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Harnessing Blockchain Technology for Transforming Indian Agriculture: A Review of Innovations and Applications

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Agriculture is a cornerstone of India's economy, contributing 18.3% to the Gross Value Added (GVA). Despite its importance, it remains one of the least digitized industries, facing challenges in transparency, efficiency, and trust. Blockchain technology, with its decentralized and immutable ledger system, has emerged as a revolutionary tool to address these challenges. This review explores the potential of blockchain in transforming Indian agriculture by analysing real-life case studies like Fertilizer Subsidy Management, Seed Distribution, Traceability interface, and land records, Public distribution systems, Blood Bank and Secure and Seamless Taxation. These

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applications showcase blockchain's capacity to enhance transparency, efficiency, and accountability while addressing systemic inefficiencies. The paper discusses the current progress, challenges, and the future trajectory of blockchain adoption in Indian agriculture. While showcasing promising applications, the study also discusses the challenges of scalability, digital literacy, and regulatory frameworks that must be addressed for widespread adoption.

Keywords: Blockchain technology; smart contracts; traceability; land records; public distribution system; fertilizer subsidy management; seed distribution.

1. INTRODUCTION

Indian agriculture faces inefficiencies due to limited digital penetration and challenges in transparency. Blockchain, a decentralized distributed ledger technology, promises secure, immutable, and transparent transaction records, addressing these longstanding issues (Lepcha, 2025). The evolution of blockchain technology and the increasing adoption of digital twins stand out as influential trends. Despite their distinct applications, these trends weave a common narrative of robust data management, heightened security, and seamless real-time interaction (Gaur *et al.*, 2025). The integration of blockchain and digital twins introducing a dynamic, data-driven approach that holds the promise of revolutionizing the agriculture sectors (Awasthi *et al.*, 2025). Distributed ledger technologies (DLTs) and smart contracts provide a unique opportunity to bring greater efficiency, transparency and traceability to the exchange of value and information in the agriculture sector (Tripoli & Schmidhuber, 2020). This paper explores blockchain's application in agriculture through significant case studies, analyzing its benefits, challenges, and future potential.

1.1 Blockchain Technology

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network.

1.2 How Blockchain Work?

The transaction process in a blockchain can be summarized as follows:

1. **Transaction facilitating:** When a new transaction is initiated on the blockchain network, all associated information is encrypted twice—once with a public key and once with a private key—to ensure secure transmission.
2. **Transaction verification:** The transaction is broadcast to a global network of peer-to-peer computers. Each node in the network verifies the transaction's validity, such as ensuring the sender has a sufficient balance to complete it.
3. **New block formation:** In a typical blockchain network, numerous nodes operate simultaneously, verifying many transactions in parallel. Once a transaction is verified and deemed legitimate, it is added to the mempool — a temporary storage area for pending transactions at a node. Each node maintains its own mempool, and miners select transactions from their mempools to assemble a new block for inclusion in the blockchain.
4. **Consensus algorithm:** Nodes that form a block attempt to add it to the blockchain, but allowing all nodes to do this freely would disrupt the network. To prevent this, a consensus mechanism ensures that only one valid block—agreed upon by all nodes—is added. The node chosen to add the block, called the “miner,”. The consensus algorithm generates a hash for the block, which is required to securely attach it to the blockchain.
5. **New block addition in blockchain:** Once the new block is hashed and authenticated, it is ready to be added to the blockchain. Each block contains the hash of the previous block, creating a cryptographic link between them. This linking form the blockchain, with new blocks added sequentially to the chain’s open end.
6. **Transaction completion:** Once a block is added to the blockchain, the transaction is finalized and its details are permanently recorded. Anyone can access and verify the transaction information at any time (GeeksforGeeks, 2025).

