



Journal of Applied Research and Multidisciplinary Studies (JARMS)

Volume 2 Issue 2, Fall 2021

ISSN(P): 2707-5087 ISSN(E): 2707-5095

Journal DOI: <https://doi.org/10.32350/jarms>

Issue DOI: <https://doi.org/10.32350/jarms.22>

Homepage: <https://journals.umt.edu.pk/index.php/JARMS>

Article: **The Challenges in Adoption of Transparency in Block Chain Technology in Logistics of Food Supply Chain**

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Article DOI: <https://doi.org/10.32350/jarms.22.05>

Citation: Yousuf, A. (2021). The challenges in adoption of transparency in block chain technology in logistics of food supply chain. *Journal of Applied Research and Multidisciplinary Studies*, 2(2), 83–102.

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A publication of the
School of Professional Advancement
University of Management and Technology, Lahore, Pakistan

The Challenges in Adoption of Transparency in Block Chain Technology in Logistics of Food Supply Chain

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Abstract

Block chain ledger technology is one of the key emerging models to be adopted by business if they want to survive in the upcoming competitive environment. It is necessary for food supply chain to overcome challenges like quality control, food frauds, maintenance, traceable and clean operation, customer satisfaction, digitization requirements and any other, this is only possible by implementation of block chain technology, which is still in earlier stages having a lot of potential for managing such challenges. This paper also discusses different challenges and risk associated with food supply chain while implementing block chain technology, discussed by many other researchers as well. In the end this paper discusses, recommends and highlights those areas where more research can be done.

Keywords: food supply chain (FSC), block chain technology (BCT), transparency, traceability

Introduction

The interest in Block chain technology has been increased many folds for past few years due to which many companies are adopting it and research institutions trying to dig it more as it has considerable advantages to be incorporated in commercial applications including financial, industrial and social sectors. Block chain has an innovative nature, applications, and business concepts that is characterized as decentralized but is fast and it is considered as disruptive to traditional industrial set-ups and particularly to food supply-chain. Block chain technology allows two parties to transact directly through linked ledgers; making transactions considerably transparent by centralized systems this ensures Food securities from the technologies provide transparency for global supply chain and helps in tracking them. For food supply chain, Information sharing and

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Communications between partners Technology can be implemented with a block chain technology that enables and ensures safety, transparency locally as well as globally.

The global food supply chain advancing sustainability challenges have been efficiently addressed through block chain technology by acting as a driver to sustainability. The potential of block chain technology in food supply chains will help to evaluate new supply chain opportunities and will help in identification of all the barriers to its implementation through sustainability oriented innovation. The increased traceability and environment friendly sustainable practices can be applied at fullest but one thing is certain any functional and psychological barrier can hinder the advantages and potential of block chain (Friedman & Ormistonb, 2022).

The food losses across the food supply chains either through manufacturers or through any actor of supply-chain is so challenging. Also the safety and authenticity of food in terms of quality is still a key concern of end user. In the era of supply chain 4.0 this issue can be resolved by tracing each and every step from farm to processing to manufacturing to end-user, by implementing block chain technology. It will ensure traceability, trust and accountability of food supply chain but still there is a long way to achieve this level by managing and looking in to the existing barriers and threats (Kayikci et al., 2022).

Traceability in food, health and safety supply chain is one of the most important feature and help as a practical tool for improving performance of supply chain its transparency and visibility. Although block chain is flourishing with the passages of time but there is still a long way to go. Sustainability and prevalent challenges are major issues to implementation of block chain in 4.0 eras particularly in food supply chain. There is a sound need for developing and testing real-life traceability solutions (Dasaklis et al., 2022).

Problem Statement

This research helps to identify and solve the critical and complicated issues in the supply chain by implanting and managing block chain technology in the systems of food supply-chains, according to the requirements of the trends.

Research Questions

- RQ1:* What is the role of block chain technology in driving transparency and traceability for food supply chain?
- RQ2:* What are the major challenges in adoption of transparent block-chain technology in logistics of food supply chain?
- RQ3:* How block-chain technologies can overcome the challenges associated to the logistics of food supply chain?

