

# The Strategic Implementation of Blockchain Technology to Enhance Supply Chain Management and Brand Value in The Agri-Food Sector

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**Abstract.** This study examines the strategic application of blockchain technology in the agri-food sector, with a focus on its potential to enhance supply chain management (SCM) and increase brand value through improved transparency, traceability, and enhanced consumer trust. A mixed-methods approach was employed, combining quantitative surveys from 150 stakeholders (farmers, processors, distributors, and retailers) with qualitative interviews from 15 experts in blockchain and SCM. Thematic analysis was used to extract insights from interview data, while survey responses quantified perceived benefits and barriers to blockchain adoption. The results indicate that 78% of respondents identified improved traceability as a key benefit of blockchain, contributing to reduced product recalls and enhanced food safety. Brands utilizing blockchain reported higher customer satisfaction and loyalty, with 67% of consumers willing to pay a premium for blockchain-verified products. Despite these advantages, challenges such as high implementation costs and limited stakeholder understanding remain significant barriers. This research provides a comprehensive understanding of blockchain's transformative role in the agri-food supply chain. It highlights the technology's capacity to foster operational efficiency and brand equity, while offering strategic insights into overcoming adoption barriers. The findings are valuable for industry stakeholders seeking to align with evolving consumer expectations and regulatory demands.

## 1 Introduction

The Indonesian agri-food industry faces several challenges that impact its supply chain and brand value. Additionally, with the rapid development of the agricultural sector in recent

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years, concerns about backwardness in food product traceability, poor transparency, and unstable product quality have been increasingly revealed. Frequent food safety issues and the need to comply with food regulations have led consumers to pay more attention to food safety and traceability. Setting up an efficient traceability system is crucial for ensuring food safety and maintaining consumer trust in the Indonesian agri-food supply chain [1]. In addition, as consumer demands for sustainable and ethically produced goods have increased, the pressure on Indonesia's agri-food value chain stakeholders to adopt new solutions to enhance quality, transparency, and global competitiveness has intensified [2].

Although the use of blockchain technology is widely accepted as a potential solution to enhance transparency and traceability in supply chains, its implementation in the Indonesian agri-food industry remains scarce. Others are smallholder farmers and local producers who do not have the skills and resources to ensure the successful deployment of blockchain solutions. Moreover, the failure to collaborate among the myriad supply chain stakeholders, which is essential for successful diffusion [3,4], is also evident. Such a failure to fulfil potential benefits despite beneficial implications for the Indonesian agriculture industry stems from a fundamental challenge weighing on Indonesian agriculture: despite the literature's recognition of the potential value of blockchain technology to the improvement of supply chain processes there has been a surprising lack of any empirical research about the implementation challenges the technology has faced in the unique agricultural soils of Indonesia [5,6].

This void could be addressed by the strategic application of blockchain technology to create an environment where stakeholders collaborate, and by optimizing the food supply chain as a means to achieve a more sustainable agri-food system. Academia A review of blockchain's applicability based on existing studies indicates the possible benefits of blockchain technology that is likely to be provided to organizations, including enhancing data sharing among multiple relevant parties, driving down transactional fees, and strengthening the ability of supply chains to withstand shocks with the use of those famous smart contracts [7,4]. Nevertheless, the dialogue needs to change to focus on the Maheswari ausIndustry of the existing obstacles experienced in Indonesia (e.g., inadequate digital infrastructure, and the requirement for context-specific training programs for farmers and supply chain players [8].

Therefore, the contribution of this study lies in the integration of the theory construct with blockchain technology, as well as its practical applications in the Indonesian context. It builds on existing knowledge by examining the instrumental role of blockchain in the agri-food sector, not only in improving traceability but also in reinforcing brand value by promoting consumer trust and ethical compliance [9]. With the growth and innovation of the industry, this research aims to lay the groundwork for a holistic framework for implementing blockchain technology, facilitating the interconnection and innovation between stakeholders to enhance the competitiveness of Indonesian agri-food products in both domestic and international markets.