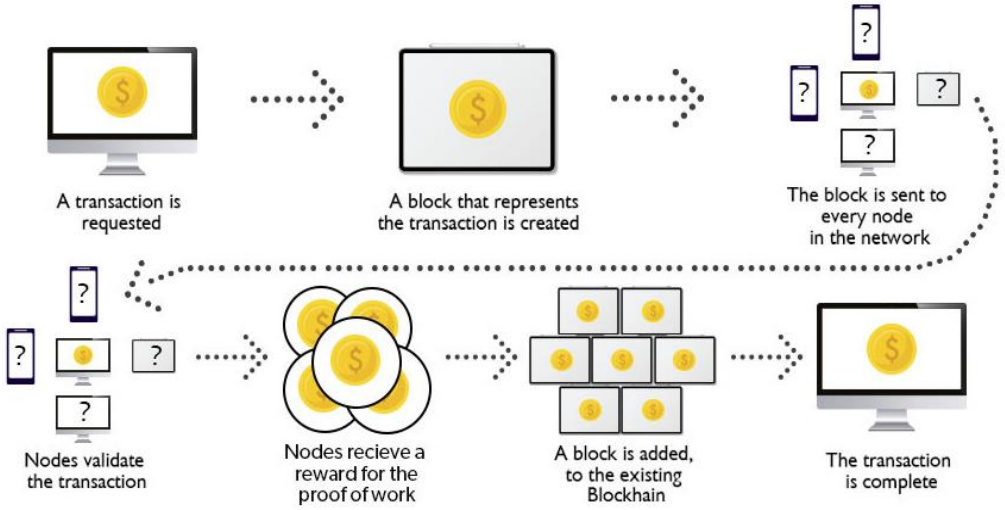

Fig. 1. Blockchain workflow (GeeksforGeeks, 2025)

2. TYPES OF BLOCKCHAIN

Blockchain networks are generally categorized into four main types: public, private, consortium, and hybrid which is shown in Fig. 2. Each type differs in terms of access, permissions, and governance structure, which influences how suitable they are for various use cases.

Public Blockchains are open and permission less networks where anyone can join, access the data, and take part in the consensus mechanism. Their decentralized and distributed structure makes them highly transparent and secure. Well-known examples include Bitcoin and Ethereum (Rańda, 2025).

Private Blockchains are permissioned networks managed by a single organization or a select group, where access and participation are restricted. They provide enhanced control and privacy compared to public blockchains, making them ideal for internal operations within companies or specific sectors. For example, they are often used in supply chain management, allowing only authorized participants to view or alter the data (Rańda, 2025).

Consortium Blockchains are semi-decentralized networks managed by a group of predetermined organizations instead of a single authority. They combine features of both public and private blockchains, providing a balance between transparency and centralized control. These blockchains are commonly used by financial institutions to facilitate efficient cross-border transactions and settlements (Rańda, 2025).

Hybrid Blockchains integrate elements of both public and private blockchains, enabling selective access and data sharing. This approach offers flexibility and greater control over how information is managed and distributed. A common use case is in loyalty programs, where general data can be made publicly available, while confidential customer details remain securely private (Rańda, 2025).

3. AGRICULTURAL SUPPLY CHAIN MANAGEMENT SERVICES

Supply chain management in agriculture sector encompasses the range of solutions designed to optimize the flow of agricultural produces from farm to consumer. These services include procurement, production planning, inventory management, transportation, storage, and distribution, all tailored to meet the unique challenges of the agriculture sector. By integrating technology such as blockchain, IoT and data analytics, it improves visibility, traceability, and efficiency across the supply chain. It also helps to reduce post-harvest losses, enhance product quality, and ensure timely delivery, ultimately supporting farmers, agribusinesses, and retailers in meeting market demands more effectively.

Several top vendors provide robust and secure supply chain management tools specifically designed to streamline agricultural distribution. These solutions help manage everything from production planning and inventory tracking to transportation and delivery, ensuring greater efficiency and transparency across the supply chain.

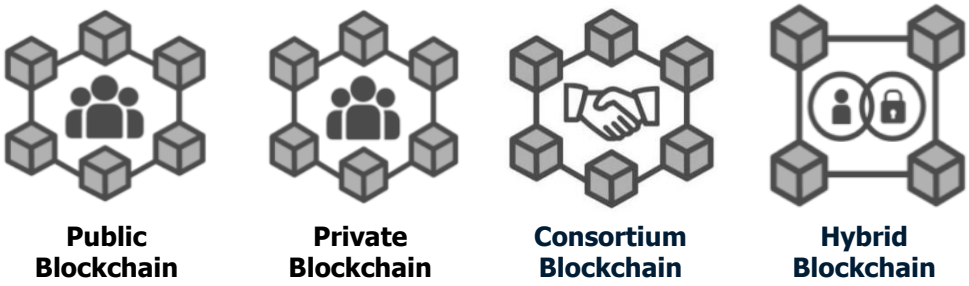

Fig. 2. Types of blockchain technology

Leading providers often offer features like real-time data analytics, blockchain integration for traceability, and mobile access for field operations. By leveraging these advanced tools, agricultural businesses can reduce waste, optimize logistics, and enhance collaboration among farmers, distributors, and retailers.

