

SEEDING THE FUTURE OF AGRICULTURE WITH DECENTRALISED IDENTITIES AND BLOCKCHAIN TECHNOLOGY

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Abstract

The rapid development of digital technology is transforming the agricultural sector, offering promising solutions to enhance productivity, traceability, and transparency. This article explores the potential benefits and challenges of implementing Decentralised Identities and blockchain technology in the agriculture industry. By leveraging this technology, stakeholders across the supply chain can increase transparency, reduce fraud, and improve the tracking and traceability of products. However, there are also some challenges on the way that need to be overcome, including investment in new technology and infrastructure and the need for training and education. Despite the challenges, the benefits of Decentralised Identities and blockchain in agriculture make it an area of great potential for innovation and growth. Blockchain technology, with its tamper-proof, transparent, and traceable nature, facilitates the establishment of a reliable, verifiable, and efficient agricultural supply chain. Combining these technologies provides farmers with access to information and resources, optimises decision-making processes, and promotes sustainability. This article concludes that the integration of decentralised identities and blockchain technology has the potential to catalyse a new era in agriculture, with benefits extending to farmers, suppliers, consumers, and regulators. The adoption of these innovations could lead to improved productivity, reduced waste, and increased trust throughout the supply chain. However, challenges remain in terms of technological complexity, implementation costs, and interoperability. Future research should focus on addressing these issues to accelerate the adoption and scaling of these technologies in the agricultural sector.

Keywords: blockchain, agriculture, farmers, Decentralised Identities, supply chain

Agriculture is one of the oldest and most essential industries in human history, providing food, fibre, and raw materials for countless civilisations throughout the ages. Today, the global agriculture sector is facing unprecedented challenges, including climate change, population growth, and economic volatility. These challenges are compounded by a lack of transparency and efficiency in the agriculture supply chain, which can lead to market inefficiencies, fraud, and food waste.

Fortunately, new emerging technologies have the potential to transform the agriculture sector to overcome these challenges. Decentralised identities and blockchain technology are two such innovations that can provide secure, transparent, and efficient solutions for farmers and agribusinesses. In this article, we will explore the role of Decentralised Identities and blockchain in agriculture and how these technologies can revolutionise the industry for the better.

The agriculture sector faces several challenges that can hinder its ability to meet the growing demands of society. These challenges

range from economic volatility to environmental degradation and social inequities. In this section, we will explore some of the challenges farmers and agribusinesses face in the agriculture sector.

One of the biggest challenges farmers and agribusinesses face is the lack of transparency in the agriculture supply chain (Kraft S.K., Kellner K., 2022). This can lead to market inefficiencies, price volatility, and food waste. Farmers may only know the final price of their crops once they are sold at the market, making it difficult to plan and invest in their farms. Similarly, consumers may not know the origin or quality of their products, leading to food safety concerns.

The agriculture sector is also characterised by market inefficiencies, which can make it difficult for farmers to access financing and resources. For example, small-scale farmers may not have access to the same markets or resources as larger agribusinesses, which can limit their ability to compete in the market. Additionally, farmers may face high transaction costs when selling their products, which can eat into their profits.

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Access to financing is another major challenge faced by farmers and agribusinesses. Small-scale farmers, in particular, may struggle to access credit or loans, which can limit their ability to invest in their farms and improve their yields. Additionally, the lack of transparency in the agriculture supply chain can make it difficult for lenders to assess the creditworthiness of farmers and agribusinesses.

MATERIAL AND METHOD

Decentralised Identities (Dib O. & Toumi K., 2020) are self-sovereign digital identities, meaning they are owned and controlled by the individual rather than a third-party institution, such as a government or bank. Decentralised Identities (Jeaca *et al*, 2022) can benefit the agriculture industry by providing a secure and transparent way for farmers and agribusinesses to manage their digital identities, transactions, and data.

By using Decentralised Identities, farmers and agribusinesses can have greater control over their personal information and data, which can help to protect against data breaches and fraud. Additionally, Decentralised Identities can help to establish trust and transparency in the agriculture supply chain by providing a verifiable record of transactions and data. This can lead to more efficient market transactions and a more equitable distribution of resources.

Furthermore, Decentralised Identities can help to increase access to financing and resources for farmers and agribusinesses. By establishing a secure and transparent record of transactions and data, lenders and investors can more easily assess the creditworthiness of farmers and agribusinesses, which can help to reduce transaction costs and increase access to financing.

Overall, Decentralised Identities have the potential to transform the agriculture industry by providing a secure and transparent way for farmers and agribusinesses to manage their digital identities and data. This can lead to more efficient and equitable market transactions, increased access to financing, and greater transparency and trust in the agriculture supply chain.

Blockchain technology (Xiong H. *et al*, 2020) has the potential to transform supply chain management in agriculture by providing greater transparency, reducing fraud, and enabling better tracking of products from farm to consumer.

Blockchain technology can be utilised in various ways to enhance the management of the supply chain in agriculture.

The property of immutable records through the use of blockchain technology creates an unchangeable and secure record of transactions. This helps to prevent fraudulent activities and enables all participants in the supply chain to access and share the same information.