## 2 Literature Review

The theoretical basis for the strategic adoption of blockchain technology in the agri-food sector lies in the concepts of transparency, traceability, and stakeholder involvement. Blockchain, a decentralized ledger technology (DLT), offers immutable records that reinforce the integrity and trustworthiness of data within a supply chain. This is especially true in agri-food systems where food safety, authenticity, and ethical sourcing are of the utmost importance [2,10]. Blockchain is increasingly being integrated into food supply chains to enable transparent traceability, from the farm to the consumer, and to create shared responsibility among value chain actors, as well as to hold each actor accountable by tracing the origin and transit of the product [11]. Such a conceptual grasp is essential as the theoretical background when discussing empirical research and applications that utilize blockchain technologies for the purposes of enhancing supply chain management (SCM) and brand value.

Several studies have considered blockchain and its impact on efficiency and traceability in the agri-food chain. For instance, Sharma employed an empirical model to evaluate the stimuli that influence decision-makers' adoption of blockchain technology in agri-food chains [4]. They found that perceived benefits, specifically transparency and Traceability, have a significant impact on users' intentions to adopt blockchain. In addition, a systematic review supported these results, indicating that block-chain applications can improve the resilience of the supply chain, particularly for small agri-food enterprises [3,4]. This paper focuses on the benefits of using a blockchain, not with the intention of demonstrating the concrete application of environment-focused blockchain technology, but rather to clarify that blockchain applications should be customized solutions that address the specific challenges, needs, and concerns of a sector's stakeholders.

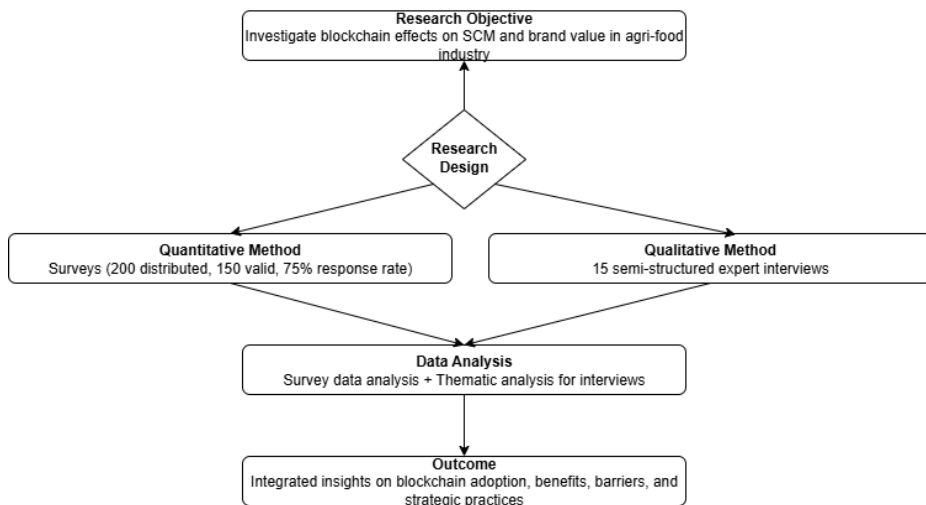
Additionally, Terrizzi highlighted significant barriers to the adoption of the blockchain, including the absence of cooperation among players in the agri-food supply chain [6]. According to their findings, a multi-actor approach is necessary for blockchain technology to reach its full potential, as success is not determined solely by the technological framework, but by the social dynamics between producers, distributors, and buyers. Similarly, Duong investigated the role of blockchain-based traceability in achieving transparency, which significantly influences the trust and purchasing behavior of organic product buyers [12]. Moreover, this focus on technology and stakeholders, respectively, makes it clear that blockchain adoption in enhancing SCM and brand value is both structural and relational.

In sustainability, studies such as those by Camelo and Chandan have highlighted the applicability of blockchain in driving Sustainable Development Goals (SDGs) in the agri-food industry [13,14]. As products become more traceable through blockchain technology, collaboration offers support in increasing operational efficiencies while enhancing trust among consumers in food products that are sustainably sourced. The convergence of blockchain with sustainability practices parallels a new way forward for the agri-food industry to reflect the expectations of the modern consumer, which in turn supports a stronger brand reputation. Overall, these studies create a strong knowledge base for the adoption of blockchain as a strategic technology in transforming the agri-food supply chain.