Here is a list of leading vendors that provide powerful supply chain management solutions designed to streamline and simplify agricultural distribution.

3.1 IBM Corporation

IBM Corporation provides a range of agricultural supply chain services. IBM Food Trust offers a blockchain-based solution that increases traceability and transparency in the food supply chain. IBM Watson's decision platform for agriculture has AI and data analytics integrated to offer actionable insights to farmers. The company also supplies IoT-based solutions that enable real-time monitoring and management of agricultural operations. The supply chain solution offered by IBM for agricultural purposes improves multiple aspects of the supply chain, right from procurement to distribution. These solutions support sustainable farming strategies and reduce carbon footprints. It also helps the cultivators to ensure compliance with environmental regulations (Camila, 2024).

3.2 Trellis LTD

Trellis LTD is a leading company focused on providing advanced technological solutions to optimize agricultural supply chains. The platform has machine learning and AI integrated that forecast demand, yield, and supply chain disruptions. These predictive analytics help make informed decisions and improve inventory management and timely distribution of agricultural products. Trellis leverages advanced analytics to assist farmers and agricultural businesses in improving crop yields. The tool identifies and mitigates risks related to weather, pests, and market fluctuations. Trellis integrates blockchain technology to ensure transparency and traceability in the agricultural supply chain (Camila, 2024).

3.3 AgriDigital

AgriDigital provides innovative agricultural supply chain services. The company utilizes blockchain technology, smart contracts, and cloud-based platforms to streamline processes. Its blockchain platform ensures secure, transparent transactions throughout the agricultural supply chain. Recording transactions on an immutable ledge helps improve traceability, reduce fraud, and develop trust among participants. Its agricultural supply chain service facilitates secure and instant payments through its platform (Camila, 2024).

3.4 Bext Holdings Inc.

Bext Holdings Inc. offers innovative agricultural supply chain services. The platform offered by the company has embedded advanced technologies such as blockchain technology, AI, machine learning, and IoT. It provides comprehensive services that optimize the traceability and quality control of agricultural products. It gives blockchain-based traceability to ensure end-to-end traceability of agricultural products. The platform collects data on various parameters such as soil health, weather conditions, and crop quality. Farmers can embrace solutions for quality control and authentication of agricultural products (Camila, 2024).

3.5 GrainChain, Inc.

GrainChain, Inc. provides robust agricultural supply chain service. By adopting blockchain technology, IoT, and smart contracts, GrainChain

aims to revolutionize how agricultural commodities are tracked, managed, and transacted. It provides self-executing contracts to ensure that payments and deliveries are made. It also offers comprehensive tools for managing the procurement, storage, and sale of agricultural commodities (Camila, 2024).

3.6 ChainPoint

ChainPoint delivers advanced agricultural supply chain services by integrating blockchain technology, data analytics, and IoT to deliver a comprehensive platform for managing and optimizing agricultural supply chains. This platform allows stakeholders to track products from farm to table which ensuring product authenticity and quality (Camila, 2024).

3.7 LexisNexis Risk Solutions (Proagrica)

Proagrica is a subsidiary of LexisNexis Risk Solutions that offers a wide range of advanced agricultural supply chain services. The company takes advantage of data analytics, connectivity, and integration technologies to offer comprehensive services. This includes farm management systems, machinery data, satellite imagery, weather data, and market information. These supply chain services for agriculture allow stakeholders to improve decision-making and operational performance (Camila, 2024)..

3.8 Agri Value Chain

Agri Value Chain relies on advanced technologies and innovative solutions to provide comprehensive services that address the needs of all stakeholders in the agricultural supply chain. It provides efficient supply chain management solutions that streamline the flow of agricultural products from producers to consumers. It delivers tools and systems for monitoring and maintaining the quality of agricultural products throughout the supply chain (Camila, 2024).

3.9 Geora Ltd.

Geora Ltd. has expertise in providing innovative agricultural supply chain services. It puts a strong emphasis on integrating advanced blockchain technologies to improve transparency, traceability, and efficiency. Its aim is to revolutionize the agricultural supply chain through data integration, smart contracts, and real-time analytics. It provides secure and efficient financial services, facilitating instant and transparent payments within the supply chain (Camila, 2024).

