliency of FSC. In this article, Part 2 covers the methodology section while Part 3 covers bibliometric analysis. The 4 part presents content analysis, while Part 5 explores the discussion and implications of this study. Moreover, Parts 6 and 7 explore possible conclusions and future directions for the study.

2. Methodology

The SLR was conducted in this research by following rigorous selection processes, examination, and reporting procedures, SLRs synthesise information from various sources to produce new insights. This technique is becoming popular because of its adherence to comprehensive guidelines, facilitating the evaluation of relevant and accessible research pertaining to a specific subject area (Samadhiya *et al.*, 2023a, b). SLR is a systematic approach which attempts to gather knowledge about a certain issue with data from various sources (Moosavi *et al.*, 2022). This technique uses a systematic method that diminishes partiality in actions such as article retrieval, selection, and summarisation. As a result, the findings are made more trustworthy. It also points up those places where research is different from the existing literature may be needed, thus providing chances for further development.

2.1 Database for literature review

The Scopus and WOS databases were selected for extraction, as they both represent the most substantial sources of academic research and scholarly articles in the fields of management, engineering and social science (Yadav *et al.*, 2022a, b). The Scopus database was selected because it has a large volume of literature and easy access for academic institutions for SLR in similar fields of research (Ada *et al.*, 2021). The WOS was chosen as a second database for data extraction. This database was selected due to its efficiency, wide use, and coverage of more interdisciplinary areas. This database offers an elaborate retrieving facility for SLR researchers in multiple subject areas (Samadhiya *et al.*, 2023a, b).

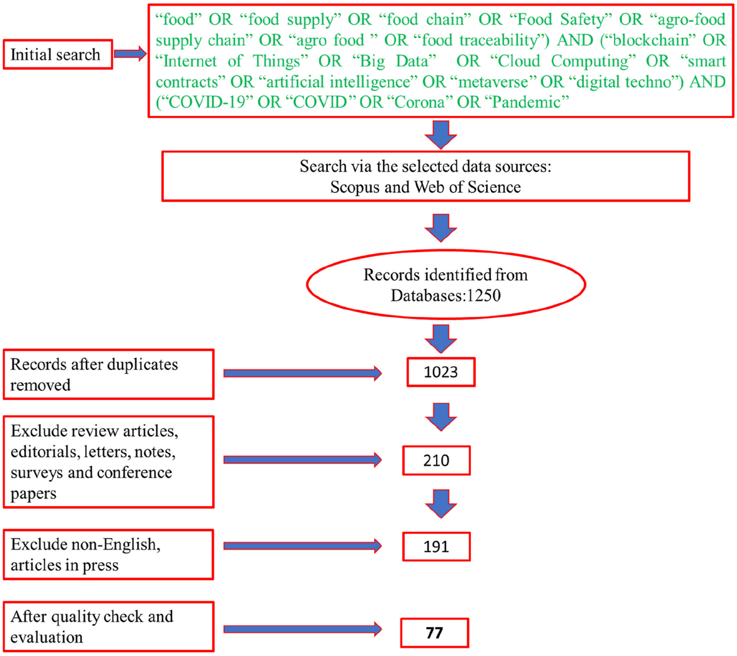
2.2 Screening of article

The selection of keywords is crucial for screening the article. So before extracting the article from the database, researchers should choose the appropriate keyword. It is necessary for researchers before the extraction of articles from various databases to set screening guidelines for which type of articles should be taken which helps to give the surety to the researcher that extracted articles are relevant to the study and no important information is missed. This article was screened using three search strings. In these search strings, the keywords are linked with Boolean connectors like “OR” and “AND”. This helps to produce a closer examination of a particular area of investigation. Typically, in this study, keywords were combined with “AND” to give the keyword phrases and “OR” was used between those words. Using Boolean operators “OR” and “AND,” this three-search string was made (“food” OR “food supply” OR “food chain” OR “Food Safety” OR “agro-food supply chain” OR “agro-food “ OR “food traceability”) AND (“blockchain” OR “Internet of Things” OR “Big Data” OR “Cloud Computing” OR “smart contracts” OR “artificial intelligence” OR “metaverse” OR “digital techno”) AND (“COVID-19” OR “COVID” OR “Corona” OR “Pandemic”).