Literature Review

Block-chain is a distributed ledger technology that is revolutionizing data, business process management and transactions. According to (Underwood, 2016) and (Lenny Koha, 2020) Block-chain was initially adopted as (fin-tech) i.e. financial technology and later on as a supply chain technology playing an important role to transport, logistics and administrative functions. There is a paramount need of infrastructure for proper digitization, clouds, and smart management and payment systems and cross border transactions etc. it will increase trade relations and change the global supply chain to a superior level. Successful implementation of block-chain technology is linked to traceability of supply chain; challenges related to implementation are still unclear as there is a continuous change in business trends as well.

Block chain technologies for food supply chain follow a technological assessment framework suggested by (Susanne Kohler, 2020) according to them four different components of a technological framework are: organization, product, technique and knowledge. This framework highlights that block chain is an important component/element in a set-up of technologies that increases transparency, traceability, and trust. This framework further encourages to research on to find block chain technologies if they can bring the required sustainable improvements in food supply chains or not. With modernization and globalization of supply chain it is very complex to keep information that from where a specific product is coming from and how it is being produced and firms have less or little knowledge about who are their second or third tier suppliers (Saveen A. Abeyratne, 2016).

This is one of the major problems faced by logistics, including information sharing among all partners (including consumers) and assurance of the transparency of food supply chain. Complexity of supply chain has made consumers more demanding for information about safety, quality, and sustainability of products (Korpela.Kari, 2017). Block chain has been advocating about improving traceability through Standardization of traceability interfaces and business processes. (Kay Behnkea, 2020). A survey conducted in 2016 is showing similar case in the food industry where 94% of consumers are keen to know about transparency of how their food has been produced and delivered (Jake Astilla, 2019).

In the network of block chain technology data is stored in different blocks and is accessible only to concerned persons to the network and only they can exchange data in mutually trusted and supervised manner ensuring all the members on the same page. Hence, this attractive feature provides transparency to block chain and to each member in the network. (Hackius, 2017). The optimization of block chain technology is dependent upon its traceability, transparency and the other most important is trust that should be present among the all supply chain partners. As Customers always love and interested to know that where they can find their product their products are from where, as well as to find the products' lifespan (PwC, 2018) .

The food sector seems very promising and rich with involvement of block chain technology, from both data processing and a practicable perspective. There are number of network analysis and studies that focus on software aspects like smart contract. However, there are some aspects like block chain connectivity with computers that help in storing and distribution of each block in a food supply-chain by the help of an updated copy, this point is of prime importance for food supply chain's block chain technology (Francesca Antonucci, 2019).

The prevention of food loss throughout the supply chain is a major challenge faced by food supply chains, with changes in models and increasing demand, interest of consumers/customer has increased to know about authenticity of food and its quality. In this case block chain technology address this issue, by helping in tracing the food all across the supply chain from starting point i.e. processing to end point i.e. customer. Block chain technology's sustainability is major challenges, because

traceability, accountability and trust by customers is mandatory in the food industry to mitigate these emerging problems and potential threats in food supply chain change can be managed by block chain technology (Yaşanur Kayikci, 2020).

The main concern of Current food traceability systems is that there are no linkages between all actors of supply chain and process details and steps of a food processing is rarely shared i.e. when a product is sold or bought. Under such a systems and paradigm food quality and safety issues arise most of the time but with block chain technology authorized partners will be able to instantly track and trace the location, history and required information of food item according to their need and requirements (Simon Pearson, 2019).

A rapid increase in depletion of natural resources has increased focus on Food supply chains particularly for quality standards, food safety, and security impacts. sustainability of food supply chains is now considered to be dealing with these challenges but limited studies and researches deal with sustainability concern for FSC (i.e. cold food supply chains) some of the important barrier may include investment cost(initial cost), size of firm, unknowing about regulations by governments, and Lack of consensus between stakeholders. These issues negatively affect the integration throughout the food supply chain throughout BCT (Abhijeet Ghadge, 2020)

Challenges in the Food Supply Chain

Block chain technologies and smart digitization like (IoT) architecture are now acting as a helping hand in the Food Supply Chain's various (FSC) operations like planning, Management and control. These provide a wide architecture to the entities for information flow and flow of physical-objects at all stages of supply chain. These technologies help in sensing, tracking, controlling and interconnectivity of processes and hence benefiting physical food ecosystems by virtual control environment aided i.e. computers. It also helps in identifying potential opportunities that direct to more integration of food supply chain (Riccardo Accorsi, 2017).