3.10 Eka

Eka is a pioneer in offering advanced agricultural supply chain management services. It offers wide range of services that integrate technology to streamline operations and optimize decision-making capabilities. It provides comprehensive commodity management solutions tailored for the agricultural sector including the functionalities for managing contracts, procurement, logistics, and inventory across the supply chain (Camila, 2024).

4. APPLICATIONS OF BLOCKCHAIN IN INDIAN AGRICULTURE

Blockchain technology in Indian agriculture offers transformative potential by enhancing transparency, traceability, and efficiency across the supply chain. It can securely record every transaction from farm to consumer, ensuring farmers receive remunerative prices by reducing intermediaries and enabling direct market access. Blockchain also facilitates fertilizer subsidy management, seed distribution, traceability interface for Indian spices, land record management, supports transparent subsidy distribution, and aids in authenticating organic and quality certifications for fostering trust, reducing fraud, and empowering farmers with greater control over their produce.

4.1 Fertilizer Subsidy Management

NITI Aayog, in collaboration with Gujarat Narmada Valley Fertilizers & Chemicals Limited (GNFC), has pioneered a Proof-of-Concept (PoC) application using blockchain technology to revolutionize fertilizer subsidy management in India. Agriculture, contributing 18.3% to the Gross Value Added (GVA) of the Indian economy, relies heavily on government subsidies. Annually, approximately ₹70,000 crore is disbursed to fertilizer manufacturers for producing 31 million metric tons of fertilizers. However, the conventional subsidy disbursal process is plagued with inefficiencies, involving multiple intermediaries, complex verification procedures, and significant delays of two to three months (GoI: PIB, 2018).

The blockchain-based system aims to transform this cumbersome process by automating and

streamlining subsidy transfers, making them real-time and transparent. Key features of the blockchain platform include distributed computing, confidentiality, authenticity, non-repudiation, data integrity, and availability. The blockchain based subsidy distribution process show in Fig. 3.

The PoC implementation underscores the potential of blockchain to enhance subsidy management, improve efficiency, and significantly reduce leakages. The outcomes of this project are expected to inform policy recommendations for scaling similar blockchain applications across India's agricultural sector. This case study illustrates the transformative impact of blockchain in addressing inefficiencies and enhancing governance in a critical component of the agricultural value chain (GoI: PIB, 2018).

4.2 Seed Distribution

Jharkhand has emerged as a pioneer in the implementation of blockchain technology in agriculture by becoming the first state in India to deploy a production-grade blockchain-based seed distribution program. This initiative aims to address systemic inefficiencies in seed distribution while enhancing transparency and efficiency. The blockchain platform facilitates real-time tracking of seed supply across the entire distribution chain. The process tracks seed distribution from government-approved seed-producing agencies to distributors, retailers, Local Area Marketing Societies (LAMPS), Primary Agricultural Credit Societies (PACS), Farmer Producer Organizations (FPOs), and finally to the farmers. This system eliminates middlemen and ensures the authenticity of seeds distributed under the seed exchange scheme and other government initiatives which is shown in below Fig. 4 (Settlemint, 2022).

Jharkhand's blockchain-based seed distribution program represents a transformative step toward digitizing agricultural supply chains. By ensuring transparency and efficiency, it enhances farmers' access to quality inputs while laying the groundwork for a robust and technology-driven agricultural ecosystem. This initiative not only improves service delivery but also sets a benchmark for other states in leveraging blockchain technology to modernize agricultural processes (Settlemint, 2022).

4.3 Traceability Interface for Indian Spices

The Spices Board of India, under the Ministry of Commerce and Industry, in collaboration with UNDP India's Accelerator Lab, has initiated a transformative project to enhance transparency and efficiency in the Indian spices supply chain. Through a signed Memorandum of Understanding (MoU), the two organizations aim to develop a blockchain-based traceability interface for spices, addressing complexities in data management across the supply chain. This system involves farmers, brokers, distributors, processors, retailers, regulators, and consumers, ensuring transparency at every stage while simplifying operations (Spices Board India: PIB, 2024).

The blockchain interface is being integrated with the e-Spice Bazaar portal, a digital platform designed by the Spices Board to connect spice farmers directly with markets. The pilot project involves over 3,000 farmers engaged in chilli and turmeric cultivation across select districts of Andhra Pradesh. This initiative is expected to make the spices supply chain more efficient by reducing information asymmetry, enhancing traceability, and promoting sustainable farming practices. The blockchain based enhance supply chain for spices shown in Fig. 5.

