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ABSTRACT BOOK

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40814- Blockchain Implementations in Precision Agriculture

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Introduction

Today, to increase the productivity of the agricultural sector and improve sustainability conditions, precision agriculture is suggested. A management strategy that helps farmers use production inputs including seeds, fertilizers, pesticides, irrigation water, and tillage more effectively to achieve greater crop yield while considering environmental issues [1]. This technology can be used in all sub-sectors of agriculture to improve the global economy. According to statistical reports, precision farming will grow by 14% in the coming years, and its market growth will reach from 7 billion dollars in 2022 to about 13 billion dollars by 2025 [2].

To improve the performance of the agricultural sector, precision agriculture relies on smart sensors, mobile apps, artificial intelligence, cloud computing, drones, and Internet of Things (IoT) technologies. Considering these technologies, it is possible to process and access real-time agricultural information such as crops, environmental conditions, soil, water, and weather, as well as food safety in the supply chain [3].

Despite the advantages of precision agriculture, this technology faces some challenges (Table 1).

Table 1. Some challenges around precision agriculture

Cases	*Challenges*
artificial intelligence projects	managing data on a large scale [4].
drones and sensors	converting diverse, inconsistent, and unstructured data into identified and classified data with high accuracy and speed [5].
small-scale farm	connecting and analysing data from multiple farms [6].
IoT technology	security challenges due to the lack of computing capacity, performance challenges due to the huge number of connected IoT devices, and the inability to process big data [4].

Therefore, in order to manage many services in precision agriculture, there is a need for decision support systems, data analysis, and mining [7]. Hence, there is an important need for complementary technology to meet the challenges ahead along with precision agriculture. Blockchain technology seems to be promising for overcoming these challenges [4]. An advanced technology that can be supported by several applications in precision agriculture; for instance, smart agriculture, food supply chain monitoring and tracking, financial management, and data security [8]. Based on a market intelligence report by BIS research, the role of blockchain technology in precision agriculture and the food supply chain will be significant (from about 42 million dollars in 2018 to about 1.5 billion dollars in 2028 [9].

Objectives

This study assesses the challenges surrounding precision agriculture, and specifically highlights the role of blockchain technology in overcoming these challenges by focusing empirical studies on this issue.

Materials and methods

A narrative review method to analysis the literature is implied according to Green, Johnson [10]'s approach. We conduct a search of the literature within the common electronic databases Science Direct, Web of Science, and Scopus. The search strategy uses two main concepts of blockchain technology and precision agriculture keywords.

Results

We investigated the role of blockchain technology in overcoming the challenges facing precision agriculture in four areas:

1. Farm supervision and optimizing inputs: Setting up a smart farm based on a precision agriculture framework requires sensors for temperature, humidity, light, and crop maturity detection. Based on the obtained digital data, blockchain technology can facilitate the monitoring process for farmers and stakeholders by providing rapid and smooth communication [11]. Patil, Tama [12] in a proposed framework for blockchain-based smart greenhouse farming pointed out that farm monitoring can prevent crop losses after harvest with crop storage monitoring technique. This framework secures communication in smart greenhouse farming by creating a connection between humidity, light, water level and CO2 sensors [12].

2. Food supply chain process monitoring and management: Blockchain ledger can play an important role in the transparency of monitoring processes in the food supply chain while using precision agriculture. This technology can increase the trust of consumers and stakeholders in the food producing and also reduces fraud in the food sector by ensuring food safety [13]. For instance, in a study, Li and Wang [14] constructed a traceability system model based on the blockchain technologies. They mentioned that during the supply chain process, blockchain technology can record data between supply chain nodes; track purchases, orders, shipments, all shipping processes and transactions; verify the transactions; link between food products and barcodes, serial codes, digital tags like radio-frequency identification (RFID); and then, share the information on the methods of production, delivery and maintenance of the product with suppliers and sellers [14].

3. Determining, recording and sharing legal issues related to land: Another feature of blockchain is its use in determining, recording and sharing legal transactions which are related to agricultural land [15]. Because the traditional registry systems have many limitations, including the inability to fully authenticate the traded lands of individuals and organizations. As Luckas [16]'s findings showed, blockchain technology can confirm the authenticity of relevant transaction records by using a decentralized public ledger. This technology analysis the information received from global positioning system (GPS) coordinates and shares it with the relevant people with confidentiality if needed [16].

4. Improving the efficiency of payments or remittances: Farmers may need a public payment system to receive real-time remittances during their agricultural activities. With compatible blockchain systems and mobile blockchain application for smart contracts, farmers will be able to receive or execute real-time payments for crops or agricultural services without involving any third-party intermediaries. Xiong, Zhang [17] presented a prototype of mobile edge computing enabled blockchain systems with experimental results to justify the proposed concept. They highlighted that in this prototype, the role of blockchain is to create fast, transparent and secure real-time transactions [17].

Discussion and conclusions

Today, precision agriculture is proposed as a management strategy to improve the productivity of the agricultural sector as well as sustainability conditions. To this aim, precision agriculture relies on smart technologies. However, the applied technologies face challenges including the need for decision support systems, data analysis and data mining. Blockchain can overcome the challenges facing precision agriculture such as, farm supervision and optimizing inputs, food supply chain monitoring and tracking, financial management and data security, and improving the efficiency of payments or remittances. This technology with decentralized shared database mechanism creates trust at any given point in the chain, leading to more effective data management and control. Therefore, the capability of this emerging technology, especially its effective application in precision agriculture, can be an attractive topic for the scientific research. Although the intersection of blockchain technology in precision agriculture should be carried out step by step, considering the issues such as energy consumption, scalability, investment costs, and the complexity of its application in the food supply chain as blockchain technology challenges in agri-food.

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