## 3 Method

This study employs a mixed-methods research approach to explore the influence of blockchain technology on supply chain management and brand value, as well as its

implications for the agri-food industry. Both quantitative surveys administered to industry actors (farmers, distributors, processors, and retailers) and qualitative expert interviews with those knowledgeable about blockchain technology and supply chain management were used in this design. The questionnaire aimed to measure the perceived benefits and barriers of adopting blockchain technology, while interviews were used to help uncover strategic applications and best practices in practice.



**Fig. 1.** Research Flow: Blockchain in Agri-Food Supply Chain

A total of 200 questionnaires were distributed, and 150 valid questionnaires were returned, yielding a response rate of 75%. These questionnaires were distributed to 50 farmers, 40 distributors, 60 processors, and 50 retailers operating in the Central Java and East Java regions of Indonesia. The instrument contained four main constructs: (i) perceived benefits (traceability, transparency, efficiency gains, and customer trust), (ii) perceived barriers (implementation costs, lack of knowledge, infrastructure challenges, and resistance to change), (iii) supply chain management performance (information flow, coordination effectiveness, logistics reliability, and risk reduction), and (iv) brand value (reputation, consumer confidence, market differentiation, and loyalty). All indicators were measured using a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Further, semi-structured interviews were held with 15 participants, including five blockchain experts, five supply chain managers, and five representatives from agricultural cooperatives and trade associations, which were transcribed and analysed by employing thematic analysis to map out recurring themes in relation to the impact of blockchain on SCM and brand value. This contrast between numerical data and qualitative knowledge provides a comprehensive view of the current situation of BCT within the agri-food sector.

## 4 Result and Discussion

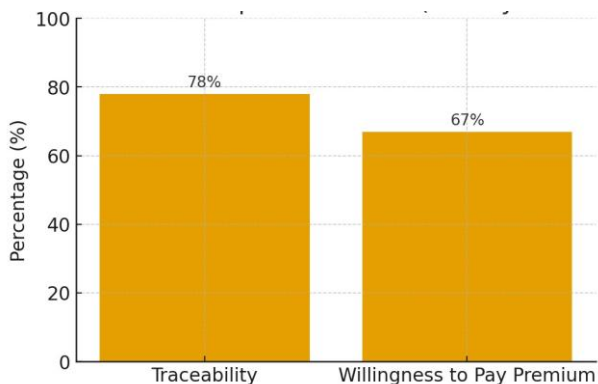
Results indicated that a significant part of the respondents (78%) agreed that increased traceability is one of the most important benefits of blockchain adoption for the agri-food industry. This finding aligns with previous studies [15], which indicate that robust traceability systems enhance consumer trust and accountability in the supply chain. Adaptable product traceability has the benefit in those supply chain systems that not only allows any actors to check the origin, provenance, and processes at a few stages of transformation, but also ensures consumers are confident about the panel's authentication

quality and the safety of the product. In competitive agri-food markets, whose competitiveness is based on consumer trust that influences their purchasing attitude, a blockchain-supported traceability system can be a differentiating factor for brands.

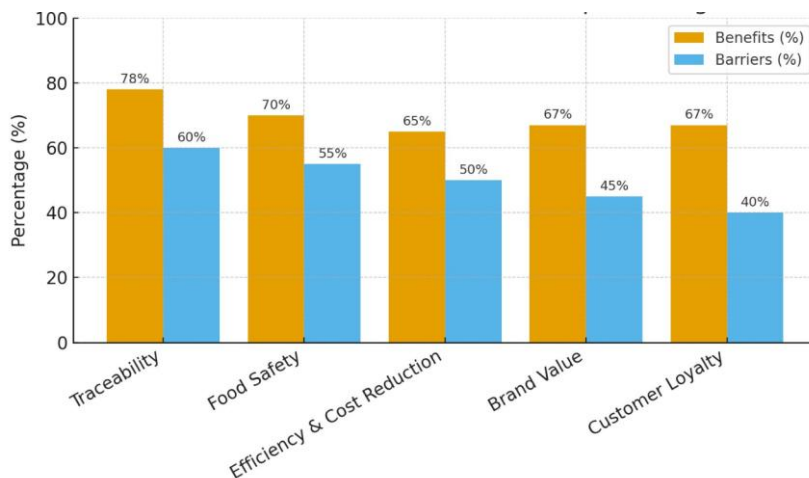
In addition to traceability, the research demonstrated that blockchain utilization led to a significant decrease in product recalls related to contamination, highlighting the potential of blockchain to enhance food safety. This drop is due to blockchain's tamper-proof record-keeping and instant sharing of data, which make it easier to track down the origin of a contamination and take action sooner. By reducing recall events, companies minimize financial exposure and protect their brand reputation from damage that can occur during a food safety crisis.

