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ROLE OF BLOCKCHAIN IN AGRICULTURE

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ABSTRACT

Blockchain technology has found applications across various sectors, and agriculture is no exception. Its role in enhancing food safety and streamlining transaction times is particularly noteworthy. As interest in Blockchain within the agricultural field grows, there's a pressing need for a comprehensive overview. In response, we have conducted a systematic literature review (SLR) aimed at gathering all pertinent research on Blockchain technology in agriculture. This review identifies current research themes, key contributions, and the benefits of implementing Blockchain in agriculture. The paper provides a detailed examination of how blockchain technologies can facilitate traceability in the agri-food sector. It starts with definitions, adoption levels, tools, and the advantages of traceability, along with a concise overview of blockchain technology's functionalities and benefits. Following this, an in-depth literature review explores the integration of blockchain into traceability systems. The discussion includes relevant existing commercial applications, while also highlighting the challenges faced and the future opportunities for Blockchain technologies in the agri-food supply chain.

Keywords: Blockchain, Agriculture, Agri-food

1. INTRODUCTION

Blockchain serves as a shared digital ledger for transactions and events, allowing all parties involved to access the same information transparently. By integrating blockchain technology with financial services, we can enhance accessibility to finance, insurance, smart contracts, electronic payments, weather data, land registrations, supply chains, and future trading solutions. This improvement can significantly increase farmers' incomes, creating a ripple effect that drives demand for products and services while encouraging investment. Streamlined supply chains will help mitigate supply shocks and stabilize inflation.Despite its potential, blockchain remains largely untapped in India, primarily due to its complexity and a lack of regulatory clarity. However, with the right political commitment and a long-term vision, we could turn blockchain into a catalyst for economic growth among Indian farmers.India, rich in agricultural heritage dating back to the Indus Valley Civilization, still faces challenges, as many farmers struggle with inadequate incomes while foreign entities thrive. A key issue contributing to this disparity is the inefficient supply chain management that often leads to excessive waste, particularly because many agricultural products have a short shelf life. Although the

government provides storage facilities, farmers lack visibility and tracking capabilities for their goods at various stages of transportation, creating additional hurdles for their livelihoods.

To enhance supply chain management in agriculture, there's a pressing need for an improved system that incorporates checkpoints at every stage, along with verification of goods status by both farmers and government officials. This paper proposes a solution that leverages Blockchain technology to foster transparency surrounding the status of goods, ultimately cultivating a healthier connection between producers and consumers. By recording details on the blockchain, the entire process becomes visible to both farmers and the officials involved in transportation. Blockchain serves as an electronic system that facilitates recordkeeping, validation, and verification without the need for intermediaries. Data is accessible to all participants, ensuring that information is transparent, reliable, and immutable; these records cannot be tampered with or erased. The system adheres to principles of governance, accountability, transparency, flexibility, availability, usability, manageability, and sustainability.

Improving agriculture requires a multifaceted approach. For instance, the study in [1] examines the factors encouraging young Irish farmers to adopt cloud computing technologies for smart farming. Another research effort in [2] delves into the applications of machine learning and big data within agriculture. The integration of ICT in this field necessitates ongoing collaboration among various technologies. These continual, cyclical improvements render agriculture a dynamic area of research. As a relatively new invention, blockchain offers practical applications, igniting interest among researchers exploring its potential in different aspects of agriculture.

2. LITERATURE REVIEW

Literature-based analyses of past work based on the standard requirement to observe typical patterns in the application of blockchain in agriculture and allied domains focus on finding the applications, challenges, gaps, and future directions.

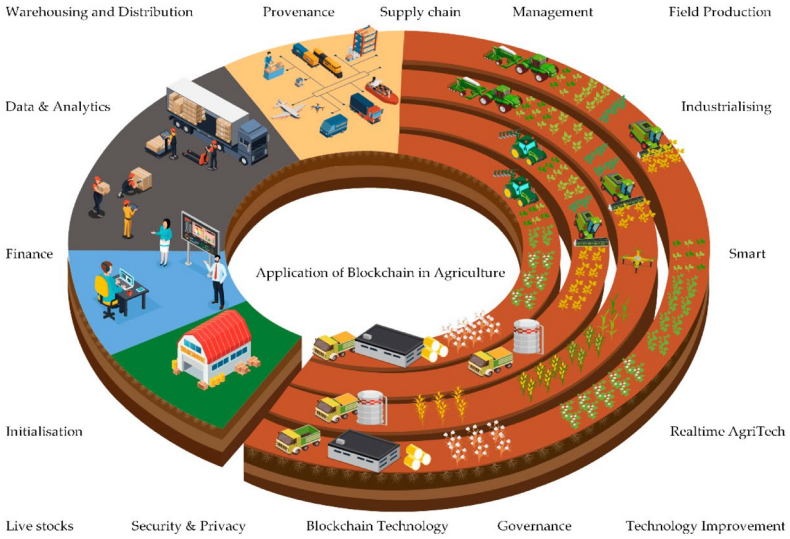

Figure 1 Application of blockchain in various verticals of the agriculture domain.[3]

