BLOCKCHAIN TECHNOLOGY FOR SMART AGRICULTURE APPLICATIONS

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ABSTRACT

In agriculture, where the gathering of such information is once in a while highly-priced, blockchain is a reliable source of fact approximately the nation of farms; It employs contracts. food may be tracked the usage of blockchain technology, which allows in building truthful meals deliver chains and building accept as true with between producers and clients. It permits adoption of statistics-driven generation to make farming extra efficient as it's miles a dependable approach of storing statistics. furthermore, whilst used along with smart contracts, it permits well timed payments among stakeholders which can be triggered by records changes in the blockchain. For both theoretical and practical views, this article investigates the applications of blockchain technology in food supply chains, smart farming, agricultural insuranceand agricultural product transactions. We also go over the difficulties of tracking smallholder farmer transactions and developing an ecosystem for using blockchain technology in the agricultural and food sector.

KEYWORDS: *Sensor Network, Agriculture, IoT, Block Chain, Food Chain Supply.*

I. INTRODUCTION

For the agriculture sector to enhance production and sustainability, it's far essential to leverage information and records. In agriculture, statistics and communication technology (ICT) drastically improves the effectiveness and performance of statistics collection, garage, evaluation, and use [1,4]. It permits agricultural practitioners and farming communities to fast get modern statistics and make higher judgments of their regular farming operations. Remotely sensed facts on soil situations, for example, can assist farmers manipulate their vegetation; cellular telephones lessen information fees, facilitating farmers' get entry to to markets and financial support; and the development of the global Positioning system allows discipline mapping, equipment steering, and crop scouting [2,3].
In precision farming, the Internet of Things and blockchain will transform us from having merely smart farms to having an internet of smart farms, giving us more control over supply-chain networks. As a result of this combination, precision agriculture will be managed with more autonomy and intelligence in a more efficient and optimum manner [4,6].

II. INFORMATION AND COMMUNICATION TECHNOLOGY TO BLOCKCHAIN

In the collecting and utilisation of data, ICT does not eliminate bias. Individuals that utilise ICT are always motivated to use data in a way that benefits them. Making data tampering difficult, if not impossible, by dispersing data management power to a large number of people is an effective strategy to eliminate bias[7].

A blockchain is a distributed ledger record in which agents record information about the operation of creating, transacting, and consuming a product or service by taking turns recording it. All parties involved administer the ledger cooperatively, usually through a P-to-P network. Before a new record can be added

to the blockchain, it must be confirmed by the network[7,8]. Any changes to the recorded data should be made using a consensus decision-making mechanism, which requires that the majority of the users involved agree. Furthermore, any change to one record will affect all subsequent records in the chain. As a result, changing data recorded in a blockchain is nearly impossible in practise. Blockchain is defined as an open, distributed ledger that can effectively and permanently record transactions between two users. Blockchain is a game hanging technology that has the potential to change the way data is used in agricultureand many more. [9,10].

III. BLOCKCHAIN TECHNOLOGY USES FOR AGRICULTURE

Blockchain technology allows p-to-p transactions to take place in a obvious manner, eliminating the want for an middleman together with a bank or a middleman inside the agricultural zone. through disposing of the requirement for a central authority, the era shifts the manner confidence is hooked up, putting it in cryptography and peer-to-peer architecture instead of an authority. As a end result, it aids within the recovery of self-belief between producers and clients, lowering transaction expenses inside the agri-food region [11,12].