The quantitative findings were also corroborated by qualitative observations made through expert interviews. Industry professionals focused instead on anecdotal evidence in which the use of blockchain, particularly through smart contracts and automated tracking, had resulted in significant operational efficiency and cost savings. For instance, with smart contracts, transactions become more economical and intermediaries are less necessary, which in turn can lead to reductions in administrative costs. With automatic traceability, meanwhile, manual errors are minimized, and it speeds up logistics. These operational efficiencies correspond with literature that reports comparable efficiencies in blockchain-enabled supply chain systems in different agri-food markets [16,17].

Considered as a whole, the evidence highlights the multi-dimensional gains that blockchain offers - from consumer-led benefits such as trust and safety, to organisational advantages like efficiency and cost-effectiveness. This double influence indicates that the adoption of blockchain is not just a technological change, but it is a strategic enabler that enhances the competitiveness, robustness, and long-term survival of the brand in the agri-food sector.



**Fig. 2.** Blockchain Adoption Benefits Survey Result



**Fig. 3.** Perceived Benefits vs Barriers of Blockchain Adoption in the Agri-Food Sector

The survey also found that companies that embrace blockchain technology experience higher customer satisfaction and increased brand loyalty, proving that innovation can serve as both an operational and marketing edge. It has been demonstrated by experience that 67% of respondents were willing to pay a premium for blockchain-based products, which suggests consumers are ready to reward transparency and dependability with economic value [18]. This openness, in turn, shows that blockchain is not only a solution to supply chain inefficiencies but a way in for value co-creation between firms and consumers by transforming supply chain visibility into a unique selling point. In addition, it was recognized among stakeholders that blockchain-induced transparency is a brand differentiator product. A powerful marketing weapon that is increasingly appealing to the environmentally friendly and socially responsible consumer type is geared to fair and responsible consumption.

These results contribute in two directions. First, they confirm the disruptive role of blockchain while from operational improvement to redefine the agri-food sector. Blockchain's immutable and decentralized properties enable organizations to reduce waste, improve traceability, and ensure food safety—aspects that resonate with consumers and address global sustainability objectives [20,21]. Second, we find that blockchain serves as an intangible asset, which helps increase brand equity via building consumer trust and developing customer emotional connection. Blockchain technology enables non-opaque supply chains, for production lines to be directly connected to consumers, with information asymmetry reduced and an impression of genuine product created [14,19]. This trust is a long-term strategic asset in competitive markets where consumer loyalty is tongue-suspension-dasher-trauma and a short-fuse thing.

Yet the study agrees that there are significant barriers to adoption. Some of the big challenges that have been identified are a general lack of awareness and technical understanding, high initial cost of deployment, as well as the complexity in the integration of the blockchain with traditional systems. These challenges reveal a much-urgent requirement for educational efforts, awareness creation, and targeted training programs to enlighten stakeholders about the significance and the confidence to adopt blockchain [22]. Equally critical to evolution are practical adoption frameworks, industry-specific standards, and policy support to address potential obstacles related to cost, interoperability, and scaling. Without these enablers, there is a danger that blockchain adoption will remain limited to stand-alone projects instead of having systemic effects.