Figure1

Challenges and Issues Concerning Food Supply Chain

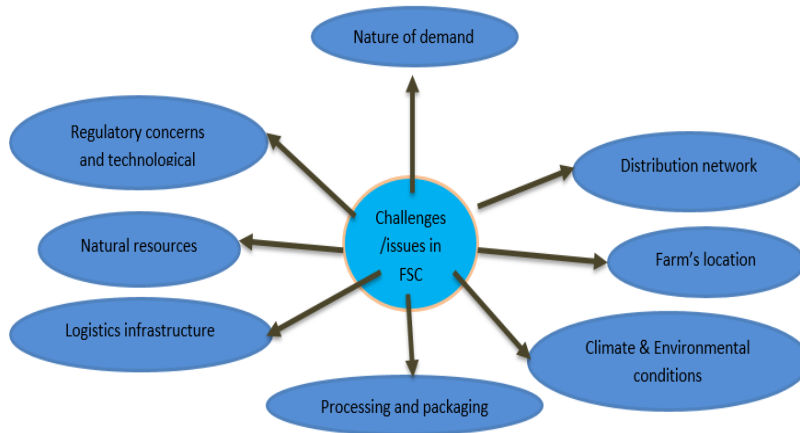


Figure 1 challenges and issues concerning food supply by (Riccardo Accorsi, 2017) and also suggested by (Papri Ray, 2019). The core supply chain for food industry has six main activities including 1. Production 2. Processing 3. packaging 4. Storage 5. transportation and 6. delivery of products to the end consumer. One important and critical factor in food supply chain is to build trust among partners and long-term relationship which is only possible when communication between partners is strong and trustworthy (ZiaUllah Muhammad, 2014).

These kind of challenges in food supply chain while implementing block chain technology has also been discussed by (Nurgazina, Pakdeetrakulwong, Moser, & Reiner, 2021) according to them there are 8 cluster of challenges 1. infrastructure and technical i.e. (connectivity, poor digitization, security of data) 2. organizational i.e. (confidentiality, participants incompetency, authority issues) 3. human i.e. (training, lack of expertise, acceptance by societies and business cultures) 4. physical (pre and post processing data sharing, tampering, censoring) 5. environmental (economic stability, energy harvesting) 6. financial (payment methods economic models and financial risk) 7. data (data integrity and governance) and 8. Intangibles (volatile and uncertain in nature). Global food scandals related to FSC can be optimized by apply

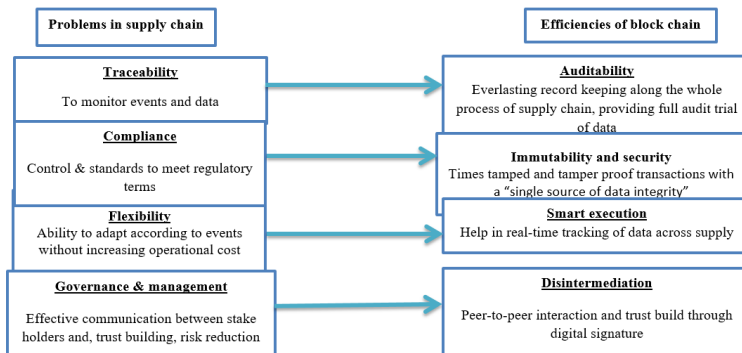
block chain technology, as they create a social and economic unreliability of existing tracking systems as a result of which the inefficient monitoring, compromised food quality and food fraud become a critical parameter. Block chain technology adoption in food SC operations will help in authentication of these critical parameters, with value addition and enhanced traceability (Dimitrios Bechtsis, 2019) and (Volha Yakavenka, 2019).