2.2.1 Inclusion and exclusion criteria. The inclusion and exclusion criteria were implied to ensure that we only employ research findings that meet the specified criteria (Nabipour and Ülkü, 2021). The Title-Abstract-Keywords” fields in the Scopus and WOS databases provided 1,250 papers through a search. We eliminated all duplicate entries from our dataset, ensuring that documents present in both databases were only included once in our final dataset (Kafa and Jaegler, 2021). This gave us a final sample of 1,023 documents. Documents types are selected as articles, while conference papers, notes, editorials and short survey documents are excluded. To prevent bias, we also exclude review papers from earlier literature reviews. This search yielded 210 publications. Next, articles in the press and non-English articles are excluded, giving a total of 191 articles. Figure 1 shows the selection of articles from two databases.

2.3 Selection of related studies

In the first screening, 191 articles were selected based on inclusion-exclusion criteria. Their titles and abstracts were subsequently examined to confirm their relevance to the research area. If it does not deliver appropriate information, their introduction and conclusion are reviewed carefully to evaluate their relevance to the study. Consequently, it was decided that 114 papers irrelevant to the subject matter were eliminated, leading to the remaining 77 papers being selected for further consideration.



Source(s): Authors' own work

Figure 1.
Selection process of articles

3. Bibliometric analysis

Bibliometric analysis refers to a variety of analytical tools and methods to analyse published research data (Donthu *et al.*, 2021). This is a popular and reliable method of analysing vast amounts of scientific data. This analysis helps to understand how a particular area is developing and reveals new areas of research. Scholars employ bibliometric analysis to see how researchers are working together, to recognise new trends, and to analyse the number of articles published. In recent years many literature reviews in the social sciences, engineering and management have used bibliographic analysis. For example, Samadhiya *et al.* (2023a, b) conducted bibliographic analysis on the use of blockchain technology in reverse logistics using R-tool. Rejeb *et al.* (2022) used bibliometric analysis to look at how COVID-19 affected the food industry. The main information extracted from the collected articles using the R-tool is shows in Table 1. The average citations per document for the articles was 16.19. From the collected articles, a total of 261 authors have contributed, out of these, 7 papers have a single author. The average number of co-authors per document is 3.81.

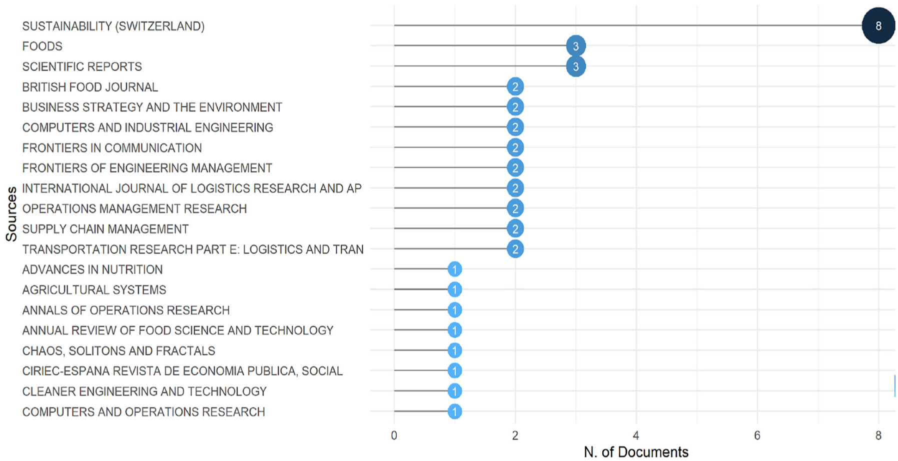
3.1 Publishing source

The quantity of papers published in various journals from 2020 to 2024 (January 2024) is displayed in Figure 2. The three top journals that publish the most articles overall include "Sustainability (Switzerland)" (8), "Foods" (3), and "Scientific Reports" (3). In addition to this, the journals "British Food Journal", "Business Strategy and the Environment", "Computers and Industrial Engineering", Frontiers in Communication", "Frontiers of Engineering Management", "international journal of logistics research and applications", "operations management research", "supply chain management" and "transportation