A review of Agriculture 4.0 and the future of the industrialization of agriculture is presented in [4]. Applications of blockchain in agriculture are discussed in [5]. Case studies of solution built on blockchain platforms for IoT are covered in [6]. In [7], the authors show how blockchain can solve privacy and security challenges in conjunction with green IoT. A review of traceability systems built on blockchain for agriculture is presented in [8]. In [9], the author discusses the need for novel privacy-preserving techniques based on a survey on smart agriculture. A review of blockchain-based applications from the food sector is presented in [10], and traceability systems are presented in [11]. A list of future and smart technologies in agriculture is given in [12]. In [13], the authors discuss the application of blockchain in other fields beyond cryptocurrency. The research in [14] contributes to the advancement of smart agriculture, emphasizing security and privacy challenges. An aspect of financial governance in the agriculture domain is presented in [15] with a review of agriculture insurance applications on the blockchain. In [16], the authors present a brief review of applications of IoT in

smart agriculture. Cases of ICT and blockchain use for precision farming are presented in [17]. Ideas on using blockchain in Agriculture 4.0 are presented in [18]. A technological review of the food industry and blockchain is presented in [19].

Blockchain technology has the potential to transform agriculture in several key ways:

1) **Supply Chain Transparency:** Blockchain can provide a transparent and immutable ledger for tracking agricultural products from farm to consumer. This helps ensure the integrity of the food supply chain, allowing consumers to verify the origin of their food and ensuring compliance with safety standards.
2) **Smart Contracts:** These self-executing contracts with the terms of the agreement directly written into code can automate processes like payments and deliveries. This reduces the need for intermediaries and can streamline transactions between farmers, suppliers, and buyers.
3) **Traceability:** In case of foodborne illnesses or contamination, blockchain allows for quick tracing back through the supply chain to identify the source of the problem. This can help mitigate risks and protect public health.
4) **Access to Financing:** By providing a transparent record of transactions and farm practices, blockchain can help smallholder farmers gain access to credit and investment. Lenders can assess risk more accurately and offer loans based on verified data.
5) **Data Sharing and Collaboration:** Blockchain facilitates secure sharing of data among various stakeholders in the agricultural sector. Farmers, suppliers, and retailers can collaborate more effectively, sharing insights on crop yields, market demand, and best practices.
6) **Fair Trade and Ethical Sourcing:** Blockchain can support fair trade practices by ensuring that producers receive a fair price for their goods. It can track payments and ensure that funds reach farmers directly, enhancing economic equity.
7) **Sustainability and Environmental Monitoring:** Blockchain can help track sustainable farming practices, carbon credits, and the use of resources, enabling better environmental stewardship and accountability in agricultural practices.

Overall, blockchain can enhance efficiency, trust, and sustainability in agriculture, making it a valuable tool for modernizing the industry.

Table 1. Companies and websites which promote blockchain solutions for agriculture supply chains[20]

Company/Commercial Product	Website
agrichain	https://agrichain.com
agridigital	https://www.agridigital.io
agriledger	http://www.agriledger.io/about/
arc-net	https://arc-net.io
Bühler Smart Supply Chain	https://digital.buhlergroup.com/smartsupplychain/
Demeter.life	https://demeter.life
DOWNSTREAM	https://www.down-stream.io
Fishcoin	https://fishcoin.co
Honeysuckle White	https://www.honeysucklewhite.com
Ripe.io	https://www.ripe.io
TE-FOOD	https://tefoodint.com

3. CONCLUSION

Currently, at this present time, blockchain has a lot of challenges and roadblocks before even implementing on a wide scale. For many participants in the food ecosystem, original attempts and obligations to implement blockchain are often obstacles. The technology should either enhance prices or reduced costs to create financial sense. Although more customers advocate transparency and food safety, if the price does not justify the cost, there is little incentive for business players to engage. The latest transformation of the organic sector is a good case study. It has come a long way for both consumers and producers to embrace the concept of organic food. However, once the higher price for organic food is justified, the advantages for switching to organic food are recognized by producers and consumers. Voice of consumers is enough for producers to make changes. The distinctive decentralized design of Blockchain ensures verified goods and procedures to generate a market with transparency for premium goods. Commanding a premium price would therefore

provide a financial incentive. In the meantime, the incentive problem could be solved by different financing structures. A blockchain-enabled monitoring scheme would increase the capacity to acquire such loans and reduce the price of the supply chain on a larger scale.

CONFLICT OF INTERESTS

None.

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