The economic implications of block chain on supply chains has a transformational potentials and capabilities to disintermediated existing business models with those models and systems that will have higher operational, cost, and value added advantages. Firms that are attempting to move forward with block chain technology with their environmental policies and strategies will ultimately reduce the additional pressure on energy and natural resources (Abderahman Rejeb, 2020).

Moreover, there are 4-T main clusters that should be considered while applying block chain technology to the logistics and transport of any block chain; these are 1.trust 2.traceability 3.trade 4.technology (Mehrdokht Pournader, 2020). Information asymmetry and information tampering are the major problems for food supply chains, resolving these block chain data problems will help processing unhampered food information throughout the food supply chain as input and output information of data processing plays an integral role in determining transparency (Xingchen Liu, 2020).

Figure 2

Blocks Chain Capabilities to Handle Issues of Supply Chain



Block Chain Tackle's Supply Chain Issues

According to (Deloitte, 2017) issues food can be effectively handled by block chain technology as depicted in fig. 2. Block chain technology is the key to deal with inefficiencies in supply chain and manage it according to the requirements and events.

Data Security and Food Safety

Block-chains ensures the safety and security of data that is very important for quality assurance of food supply chain as every “block” ensures the consensus and verification of all the transactions, hence makes the access impossible for unauthorized people (Wang, Wu, Chen, & Evans, 2021). This immutability factors helps in maintaining sustainability of food supply chain through tampering free practice as only validated peer-to-peer exchange of information can take place but this still a concern to food supply chains (Friedman & Ormistonb, 2022).

This pattern of challenges related to supply chain and these challenges managed by block chain technology is also used by (Papri Ray, 2019). Role of block-chain technology in logistics of food supply chain can also be understood by example of Halal food i.e. food in which its halalness status is regulated by a shariah institution, and designated by the government. This is one of the crucial examples of food supply chain as halal status of food should be traced from the very starting points i.e. from raw materials, its processing, packaging, transportation and distribution processes until it reaches to end consumers/user. So there should be a surety that halal food is free from any contamination that can change its halal status. The problem needs a continuous tracing of halal food along the supply chain from the upstream to downstream in, but in reality it is difficult to maintain transparency. Block chain technology can help to track along supply chain for its halal status because block chain is transparent and distributed. The distribution systems with traceability of food supply chains can be developed by implying block chain technology that incorporates transparency and neutrality in food supply chain. (Novianti, 2020).

Currently, major challenge faced by food supply chains is centralization of food tracking systems. In such systems information about food status is only available to those who control or deal with the information. The

demand in transparency of the food status and trust of customers tells us that, it is a high time to incorporate block chain technology in food supply chains, where many parties can access the food status any time, according to their requirements and needs (Novianti, 2020).

After a series of food scandal particularly in European countries like meat scandals in 2013 (horse meat) and, 2008 pork crisis scandals in Ireland have clarified the importance of food safety and quality and of regulations for end-user or consumer to protect the, (Fabian Sander, 2018). There is another scandal related Brazil's meat in 2017 that had a far-reaching impact on the European Union, as the European Union is the major Brazilian poultry importer (Bloomberg, 2017).

These kinds of issues in food supply chains are in utter need for the systems having traceability and transparency so that they can deliver value and reliable product to end user. The value and implementation of Block chain technology can create and protect a reliable digital records and environment between all stakeholders (Subramanian N., 2020), (Lemieux, 2016) and (Nurgazina, Pakdeetrakulwong, Moser, & Reiner, 2021).

Block Chain in Food Traceability and Transparency

Block chain has a unique feature to tie other technologies like remote sensing and artificial intelligence (AI) and with every new technology this helps in effective data collection, tracking location, time, temperature, humidity levels etc. and then reports back block chain (S. Musah, 2019). This digital record help in creating compliance for authenticity, and quality in supply chain and particularly for food supply chains. This information helps is accessibility of product along the supply chain for every stakeholder (Prince Kwame Senyo. Kecheng Liu, 2019).