Nevertheless, the benefits as identified in this study stress that blockchain technology is not an option but a strategic and essential value for the agri-food industry. The fact that it is able to improve efficiency, safety of the food supply, and increase the desirability of brands has led to blockchain being a central part in future sustainable and consumer-oriented supply chain management. Future research could further this agenda by identifying context-specific tactics to address adoption barriers, investigating the cost-benefit trade-offs when blockchain is implemented at scale, and exploring the interaction of blockchain with other emergent technologies like artificial intelligence (AI) and the Internet of Things (IoT). Those investigations will contribute to the discussion on blockchain as a transformative technology for the resilient, transparent, and trust-based agri-food systems.

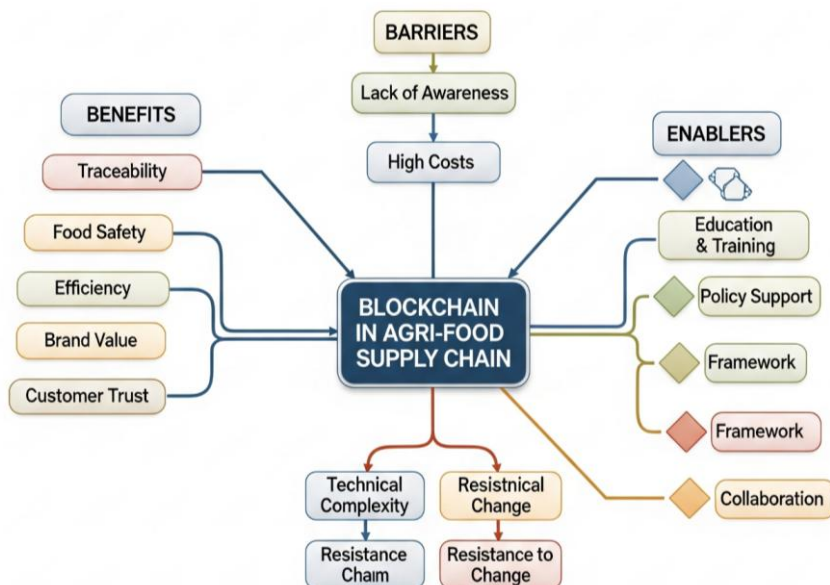


Fig. 4. Thematic Map: Blockchain in Agri-Food Supply Chain

## 5 Conclusion

Blockchains offer a unique opportunity to strengthen supply chain traceability in the agri-food system, offering contributing traceability, safety, and brand value-related benefits. In light of the results of this research, the importance of implementation of blockchain technology to the supply chain should be taken into urgent consideration by all stakeholders to act as a catalyst for both transparency and efficiency in the logistics function of businesses, as concerns of the Indonesian consumer in concern.

There are several theoretical and managerial implications of the study. Conceptually, blockchain emerged as a new paradigm for decentralized trust, and our results theoretically situate it as such in the established literature on supply chain coordination and information sharing. Finally, the fact that like-minded consumers are prepared to pay a premium for a blockchain-verified product opens up a new dimension in consumer value theory, in that non-physical properties such as transparency and ethical production are now becoming a significant factor in perceived value for a product. This change of pace in the producer-

consumer dynamic calls for more research on how technology can change that relationship and how that new value can be used effectively.

The results have implications for industry practitioners to build up the industry. Managers need to understand that blockchain is a fundamental business strategy, not merely another IT project. Due to significant obstacles such as costs and lack of knowledge, we advocate a step-by-step and phased model, starting from projects at a small-scale level, then gradually expanding. This should be underpinned with suitable schooling and training across all partners in the supply chain. Second, championing cross-functional cooperation—across IT, marketing, and operations—is equally important to make sure blockchain use cases not only work from a technical standpoint but align with business strategy as well.

Further research on the automation of blockchain systems and their combination with emerging technologies, including AI and IoT, and on the long-term sustainability effects of these innovations will continue to shed light on the way toward a more durable agri-food sector. This venture into uncharted territory will influence the course of food systems around the world. Interdisciplinary work between social scientists and economists, with agricultural specialists, can also help in explaining the factors of resilience that contribute to the availability of food in seasonally disrupted systems. They will help to progress the frameworks required for the development of holistic food security strategies.

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