**EDUZONE: International Peer Reviewed/Refereed Multidisciplinary Journal (EIPRMJ), ISSN: 2319-5045**
**Volume 12, Issue 1, January-June, 2023, Available online at:** www.eduzonejournal.com

# A Study on Different Aspects of Blockchain & Internet of Things

**Jyotiraditya Singh**

Punjab Technical Institute, India

## ABSTRACT

**AI techniques can enable farmers to make data-driven decisions and act in a more efficient manner. AI can be used to automate and optimize tasks such as plant identification and soil analysis. These technologies can also be used to optimise crop production, reduce waste and manage resources. Blockchain technology can help farmers with supply chain management, allowing for more transparency and traceability of products. Furthermore, blockchain technology can be used for smart contracts for automated payments and other transactions. With the implementation of these innovative technologies, smart agriculture can become more sustainable and efficient.This paper further elaborates on the potential application of these technologies in agriculture, providing a bigger picture of where and how they can be used. Finally, it highlights the key areas in which CSA, AI, and blockchain-enabled solutions can help to address some of the challenges and opportunities facing agriculture, ultimately driving more sustainable, efficient, and profitable farming.**

**Keywords: Blockchain, IOT, Agriculture, Supply Chain Management**

## INTRODUCTION

Climate change is causing more frequent and severe unpredictable weather events, such as drought, floods, and heatwaves, that can significantly disrupt farming operations. As the climate continues to warm and more extreme weather events become commonplace, farmers are left exposed to greater risk and uncertainty [1]. Farmers must now plan and manage their operations with an expectation of irregular weather patterns and unpredictable losses. A hotter atmosphere holds more moisture and can cause extreme precipitation events like floods or intense downpours that can wash away crops, drown livestock, and cause soil erosion [2]. Excessive heat can have a direct impact on crop yields and reduce soil fertility, damaging the health and productivity of the land [3]. In regions that rely on a single crop for their livelihood, climate change can cause a great deal of stress and hardship [4].

Climate change has caused increasingly unpredictable weather patterns, leading to a greater risk of crop damage. Unpredictable weather such as drought, flooding, and extreme heat can lead to reduced crop yields, soil erosion, and increased pests and disease [5]. Changing temperatures can also increase the frequency and intensity of extreme events, such as floods, which can wash away crops, drown livestock, and cause soil erosion [6]. In addition, extreme heat can dry out soils and damage the health and productivity of crops and lands. Moreover, changes in precipitation patterns can result in a decrease in soil moisture, leading to possible crop failure [7]. Farmers must therefore plan and manage their operations with an expectation of irregular weather and potential losses from climate change [8].

Long-term sustainable land and water management practices can help farmers monitor and predict weather patterns, and adjust their agricultural practices to prevent crop damage, conserve resources, and maintain high yields [9]. For example, sustainable irrigation methods for crops and effective rainwater harvesting can help maintain soil moisture levels. Other strategies such as crop diversification, rotation, and winter cover crops can help reduce the risk of crop failure due to extreme weather, pests and disease [10]. In addition, using bio-control products, chemical agents and breeding practices can help reduce and eliminate pests and disease that can damage crops. By implementing these practices, farmers can minimize climate risks and maximize yields [11].

Optimization of sustainable agricultural processes is important because it ensures that farms are able to produce healthy and safe food while reducing their environmental impacts [12]. Sustainable agricultural practices focus on improving economic, social, and environmental outcomes. This means that they require careful management of land, water, and other resources, as well as the selection of appropriate crop cultivars to maximize yields and minimize climate risks [13]. Optimizing these processes helps farmers make the best use of resources and increase yields, while aiming to reduce environmental damage from farming [14]. It also helps them to develop systems that are resilient to changing conditions and are better able to absorb and adapt to climate change. Ultimately, optimization of sustainable processes benefits the environment, farmers, and consumers alike [15].

CSA technology has become increasingly important in the context of sustainable agricultural practices. CSA implements practices such as reducing soil erosion, increasing water retention, and optimizing the fertility of soils [16]. By reducing soil erosion, less nutrients and sediment enter downstream water bodies. By increasing water retention, both water stress and runoff can be significantly reduced [17]. Using improved soil fertility, soil health and crops yields can be increased in an climate-resilient manner. CSA technologies also provide better yields and cost savings for the farmers, which can ultimately lead to an increase in their profits [18].

Researchers are looking to innovate practices within the agricultural supply chain. CSA technology allows them to do this in an environmentally responsible, efficient and cost-effective manner [19]. As the technology develops, its applications are beginning to extend to other areas like food safety, water pollution prevention, and air pollution prevention [20]. CSA technology provides a mechanism for solving the challenge of sustainable food supply, by improving the efficiency and magnitude of the production of food [21].