Furthermore, the use of blockchain technology can also increase transparency and trust in the supply chain by providing all parties with complete visibility of the chain from farm to consumer. Blockchain technology provides increased transparency in the supply chain, which enables efficient and better tracking and traceability of products at every stage. This leads to greater efficiency and reduced risk of errors in the supply chain. Additionally, blockchain can be used to create a verifiable record of product origin, allowing for more efficient recall procedures in the event of a product safety issue.

In addition, using blockchain technology to track products at each stage of the supply chain enables better quality control, ensuring that products comply with required standards and enhancing their overall quality.

Through the use of blockchain technology to track products, food waste can be minimised by ensuring timely delivery to consumers and minimising the risk of spoilage. Also, the use of blockchain enables real-time updates, which provides all parties with access to the latest information.

Tracking products with blockchain technology can lead to improved logistics, resulting in reduced transportation and storage costs. Also, by using it, it is possible to reduce the time and cost associated with manual record-keeping and data entry.

Increased trust can be achieved through the use of blockchain technology by creating a more transparent and reliable supply chain. This can help to boost consumer confidence and ultimately increase demand for agricultural products.

RESULTS AND DISCUSSIONS

Overall, blockchain technology has the potential to revolutionise supply chain management in agriculture by increasing transparency, reducing fraud, and enabling better tracking of products. Farmers, processors, distributors, and consumers can benefit from a more efficient and trustworthy supply chain by using blockchain.

Examples of how blockchain has been implemented in agriculture:

AgUnity

AgUnity (AgUnity) is a dApp that uses blockchain and Decentralised Identities to provide small-scale farmers in developing countries with secure and transparent access to market information and financing. Through the AgUnity platform, farmers can register their Digital Identities and access various services, such as price information, financing options, and insurance. This can help increase market transaction efficiency and reduce transaction costs for farmers.

Provenance

Provenance (Provenance) is a blockchain-based platform that provides supply chain transparency and traceability for agricultural products. Using Decentralised Identities and smart contracts, Provenance enables farmers and agribusinesses to create a verifiable record of their transactions and data, which can help to establish trust and transparency in the supply chain. This can lead to more efficient market transactions, reduced food waste, and increased consumer trust.

TE-FOOD

TE-FOOD (TE-FOOD) is a blockchain-based platform using Decentralised Identities and smart contracts to provide food traceability and supply chain management solutions. Using TE-FOOD, farmers and agribusinesses can create a verifiable record of their products, which can help to establish trust and transparency in the supply chain. This can help to reduce food fraud and increase consumer trust in the safety and quality of agricultural products.

Farmer Connect

Farmer Connect (Farmer Connect) is a blockchain-based platform that uses Decentralised Identities and smart contracts to provide supply chain transparency and traceability for coffee farmers. By using the Farmer Connect platform, coffee farmers can create a verifiable record of their products and transactions, which can help to establish trust and transparency in the supply chain. This can help to increase market efficiency, reduce transaction costs, and improve the livelihoods of coffee farmers.

Qloud

Qloud (Qloud) is a storage and communication system with enhanced confidentiality, access control, and integrity capabilities developed on top of OpenDSU open-source software that brings data privacy and blockchain to another level (Morogan M.D.C. *et al*, 2022). Qloud can be used to store any type of data in full control of the owner. Furthermore, because some farmers or agriculture organisations may be reluctant to share their information with others, this type of application can help the adoption of new technologies and new ways of communication.

Decentralised Identities, blockchain technology, dApps, and smart contracts have started to be implemented in agriculture to provide secure and transparent access to market information, financing, and supply chain management solutions. By using these technologies, farmers and agribusinesses (from small to large) can establish

trust and transparency in the supply chain, increase market efficiency, reduce transaction costs, and improve their livelihoods. Moreover, by using the Self-Souverane Applications (SSApps) (Alboaie S. *et al*, 2020) and other OpenDSU technologies, they can fully control their data and how it is used in a fully cooperative environment.

Decentralised identities and blockchain have the potential to bring significant benefits to the agriculture industry, as seen above. However, the implementation of Decentralised Identities and blockchain in agriculture also presents several challenges. These challenges include the need for significant investment in new technology and infrastructure, the complexity of integrating blockchain into existing systems, the need for training and education for all stakeholders, the potential for interoperability issues between different systems, the difficulty of ensuring data privacy and security, and the risk of technological obsolescence as new systems and technologies are developed. In addition, there may be regulatory and legal hurdles that must be addressed, as well as issues related to governance and ownership of data.

Despite these challenges, the benefits of Decentralised Identities and blockchain technology in agriculture make it an area of great potential for innovation and growth. Data transparency and traceability through technologies like blockchain are important for socially and environmentally conscious decision-making and to facilitate trust among stakeholders (Abdulai A.R. *et al*, 2021). By working collaboratively with stakeholders across the supply chain, farmers, processors, distributors, and consumers can all benefit from a more efficient, transparent, and trustworthy supply chain that supports sustainable agriculture practices, protects food safety, and improves the livelihoods of farmers and rural communities.

CONCLUSIONS

In conclusion, Decentralised Identities and blockchain technology have the potential to revolutionise the agriculture industry by bringing greater transparency, efficiency, and trust to the supply chain. While there are challenges to overcome, the benefits of this technology make it a promising area for innovation and growth. By leveraging Decentralised Identities and blockchain, farmers, processors, distributors, and consumers can work together to create a more sustainable, secure, and equitable food system for all at this moment and in the future.

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