Description	Results
Main information about data	
Timespan	2020:2024
Documents	77
Document average age	2
Average citations per doc	16.19
References	4,591
Document contents	
Keywords plus	400
Author's keywords	290
Authors	
Authors	261
Authors of single-authored docs	7
Authors collaboration	
Single-authored docs	8
Co-authors per doc	3.81
International co-authorships %	44.16

Source(s): Authors' own work

Table 1. Main information about the collected article



Source(s): Authors' own work

Figure 2. Journal-wise statistics of papers published

research part e: logistics and transportation review" has published 2 papers. In addition to that, 45 more journals are also available, and each has contributed one article to publishing papers on the relevant subject.

3.2 Affiliation statistics

The top papers on FSC using digital technologies are shown in Figure 3. Yasar University has published the most research papers, with a total count of 13. Following the University of Muhammadiyah Malang, Shaanxi Normal University has published 7 articles, while Shaanxi Normal University participated in the publication of 6 papers.

Figure 3. Institute-wise articles published

Source(s): Authors' own work

3.3 Analysis of the corresponding author's country and tree map of keywords

The analysis of the selected publications shows that digital technologies for the FSC have been widely used and publicised globally. The distribution of research papers by country is illustrated in Figure 4. China is the most active contributor, with the highest 14 publications among the 77 chosen articles. In addition, India, Korea and the United Kingdom are also the leading contributors to the publication of papers on FSC using digital technologies.

The number of articles published by India, Korea and the United Kingdom was 6. We found that all papers from Australia, Brazil, Italy, Turkey, Greece and Guinea are multiple-country publications (MCP), while papers from Korea, Germany, Spain, Colombia and Latvia are single-country publications (SCP). The tree map in Figure 5 shows the fifty most-used keywords by the author in scholarly articles. Most words are used for COVID-19 and food

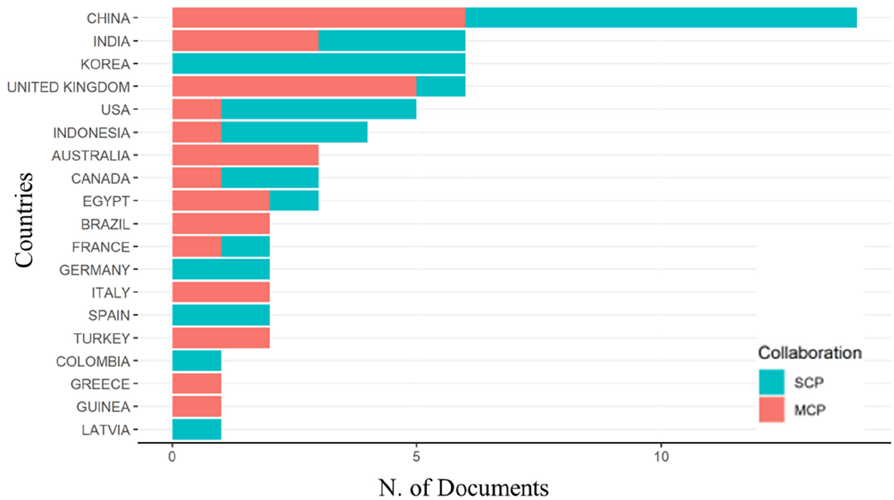


Figure 4. Most relevant countries by corresponding author

Source(s): Authors' own work

Source(s): Authors' own work

Figure 5.
Tree map of keywords used in the FSC by digital technology

supply. The other keywords frequently used are artificial intelligence (AI), supply chain, pandemic, agriculture, blockchain, and supply chain management.