IoT sensors allow ranchers to monitor temperature, humidity, soil moisture, and other environmental data, which can then be used to efficiently manage and conserve resources such as water, land, and energy [22]. Smart irrigation systems help control the amount of water dispersed and monitor the usage, helping farmers conserve resources, reduce water usage and increase crop yield [23]. Additionally, use of AI and big-data analytics assists ranchers in identifying areas in their production processes that need improvement in order to maximize yield and quality. Farmers can also use machine learning solutions to predict the harvest quantity depending upon a variety of factors, such as weather, soil type, and water availability [24]. In this way, ranchers are able to improve their crop yield and overall productivity in an efficient and cost-effective manner [25].

Finally, blockchain technology can also be used to improve the agricultural supply chain. By using blockchain, farmers, suppliers, brokers, and retailers can securely, accurately and transparently track data from farm to store, monitoring the entire supply-chain process [26]. This can provide an efficient transaction system for smoother tracking, sharing, and validation of transactions, as well as improving transparency, trust and traceability. Blockchain technology also helps reduce manual data-entry, eliminating manual processes and keeping records for further analysis and research [27]. In this way, blockchain technology contributes to a sustainable agricultural supply chain that is secure and efficient [28].

It permits farmers to interact with the environment and receive data about it in a real-time collection [29]. This data is then used to optimize and control the environment to ensure the best possible outcome for their crops. IoT also assists farmers in monitoring soil conditions and temperature, as well as monitoring irrigation systems [30]. Through its ability to provide actionable insights, IoT helps improve decision-making processes and increases the productivity of the crops [31].Also, drones can be used to surveil large areas of crops, allowing farmers to track pests and disease, monitor water stress, and apply precision agriculture adjustments, ultimately leading to an increase in yields [32,33]. By utilizing sensors in drones, farmers can effectively monitor weather, soil moisture, and other environmental parameters from a bird's-eye view [34]. All of these advancements in data collection and analytics provide better decision making abilities for farmers and the implementation of more efficient farming practices [35].

## OBJECTIVES OF THIS RESEARCH

It is planned to use this integration to create a central platform for collecting, analyzing, and deploying agricultural information [36]. The main aim is to reduce the various computing and data transmission capacity cost, reduce the costs of labour, improve crop performance, and develop the overall agricultural sector. By utilizing the abovementioned technologies, the proposed platform aims to generate comprehensive insights, increase the efficiency of agricultural operations, and provide a competitive edge [37]. The proposed platform also offers a competitive advantage to both farmers and organizations that depend upon crop outputs. Furthermore, through the use of blockchain, each transaction is logged on a distributed ledger, which creates a trusted record and an immutable audit trail. This ensures that all transactions stay secure and verifiable [38]. The platform also provides data security and privacy, as the shared resources are encrypted and stored on the blockchain. Overall, this paper suggests that the combination of these advanced technologies have the potential to reduce costs, improve farming efficiency and performance, and enable a secure and trusted environment for agricultural operations [39].It identifies the advantages of using these technologies and how they can be utilized in creating a unified platform for agricultural information gathering, analysis, and deployment. Additionally, it discusses how the combination of these three technologies could provide improved cost reduction, labour efficiency, and security. Finally, it outlines the planned objectives for the development of a smart CSA platform and how it could be integrated with other agriculture-related technologies in the future [40].

**IOT**
It integrates physical or non-physical devices with the surrounding environment. It assists to connect devices, make it wireless, and enable communication among them, with the Internet for efficient data exchange. This determines the accuracy and timeliness of the data collected. IoT-based CSA platforms increase the efficiency and accuracy of collecting, scheduling, transferring, and processing data in an agricultural environment [41].

The use of Artificial Intelligence (AI) in CSA brings automation and intelligence in the process of collecting agricultural data. AI can synthesize the data collected from various sources into logical conclusions and insights which could potentially assist with decision making and strategies. This can help farmers to efficiently collect and organize data, create predictive models, automate certain CSA tasks and processes, and introducing new strategies to optimize production and resources [42].

Finally, blockchain technology is considered to be ideal for smart contracts and digital trust in CSA applications. It helps enable secure and transparent data sharing between stakeholders for exchanging data regarding the supply chain, digital management, online payments, and assets there by providing traceability and real-time tracking. With increased security, integrity and accuracy of data, smart contracts can assist to ensure good quality of agronomic production [43].The combination of these three technologies in CSA can play a vital role in providing a unified platform for agricultural information gathering, analysis, and deployment. It could potentially offer numerous benefits such as increased cost reduction, labour efficiency, security, accuracy and integrity of the data collected, increased efficiency and speed in decision-making processes, and asset tracking [44].