4.4 Land Records Management

In India, land ownership is currently proven through a presumptive land titling system, relying on a chain of documents that trace the transfer of title over time. However, this system is fraught with challenges, including the potential for disputes over intermediate transactions and widespread property fraud. The office of the sub-registrar (SRO), governed by the Central Registration Act of 1908, only registers deeds between parties without verifying ownership, leaving significant gaps in the system's reliability (NIC, 2024).

Blockchain technology presents a robust solution to these challenges by enabling a transparent, immutable, and decentralized record-keeping system. Integrating blockchain into land record management can ensure real-time updates, secure transaction validation, and tamper-proof documentation. With blockchain, the sale deed registration process, including biometric verification and digital documentation, can be

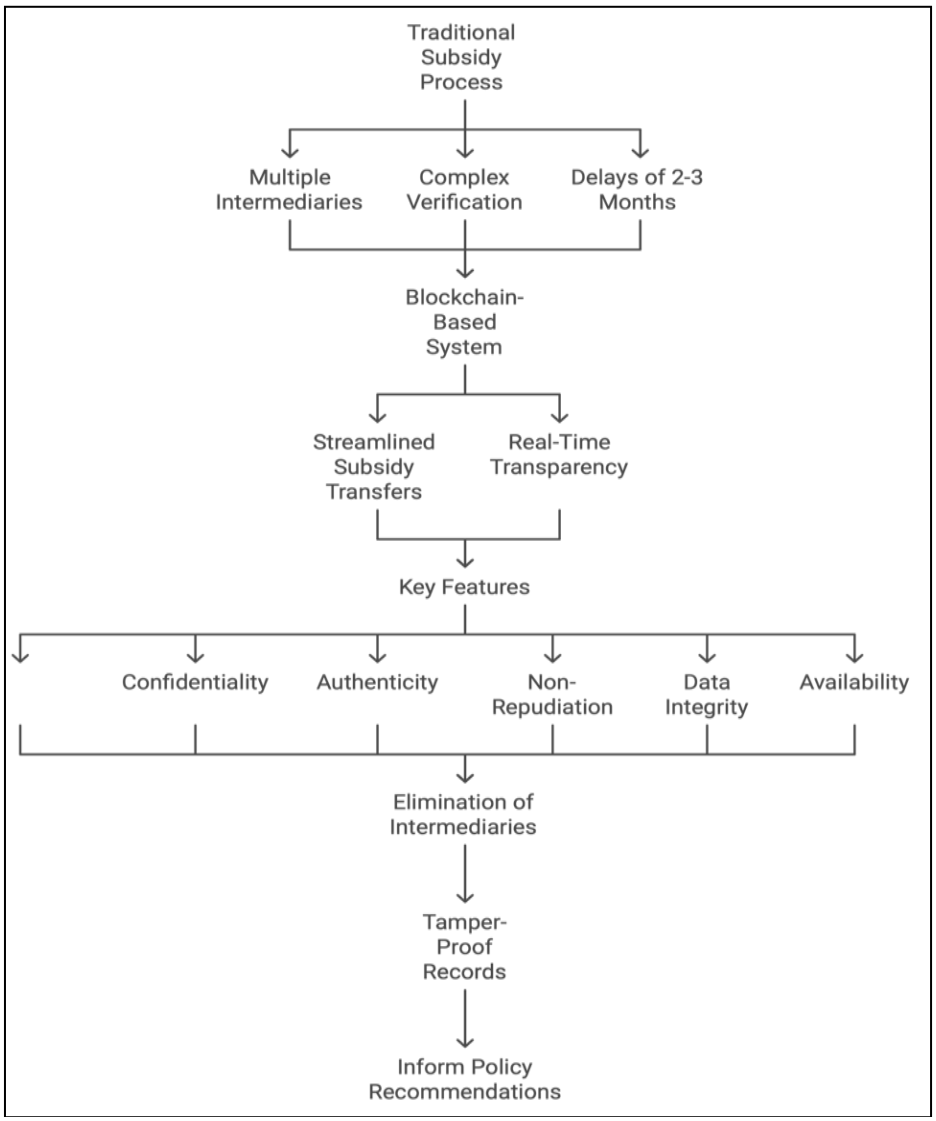

Fig. 3. Blockchain based subsidy distribution process