4. Content analysis

After thoroughly examining 77 carefully chosen articles, we did a content-based analysis of the literature. The primary objective of this article is to explore how digital technologies contribute to the resilience of the FSC. In this context, we identify three main clusters, with a focus on key aspects such as visibility, flexibility, and collaboration.

4.1 Visibility in FSC through digital technology

Food supply chain visibility is the ability to trace the flow of food from farm-to-table (Al-Talib *et al.*, 2020). Digital technologies are a prerequisite for FSC visibility, besides being attitudes amicable to it. All stakeholders—producers, distributors, retailers and consumers can profit from this (Frank *et al.*, 2019). Comprehensive visibility throughout the FSC is important as it can detect risks in time or even forecast them before they occur (Ali *et al.*, 2023). Digitisation is the process of converting information and processes into digital format. This includes the use of digital tools and technologies to facilitate communication and data management. In different the stages of the supply chain, digitisation may provide real-time data and greater transparency (Iranmanesh *et al.*, 2023). More visibility means developing adaptable strategies. For example, when glitches can be seen, a flexible supply chain can switch to an alternative route or turn on emergency procedures rapidly. Improvement of supply chain may enable managers to lessen the uncertainties around supply and demand (Michel-Villarreal *et al.*, 2021). Moreover, less visibility raises the risk of product recall (Qian *et al.*, 2022).

The use of digital technologies for the visibility of the FSC plays crucial role as it makes sure that the whole process, from the farm to consumers' table, is safe, high-quality, and efficient (Masudin *et al.*, 2021). These technologies in the FSC improve transparency, trackability, and data-driven insights across all phases (Burgos and Ivanov, 2021). Transparency achieved through blockchain builds trust and improves information sharing among FSC stakeholders (Iranmanesh *et al.*, 2023). Iftekhar and Cui (2021) used blockchain in the food supply chain for real-time minoring. Implying blockchain in the FSC ensures that each and every information that reaches the stakeholders is correct and secure also easily accessible. FSC also uses the traceability system helping confirm food safety and quality to sustain customer belief (Masudin *et al.*, 2021). Blockchain is also making sure that each and every transaction and movement in FSC is logged in securely and cannot be distorted (Samadhiya *et al.*, 2024). This enhances transparency and traceability, which identifies the source of contamination or quality issues effortlessly (Casino *et al.*, 2020).

4.2 Flexibility through digital technology for FSC

Flexibility in view of FSC states the ability of the system to adapt, adjust, and react efficiently to changes and uncertainties in the supply chain environment (Siagian *et al.*, 2021). By using digital technologies in FSC considerably reduces uncertainties by generating real-time data. This enhances flexibility and agility in the supply chain from farm to consumers' table (Michel-Villarreal *et al.*, 2021). This data can allow stakeholders to quickly make changes and survive in the face of a market that might suddenly change or unforeseen disaster. FSC must have flexibility and adaptability so that any disruptions cannot affect its operations (Pimenta *et al.*, 2022). This flexibility enables it to modify steps smoothly and quickly, when any kind of disturbance is there. Real-time data will help the supply chain in being more adaptive to changes in consumer preferences, market demands, or external factors (Wang and Yang, 2022).

For example, routes can be optimised so transportation costs go down; advanced analytics can shorten delivery times. Digital technologies enable the use of vast data sets for predictions of demand patterns allowing better planning and preventing both overstocking and stockouts (Annosi *et al.*, 2021). Automatic reordering might be triggered by automation when the stock is running low, thus preventing stockouts and enabling a steady supply to be maintained. Automated, real-time supply chains allow for more flexibility than traditional supply chain (Burgos and Ivanov, 2021). Digital technology provide real-time supply chain monitoring and inventory, demand and output (Kauric *et al.*, 2014). In use of digital technologies in a FSC have balancing features like flexibility and visibility. Flexibility is about adaptability and responsiveness; visibility is about transparency and traceability. All are necessary for the system to be efficient and resilient.