The objectives of developing a unified platform using these technologies are to collect and process data with high accuracy and integrity, improve access to agricultural information and resources, optimize operational and production processes, increase security and reduce operational costs. The platform should also be easy to integrate and scale in order to be adopted by existing agricultural systems. Lastly, the platform should include features that integrate with other agricultural technologies such as sensors, drones and smart farming products [45].

**IOT Needs in Agriculture**
1. High Availability: Protocols must be dependable and enable reliable communication even under difficult environmental conditions often associated with agricultural settings, such as extreme climate and high levels of dust and moisture.

2. Flexibility: Protocols must be able to accommodate the varied needs of different agricultural applications, from large-scale mechanized farms to small-scale organic farms.

3. Seamless Connectivity: Network protocols should be optimized for low-power, low-latency communication, as agriculture often involves distributed IoT devices that are located in different parts of a field.

4. Field Sensor Suitability: Protocols must enable the connection of different types of field sensors, such as pressure, temperature, soil moisture, and air quality sensors.

5. Large Data Management: Protocols should enable the efficient management of large volumes of data collected from different sensors over the network.

6. Machine Learning Capability: Protocols must support machine learning capabilities that enable the automatic analysis of collected data to help inform decision making.

7. Alerts and Notifications: Protocols must provide easy mechanisms for alerting users and stakeholders when important conditions such as temperature, humidity or water level thresholds are reached [46].

IoT (Internet of Things) communication protocols are a set of communications protocols and standards for the interconnection of physical objects and the systems used to control them. These protocols are used to provide an efficient and secure communication medium between various devices connected in an IoT system. Examples of these communication protocols include Wi-Fi, Bluetooth, Zigbee, EnOcean, and Thread. These protocols can be used to establish communication between different devices, transfer data between devices, and enable control of different connected devices [47].

**Types of Technologies in IOT**
1. Edge Computing: It is relying on a centralized server. Edge computing can be used to quickly and securely process and analyze data from an IoT system.

2. Fog Computing: A form of computing where data processing is performed closer to the source, such as at an edge device or gateway. This allows for quicker responses to events and more efficient data processing.

3. Cloud Computing: It allows for data and applications to be stored and accessed from the cloud, enabling quick access to data regardless of the user's physical location.

4. Embedded Solutions: Embedded solutions are computer systems that are designed to fit inside a device, such as a small chip. These solutions can be used to create specialized pieces of hardware that are used within an IoT system.

**Blockchain**

Blockchain is a type of distributed ledger technology that stores transactional data across a network of computers. It is a secure, tamper-proof way of keeping track of transactions and asset ownership. Each block is linked to the previous one and contains a cryptographic hash of the data contained in the previous block, making it virtually impossible for malicious actors to alter past records [48]. Additionally, as the data is stored across multiple computers, it is not vulnerable to the risks associated with a single point of failure. This makes blockchain a secure, reliable, and extremely transparent way of storing data [49].The first instance of blockchain was first introduced in 2008 as a part of the Bitcoin blockchain. Since then, developers have created many other implementations of blockchain technology. These new blockchains have been used for a variety of applications, from smart contracts and cryptocurrency to land registries and supply chain tracking [50]. As the technology continues to evolve, the potential for its practical use cases is immense. Blockchain has the potential to revolutionize the way organizations and individuals manage data and secure transactions.

The concept of blockchain in agriculture has been gaining traction in recent years. Blockchain technology can provide farmers with greater transparency into the state of the agriculture sector and the accuracy of their produce; in the U. S. , for instance, blockchain can be used to monitor the safety of agricultural products, create a record of transactions, and track pedigree and origin of food products. It can also enable more efficient traceability, prove authenticity and reduce fraud. Additionally, as blockchain technology is decentralized, it gives farmers more control over their data and ensures that their work is secure and immutable. In short, blockchain could help guarantee the integrity of the food system, increase yields and reduce food waste [51].

## CONCLUSION

This application of IoT technology allows more efficient tracking of crop health, soil nourishment and water usage, predicting climate change and providing information that could help farmers to make better decisions. Additionally, the application of blockchain technology on IoT devices can secure the accuracy and privacy of the information collected and stored. This way, farmers have secure access to the data used to analyze their crop yields. Finally, blockchain-based smart contracts can be used to create a digital chain of custody for food, providing crucial step for supporting the efforts of maintaining a safe food supply.

This can provide farmers with accurate insights into their fields and help them optimize inputs and tailor crop selection. ML can also be used to classify soils and predict disease development, which can help improve yields and quality. In summary, IoT and ML technologies can help drive efficiency in agricultural processes by providing farmers with accurate insights into their soil, climate, and crops. In addition, blockchain technology can be used to ensure privacy and accuracy of data, and facilitate digital chains of custody for food to ensure safety.

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