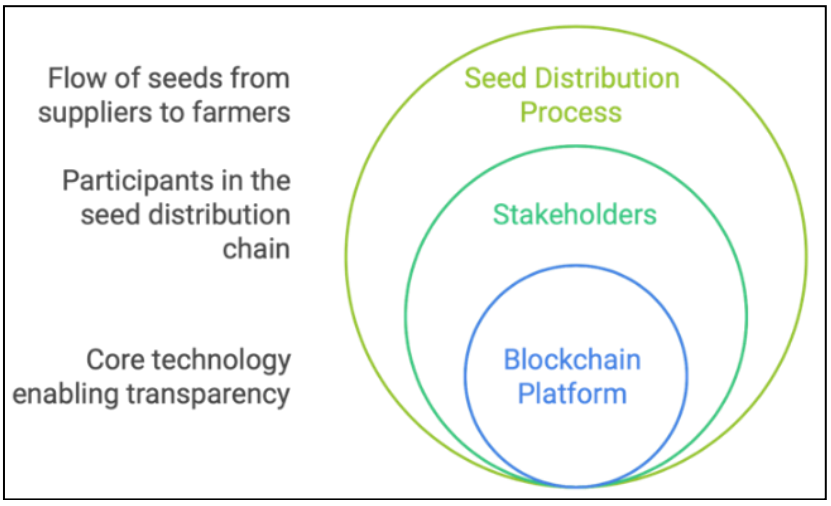

Fig. 4. Blockchain based seed distribution system in Jharkhand

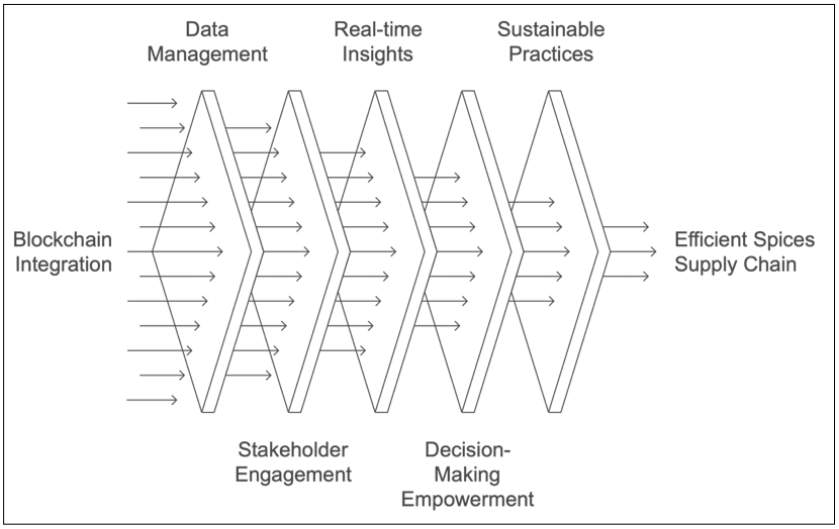

Fig. 5. Supply chain for spices

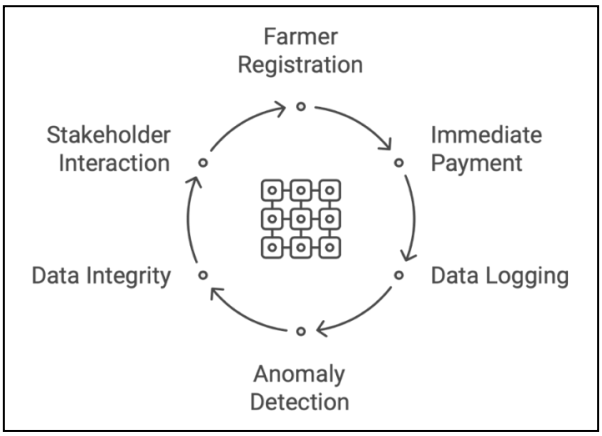

Fig. 6. Blockchain based public distribution cycle

linked directly to land ownership records, eliminating discrepancies and reducing fraud. This technological intervention has the potential to revolutionize land governance in India by streamlining processes, increasing trust, and enhancing the delivery of benefits to stakeholders, particularly farmers (NIC, 2024).

4.5 Public Distribution System (PDS)

The Public Distribution System (PDS) in India is a critical mechanism for providing subsidized food grains to ration card holders. However, it is plagued by inefficiencies and a lack of accountability throughout its supply chain, which includes farmers, millers, transporters, state agencies, fair price shop (FPS) owners, and beneficiaries (GoI, 2024). Leakages and delays in payments, especially to farmers, are common challenges.