4.3 Collaboration through digital technology for FSC

All stakeholders participating in the supply chain need real-time information sharing (Annosi *et al.*, 2021). This is important for successful collaboration. By means of effective collaboration, any doubt and unexpected events can be reduced (Al-Talib *et al.*, 2020). Among supply chain partners working together, information is exchanged on resource availability, route optimisation, inventory levels, production schedules and sales forecasting data (Ning *et al.*, 2023). Implementation of digital technologies provides real-time visibility in the entire FSC Which helps all stakeholders to monitor the movement of goods from farm to end user (Vasanthraj *et al.*, 2023). Technologies such as IoT can monitor the location and environmental conditions of shipments in real time; this is better quality assurance and cuts the risk of spoiling (Onwude *et al.*, 2020). IoT devices with GPS modules installed can give out position data in near real-time, to locate where exactly that shipment is at any given moment (Khan *et al.*, 2020).

5. Discussion

The purpose of the present study was to address the two research questions using bibliometric and content analysis. A research framework has been established to correlate this question in the context of digital technology used in resilient FSC. This section will explain the details of that framework for better understanding. The FSC's resilience is enhanced by its ability to recover from disruption. It should be noted that the incorporation of digital technologies helped in terms of FSC resilience in contrast to traditional supply chains (Burgos and Ivanov, 2021). Figure 6 shows the framework for the impact of digital technologies used on FSC.

Resilient supply chains are more efficient because they can reduce food waste through optimised inventory management, transport, and distribution processes. This also involves environmental benefits and cost savings throughout the FSC (Galvez *et al.*, 2018). The studies also discuss how food digitalisation increased traceability in the food chain (Yadav *et al.*, 2022a, b). When a company disrupts its FSC, it loses power over its operations and financial interactions with its stakeholders (Rashid *et al.*, 2024). The risk-sharing approach from the stakeholders mitigates the supply chain's agility and dependability, fostering its resilience to disruption. Ivanov and Dolgui (2019) highlighted the importance of using data analytics to increase visibility and forecast accuracy. Big data analytics can help companies retrieve from the effect of several turbulences (Papadopoulos *et al.*, 2017). The flow of information between FSC stakeholders becomes more efficient by using digital technologies in the food industry, which also helps increase supply chain management flexibility. Digital technology establishes a trusted, collaborative environment that ensures an FSC's resilience towards all types of disruptions it could face, including natural disasters, pandemics, political events, or economic crises (Alabi and Ngwenyama, 2023). It also improves its food security because a continuous food flow makes it far less vulnerable to unanticipated actions. A resilient FSC