Block chain in food traceability is now been aggressively pursued by many industry leaders across the globe like Wal-Mart. Food supply chain for traceability, are mainly trying to address five major issues by the help of traceability systems or block chain systems that include: 1. food fraud, 2. Regulatory concerns and compliance, 3. Food safety or recalls, 4. social issues and health problems, and 5. consumer information. In food traceability block chain has been mainly used for food commodities that

need production and have disparate, fractured supply chains like in sea food supply chain (Thomas Burke, 2019).

Food fraud affects all the sectors and areas related to food and there is a growing interest to improve and introduce detection methods with greater traceability and transparency for all users. One of the food frauds in Michigan State describes that food fraud includes activities like “1.Misbranding, 2.Contamination, 3.tampering 4.licensee fraud, 5.theft and alteration, and 6.copied or counterfeiting” (Michigan State University Food Fraud Institute, 2017). This is the reason that Traceability is a pivotal element in food supply chain i.e. for safety and sensitivity of food and pharmaceuticals. In case of food supply chain both Upstream and downstream (from manufacturers, producers etc. to distributors, wholesalers etc.) require information for traceability that helps in storing and handling according to regulatory compliance for all authorities and for customers demanding more (fran Casino, 2019).

The traceability systems used by food supply chains improves the tracing of food safety and quality. Now, it acts as a strategic tool in food supply chains to improve safety of system, to check quality of raw materials and managing inventory. In this competitive era of businesses it provides an edge and competitive advantages, by helping firms in identifying the cause of issues like quality control problems then its extent and also the ways to resolve them (T. Dasaklis and F. Casino, 2019) And (Myo Min Aung, 2014).

A company in Mid-western USA is using Block chain technology in production and supply chain delivery system for eggs as well where they are taken from farm to consumer; this is a detailed case egg distribution. The list of activities includes tracking products from farm to the end point i.e. fork using block chain or IoT enabled technologies for more traceable FSC. End-users/Consumers can access the information they need for making food choices they want to make and buy and from the companies they like. All this set-up helps in building good relationships with their customers and all stakeholders, as a result of this efficiency is increased, risk is reduced and there are no fraud no product loss. This is how block chain technology is transforming the world’s food system (Daniel Bumblauskas, 2019) and (KayBehnkea, 2020).

Design/Methodology/Approach

A critical literature review has been conducted to highlight the challenges of logistics of food supply chain and possibilities to tackle them for making it more transparent.

Findings

This study found that block chain technology provides new opportunities for food supply chain and help in managing the challenges of traceability. This study discussed several implementation challenges that rise while managing in supply chain and how the block chain provides traceability and transparency to each and every stakeholder of FSC. This paper is a term paper and it also discusses some effective framework by different researchers for efficient adoption of this block chain concept into food supply chain.

Practical Implications

This study is expected to help supply chain managers in understanding the challenges in incorporating block chain technology for effective implementation in food supply chain. Objective of this research is to identify those short comings in food supply chain that can be handled by block chain technology and to encourage more theoretical and thematic work for ensuring implementation of block chain technology in food supply chain, as block chain in food supply chain is in initial stages and more research work will provide a guide.

Originality/Value

This study provides an analysis for the challenges in adoption of transparent block chain technology in logistics of food supply chain. This paper also gives the recommendations for these challenges/issues and how to cope them. Digitalization with decentralization is changing the business environment and hence making it more challenging. These recommendations are specifically for the people they're addressed to.

Analysis and Discussion

Few benefits and challenges that are derived from the above written literature review and discussed by (Deloitte, 2018) and (Papri Ray,

2019) can be summarized as follows: all these benefits try to fill the loop holes of supply chain to increase its traceability and transparency.