Blockchain technology offers a transformative solution for managing the PDS supply chain through its decentralized distributed ledger. By integrating blockchain, the entire supply chain—from procurement at Minimum Support Price (MSP) to final distribution at FPS—can be streamlined. Blockchain enhanced the public distribution cycle shown in Fig. 6.

A Proof of Concept (PoC) application has been developed as a Python-based web platform, incorporating blockchain and relational database management systems (RDBMS). The PoC supports three stakeholders: farmers, millers, and administrators. The system enables miller and farmer registrations, with data written simultaneously to both blockchain and database systems. Updates to procurement data are securely logged and compared to identify anomalies. The superuser module further

ensures data integrity by cross-verifying information between the database and blockchain. Deployed within a Docker container, the application facilitates efficient stakeholder interaction and decision-making based on a local copy of the blockchain ledger. APIs can facilitate the interaction between web applications and blockchain networks, enabling functionalities such as querying blockchain data, submitting transactions, and interacting with smart contracts (Dudhagara & Joshi, 2017).

4.6 Blockchain-Backed Agri-Cooperative Platforms

Blockchain technology is increasingly being recognized as a valuable tool for improving the efficiency and transparency of Farmer Producer Organizations (FPOs) and agricultural cooperatives in India. These organizations, which bring together smallholder farmers to access shared resources, often face operational challenges such as poor record-keeping, delayed payments, and lack of trust among members. Blockchain addresses these issues by providing a secure, decentralized system for recording every transaction—from input distribution to final sales and profit-sharing. The immutable nature of blockchain entries builds trust and accountability among members by ensuring all data is tamper-proof and accessible in real time (NABARD, 2021).

Recent pilot projects in Maharashtra and Andhra Pradesh, supported by NABARD and agri-tech startups, have tested private blockchain networks in FPOs. Initiatives like “ShetkariChain” enabled farmers to view updated information on prices, bids, and transaction status through mobile apps, while smart contracts ensured automatic payments after deliveries were confirmed. These systems are also being linked with platforms like eNAM and formal financial institutions to build digital credit histories for cooperatives, improving their access to loans and working capital. Additionally, blockchain is being explored for recording organic certification, pest surveillance, and regulatory compliance, enhancing the quality and market reach of agricultural produce (NABARD, 2021).

4.7 Blockchain for Traceable Coffee Supply Chains

Blockchain technology is increasingly being explored to enhance transparency and traceability in agricultural supply chains. One notable initiative in India is CropChain, developed by Eka Software Solutions, which aims to digitize and secure the farm-to-cup journey of coffee using blockchain.

CropChain addresses key issues in the Indian coffee industry, such as lack of traceability, quality assurance challenges, and market trust gaps. The platform leverages blockchain to record immutable data at every stage—from the farmers harvesting beans in Karnataka's coffee-growing regions to processing, roasting, packaging, and retail distribution. Each transaction or process is time-stamped and cryptographically linked, creating a transparent and tamper-proof supply chain ledger (Eka Software Solutions, 2021)

By recording vital data such as origin, farm practices, certifications, processing methods, and storage conditions, CropChain enables end consumers to trace the provenance of their coffee. This fosters consumer trust and opens up premium pricing opportunities for farmers who meet global quality and sustainability standards.

In addition to traceability, CropChain integrates quality testing results, logistics data, and payment records, thereby creating an integrated digital ecosystem (Eka Software Solutions, 2021).

5. OPPORTUNITIES AND CHALLENGES

Blockchain technology presents significant opportunities for transforming Indian agriculture, primarily by fostering transparency and trust throughout the supply chain through the elimination of intermediaries and enhanced traceability. It promises efficiency gains by automating processes, reducing delays, and streamlining the disbursement of subsidies. Furthermore, it empowers farmers by enabling the creation of robust databases, ensuring targeted interventions and equitable access to various schemes. This technological advancement also contributes to India's global competitiveness by enhancing product authenticity and supply chain visibility, thereby boosting export potential. GST Chain has been established using the BlockChain Technology to record the GST transactions of various stake holders involved in GST management, by linking them like a chain. (NIC, 2024)

Blockchain technology presents a promising avenue for enhancing ethical data practices in AI systems. By enabling decentralized, tamper-proof records, blockchain can improve transparency and accountability in data collection, storage, and usage (Kumar *et. al.,* 2024).