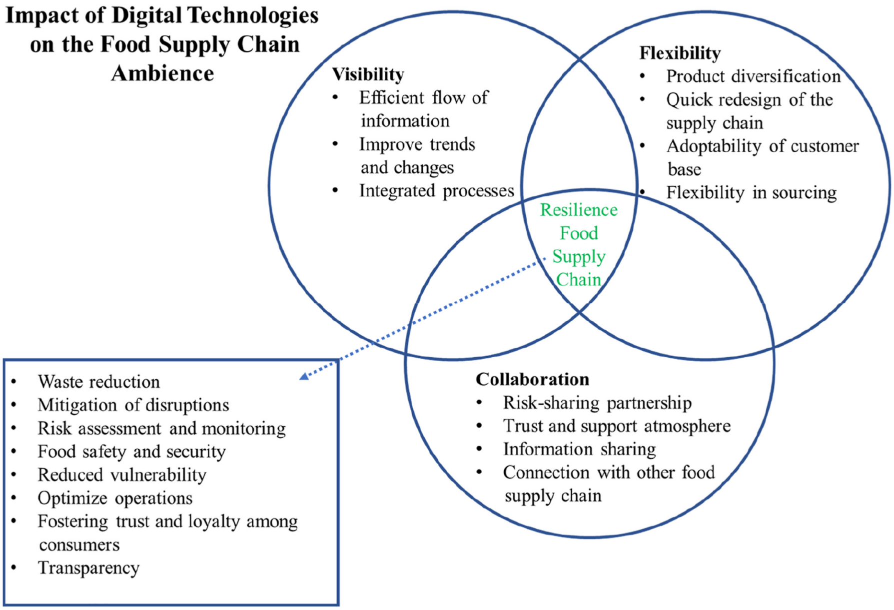


Figure 6. Framework for the resilience within FSC

Source(s): Authors' own work

minimises the risks of food shortages and guarantees a steady supply of healthy, safe food, which is particularly essential for public health in crisis times (Sharma *et al.*, 2021). In the FSC, digital technology integration has a particular influence in several domains. Like as a blockchain guarantees the transparency, traceability, and immutability of FSC (Galvez *et al.*, 2018). Blockchain is like a safe ledger, it ensures that no one can tamper with the information. Additionally, IoT and sensors provide real-time updates on perishable goods such as temperature, humidity and other indicators to sustain their shelf life (Yadav *et al.*, 2020). In many investigations, the AI and ML models are employed for predictive analytics, future tendencies forecasting, pattern recognition, and risk management in the FSC (Kazancoglu *et al.*, 2023; Hassoun *et al.*, 2023).

Further, digital technologies through predictive modelling and future trends forecasting enhance flexibility and allow stakeholders to adjust according to the market conditions (Ning *et al.*, 2023). In today's digital age, collaborative platforms such as cloud-based technologies and blockchain allow stakeholders to stay continuously connected and share valuable data. Simply by using digital technology-based traceability solutions, we can now monitor the entire supply chain live in real-time. This enhances efficiency in the overall FSC system (Casino *et al.*, 2020). It could help food companies speed up the recall process as well as save them unnecessary expenses. Faster recalls with increased traceability reduce the chance of contamination, shorten time spent on recalls and are good for consumer trust. Galvez *et al.*, (2018) used blockchain for food traceability and suggested that this technology prevents fraud, improves efficiency, saves time and cost and also improves trust between stakeholders.

IoT and RFID tags are utilised to deliver real-time temperature, inventory, batch tracking, humidity and location-based information. By using this information, it could help organisations optimise their inventory better so they don't lose money. Caro *et al.* (2018) created two traceability systems that used a blend of blockchain and IoT on Ethereum and Hyperledger Sawtooth, respectively. They saw that blockchain technology gives transparency and auditability. Köhler and Pizzol (2020) suggested that blockchain and RFID technology, improved transparency to stakeholders and reduce the risk of contamination, and quickly acted to potential issues. This method improves risk management and verifies the transfer of foodstuffs both safe and of high quality.

5.1 Theoretical and practical implications

This SLR demonstrates digital technology's role in enhancing resilience within the food supply chain. The incorporation of digital technology carries significant theoretical implications for the FSC, suggesting that enhanced visibility through digital technology enables better risk detection and even prediction, aligning with theories of risk management in FSC literature that emphasise the importance of information flow and transparency in mitigating risks (Köhler and Pizzol, 2020). Digitalisation allows real-time access to data so that stakeholders can easily accommodate the changes in the market and become more resilient (Alabi and Ngwenyama, 2023). The experts in FSC can use advanced digital technology like Neural Networks and Machine Learning to learn more about complex systems. By creating the decision support systems, they can reduce food waste and plan the routes properly which also contributes to greater transparency and higher flexibility such that the supply chain uses less fuel resulting in lower CO_2 emissions. Digital technologies not only enhance the efficiency of the FSC, but also make the FSC system more resilient.