Table 1

Benefits and Challenges that are Derived from the Above Written Literature

Primary benefits	Secondary benefits
Reduced risk of loss and food frauds	Company's recognition and customer loyalty increases
Increased traceability	Data is more secure
Compliance and regulations for safety	Easy to overcome malpractices
Easy data accessibility	Stakeholders trust and engagement increases

According to (Banerjee, 2018), Some of the challenges that can act as a barrier in transparency of applying block chain technology in supply chains can primarily include: (a). Interactivity: Block chain can be implanted in those supply chain with strong communication via IT systems to ensure smooth flow of information. (b). Infrastructure requirements: Block chain works best on strong internet connectivity and requires strong IT networks which again can be challenging for developing economies (c). Data storage cost per transaction: cloud storage of data requires a lot of space for indefinite and permanent storage. (d). Maintenance and on-boarding costs especially at the initial stages. (e). Size restrictions are there for payload due to Lack of standards for network and infrastructure that makes it challenging for implementing block chain. (f). Data validation issues arise as it is necessary for all stakeholders to be involved in the block chain to validate it and to make it faster, currently it takes 8 to 19 minutes.

In case of food supply chain it should be a time up-to few seconds to make it transparent which is challenging in nature (g). Absence of Regulatory and legal concerns as it also helps in trust building among the partners. (h) Trust is one of the critical factors and a serious challenge in block chain technology for supply chains, particularly. Block chain technology requires data sharing between partners that can only possible when trust exists and then it'll help in progress of supply chains.

There are several issues in food supply chain like in Halal industry, such as Halal frauds and contaminated food i.e. sensitive issues particularly to halal food supply. Such kind of problems need integration that can be insured via block chain technology. Food supply chain requires a comprehensive conceptual framework for maintaining integrity of food supply chain and verification of halal processing of food using block chain technology. Industry 4.0 along with block chain technology provides an ideal solution to the challenges faced by food supply chains across the world (Sarah & Bergmans, 2021).

Conclusion

There is a lot of discussion about Block chain technology and a trend is rising that can be effective for businesses if it is implemented in the supply chains and can create an impact particularly on food supply chains. The research has highlighted and is focusing on challenges and pain points of food supply chains that can be improved by the help of block chain technology. The literature review technique has helped in identifying different crucial factors that needs to be considered while implementing block chain in different sectors of food industry.

By recognizing all the challenges to implementation of block chain technology in food supply chain will help to solve safety, quality and traceability problems. This will help in developing healthy electronic food network to encounter the food frauds to the customers. The block-chain technology will help to record and check status of food any time and everywhere by the help of data storage and data exchange occurring across the supply-chain. Unsafe food and problematic area will be identified at any point it will also reduce manual operations (Balamurugan & Ayyasamy, 2022).

Block chain adoption in food supply chain is still in its initial stages and it has a lot of potential for managing food crisis and associated risks for food supply chains is still in an early stage, it is significant to have a thematic framework to systematically understand the processes, benefits, and challenges (Chen, Liu, Yan, Hu, & Shi, 2021). Block chain technology in upcoming era is expanding its way from farm to fork, a US fresh produce food supply chain is also facing a lot of challenges in implementation of

block chain technology. These challenges are related to food safety, loss, frauds, and wastages. Block chain technology will enhance resilience of food supply chain that's why stakeholders must consider it as a future prospect for businesses growth (Collart & Canales, 2022).

Block chain technology is associated with organizational innovation technological tool for sustainability, protection from food frauds, human right violation, and financial benefits. But at the same time it is also facing barriers like protecting food supply chain status of quo, cooperative barriers, functional and psychological barriers (Friedman & Ormistonb, 2022). In complex food supply chains block chain technology serves a lot of purpose like authentication, handling, storage, food forensics and food supply chain resilience. The adoption factors of block chain technology include wide range of aspects like organizational security complexities, organizational readiness, competitive environment, government policies and transparency of existing supply chain. Some of the barriers are costs, stakeholder concerns, legal issues, complexity of problem, scalability, uncertainty, technological infrastructure and required expertise (Callinan, Vega, Clohessy, & Heaslip, 2022).

Future recommendations

The future of this paper is linked developing and designing a model that can help in the block chain adoption and implementation in the food supply chains in developing countries. It is fair distributed technology where all parties can participate at an equal level. This provides transparency with all information of the block chain while keeping it safe as the data cannot be changed without the approval of each stakeholder. It will help in outlining the practical applications of block chain technology and IoT to address the most relevant challenges of FSC security, food safety and its traceability. Further researches should be conducted on food trade, processed, perishable and frozen food and all other related areas.

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