However, the path to integrating blockchain in Indian agriculture is not without its hurdles. Key technical barriers include limited digital literacy among stakeholders and inadequate infrastructure in rural areas. Scalability issues present a considerable challenge, as integrating blockchain across the diverse and fragmented agricultural systems of India requires substantial investment. Moreover, the absence of standardized policy and regulation frameworks, along with the need for legal recognition of blockchain-based records, creates uncertainty. Finally, ensuring data privacy while simultaneously maintaining the transparency inherent to blockchain technology remains a critical concern that needs careful addressing.

6. CONCLUSION

The adoption of blockchain in Indian agriculture is in its nascent stage but shows immense promise. Policymakers, private players, and researchers must collaborate to overcome challenges, scale successful PoCs, and develop innovative solutions tailored to the sector's needs. With strategic implementation, blockchain offers significant benefits in agriculture by enhancing transparency, traceability, and efficiency across the supply chain. It allows farmers, distributors, and consumers to securely track the journey of agricultural products from farm to table. Smart contracts can automate transactions and payments, minimizing delays and cutting down on middlemen. Additionally, blockchain can help in managing agricultural subsidies and public distribution system effectively, ensuring that benefits reach the intended recipients without corruption or inefficiencies. Overall, it builds trust and accountability in agricultural practices and markets.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Awasthi, M., Raghuvanshi, C. S., Dudhagara, C., & Awasthi, A. (2025). Exploring virtual smart healthcare trends using digital twins. *Digital Twins for Smart Cities and Villages*, 377–406. Elsevier. https://doi.org/10.1016/B978-0-443-28884-5.00017-8

Camila (2024). Top 10 agricultural supply chain service providers in 2024. Kings Research. https://www.kingsresearch.com/blog/top-10-agricultural-supply-chain-services-2024

Dudhagara, C. R., & Joshi, A. (2017). API integration in web application. *International Journal of Trend in Scientific Research and Development*, 1(2), 31–34.

Eka Software Solutions. (2021). CropChain: Enhancing traceability and transparency in coffee supply chains using blockchain. https://www.ekaplus.com

Gaur, A. S., Sharan, H. O., & Dudhagara, C. (2025). Research trends in blockchain and digital twins. *Digital Twins for Smart Cities and Villages*, 561–580. Elsevier. https://doi.org/10.1016/B978-0-443-28884-5.00024-5

GeeksforGeeks. (n.d.). *How does the blockchain work?* https://www.geeksforgeeks.org/how-does-the-blockchain-work/

Government of India: Press Information Bureau. (2018). https://www.pib.gov.in/Pressreleaseshare.aspx?PRID=1537221

Government of India, Ministry of Electronics & Information Technology. (n.d.). *Application of blockchain technology in Public Distribution System.*

https://blockchain.gov.in/Home/CaseStudy?CaseStudy=PDS

Kumar, R., Joshi, A., Sharan, H. O., Peng, S.-L., & Dudhagara, C. R. (2024). *The ethical frontier of AI and data analysis*. IGI Global.

Lepcha, M. (2025). Types of blockchain explained: A complete guide. https://www.techopedia.com/4-types-of-blockchain-explained-a-complete-guide

NABARD. (2021). *Farmer Producer Organisations: Status, Issues & Suggested Policy Reforms.* National Bank for

Agriculture and Rural Development. https://www.nabard.org

National Informatics Centre. (n.d.). *GSTChain: A blockchain network application for the Goods and Services Tax (GST)*. https://blockchain.gov.in/Home/CaseStudy?CaseStudy=gstchain

National Informatics Centre. (n.d.). *Land registration using blockchain technology*. https://blockchain.gov.in/Home/CaseStudy?CaseStudy=LandRegistration

Rańda, D. (2025). *Types of blockchain technology: A complete overview*. CrustLab. https://crustlab.com/blog/types-of-blockchain-technology-a-complete-overview/

Settlemint. (2022). *Jharkhand blockchain seed distribution*. https://news.settlemint.com/news/jharkhand-blockchain-seed-distribution

Spices Board India: Press Information Bureau (2024). https://www.pib.gov.in/PressReleasePage.aspx?PRID=1709674

Tripoli, M., & Schmidhuber, J. (2020). *Emerging opportunities for the application of blockchain in the agri-food industry*. FAO and ICTSD.

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