Integrating digital technologies into the FSC has significant practical implications. This study has significant implications for investors, policymakers, entrepreneurs, and governments. It underlines the importance of investing in digital technologies and ensuring the resiliency of the FSC. This resiliency provides a competitive edge and improves overall business operations. The FSC stakeholders are also able to proactively manage risks, as they can anticipate potential disruptions. This also results in cost savings and better efficiency, as businesses can avoid costly recalls and FSC failures (Galvez *et al.*, 2018). The use of these technologies ensures seamless communication, and this results in better resource utilisation. It also results in a more efficient route planning process and better coordination of departments across the supply chain. Utilising digital technology can reduce the risk of food spoilage. For example, IoT provides real-time monitoring of environmental conditions during shipment to confirm good's quality and minimise spoilage (Khan *et al.*, 2020). Tempered data is a big issue in supply chains. However, the problem can be solved by using blockchain. The utilisation of blockchain can lead to a reduction in cases of fraud and a corresponding increase in operational efficiency (Casino *et al.*, 2020). These improvements directly save significant amounts of both time and money for all stakeholders involved. This in turn brings about increased satisfaction retention among the customers, who get fresher products. The theoretical implications serve to underscore the alignment of practical implementations with established concepts in FSC management literature. The practical implications also indicate tangible benefits and results arising from introducing digital technologies into the FSC.

Digital technologies are significantly bolstering the resilience and operational efficiency of FSCs, but inadequate infrastructure is the primary barrier to FSC resilience. However, if appropriate digital infrastructure can be established then it can also contribute to making FSCs more resilient. As a real example, reports from international organisations like The International Food Policy Research Institute and The United Nations Industrial Development Organisation prove that businesses taking advantage of digital technology in their FSCs are better able to withstand problems caused by COVID-19 [1], [2].

6. Conclusion

This paper reviews in significant to detail how digital technologies in the FSC enhance resilience, exploring their role. We examine the Scopus and WOS databases for FSC research articles. Then, we used different criteria to screen the available literature. Finally, we were left with 77 papers that we analysed for further literature evaluation. After that, these selected 77 articles were inspected using several categorisation criteria. The selected articles show that the top publications in the field are the "Sustainability (Switzerland)", "Foods", and "Scientific Reports" and China is the most active contributor, with the highest 14 publications among the 77 chosen articles. Our content analysis highlights the crucial role of digital technologies in the FSC, emphasising their significance and impact. Digital technologies present a revolutionary opportunity for the agri-food sector, offering substantial benefits in terms of traceability, real-time monitoring, food safety, and transparency, thereby enhancing the resilience of the FSC. The growing incorporation of blockchain, IoT, AI, and cloud computing in agri-food processing demonstrates successful applications and anticipates a bright future for the industry.

7. Limitation and future work

Implementing digital technologies requires financial investment, and smaller businesses may struggle to afford and adopt these technologies. This can create disparities in the resilience of different segments of the FSC. Digital technologies rely heavily on infrastructure, in developing countries, there may be inadequate infrastructure to support advanced digital technologies. Digital technologies offer opportunities for greater transparency and traceability in the food supply chain, but there are challenges in ensuring the accuracy and reliability of the data collected and shared across various platforms. Poor Internet connectivity and a lack of reliable power sources can hinder the implementation of digital solutions in the FSC. Many segments of the FSC involve diverse stakeholders, each using different systems and technologies. Integrating these diverse systems can be challenging. Addressing the limitations require all stakeholders from industry, government, policymaker and technology companies to work together in developing more resilient, efficient and sustainable digital technologies for the FSC.

Exploring the ongoing impact on transaction costs, trust, and supply chain alignment among members of the FSC is crucial for future research. As research within the FSC field evolves rapidly, numerous digital techniques remain in the phase of research and development. The initial costs associated with implementing digital technologies, such as infrastructure, software, and personnel training, pose a significant hindrance for many stakeholders within food supply chain systems. So, there is a pressing need for further research aimed at the development of cost-effective digital solutions that can be seamlessly integrated into FSC systems.

Notes

1. https://www.ifpri.org/blog/digital-innovations-accelerated-covid-19-are-revolutionizing-food-systems-implications-un-food (Accessed on 15th April 2024)
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