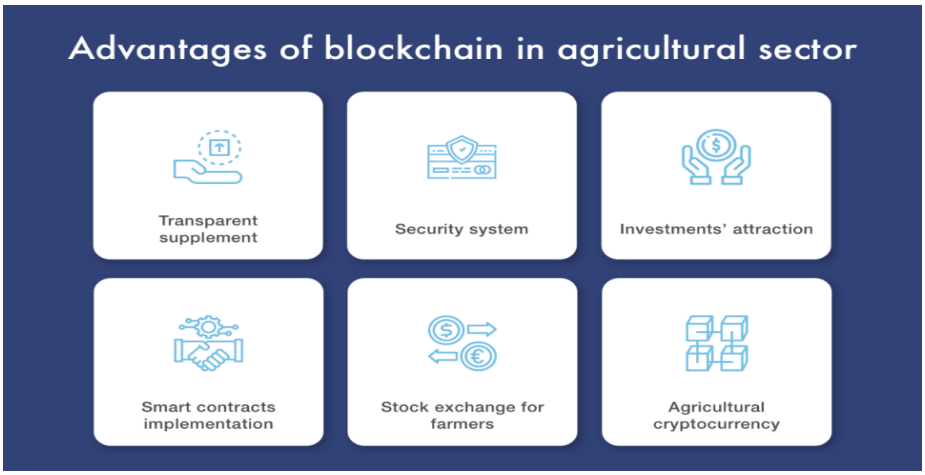

Figure 1: Showing the Advantages of Blockchain in Agriculture Sector.
(Source:https://www.techiexpert.com/wp-content/uploads/2019/07/Blockchain-in-Agriculture-2.png)

The blockchain presents a best and secured way for transactions between nameless events. As end result, fraud and faults transition can be recognized right away. furthermore, clever contracts may be used to record troubles in actual time. due to the complexity of the agri-meals gadget, this facilitates to deal with the trouble of tracking merchandise across a large deliver chain. As a end result, the generation addresses concerns of meals quality and safety, which can be of high importance to governments, customers, and others [12].

The blockchain generation permits the collection of correct facts and offers transparency to all events worried. From the point of introduction to the factor of loss of life, blockchain can track each level of a product's price chain. For creating facts-pushed facilities and coverage solutions to make farming smarter and less inclined, sincere facts from the agricultural system is highly useful [13].

IV. APPLICATIONS

There are many types of agricultural and food applications here we are focused on some important and useful to our Indian society farmers.

4.1Agribusiness Insurance

Extreme weather threatens agricultural productivity, jeopardising food security. Environmental change is projected to worsen weather extremes in the future, affecting both agricultural and livestock output.

Agricultural insurance schemes have long been regarded as a useful instrument for managing weather-related hazards [13]. Farmers pay coverage insurance payment earlier than the cropping period starts, and that they acquire coverage insurance repayment if their farm suffers a loss. As an end result, the insurer assumes complete obligation for the insured risk, and farmers are better prepared to govern their economic publicity to weather extremes, i.e., monetary losses attributable to weather extremes. in addition, within the event of climate risks that impact all of the included farmers in a systemic manner, the insurer can use a reinsurance firm to similarly hedge the systemic aspect of the chance [14].

In terms of the way losses are assessed and, as a end result, how pay-outs are caused, agricultural insurances vary. Insurances that reimburse farmers based on a damage assessment done via a farm expert are referred to as indemnity-primarily based insurances. while indemnity-primarily based insurances are capable of as it should be covering losses, they're liable to asymmetric information problems. more precise, facts at the riskiness of agricultural output and practises is transmitted asymmetrically among farmers and insurers. Farmers are expected to have a higher knowledge of both destructive choice and moral threat. Farmers having a bigger ex ante hazard exposure are much more likely to acquire coverage insurance than farmers with a decrease risk, in line with unfavourable choice. When farmers are insured, they are more likely to engage in riskier agricultural techniques[14,15]. This is known as moral hazard. If the insurer has insufficient knowledge on the two situations, these events result in market failure of the insurance system. As a result, indemnity-based insurances are prone to expensive damage assessment and must adopt mechanisms to minimise asymmetric knowledge concerns, such as deductibles. Furthermore, products that cannot be quantified, such as grazed meadows, are not covered, despite the fact that they cause financial loss[16].

In short, insurances are becoming very important for risk management tool for farmers, with the reduction of basis risk being of primary concern. In two ways, blockchain technology can help to improve index insurance.

- Payments may be issued on a timely and automatic basis depending on meteorological data that triggers a smart contract payout.
- Using a smart oracle, weather data and other data sources, such as plant growth data or data gathered by farm machinery, may be automatically merged, reducing basis risk and accelerating up the index calculation and payout process.

Smart contracts that employ smart oracles to integrate external data have previously proved effective in various crypto-economic applications[20].

4.2 Agriculture with Intelligence

The important statistics and records on the resources that preserve all forms of farming is on the coronary heart of the agri-food platforms. facts and information are generated and managed with the aid of many actors and stakeholders based on their necessities and talents. ICT, the internet of things (IoT), and numerous modern-day facts amassing and analysis technologies such as unmanned aerial cars, sensors, and machine learning are all utilized in smart agriculture [20,21]. The improvement of a comprehensive safety device that allows the utilization and management of data is a essential factor of building clever agriculture. conventional facts management methods are centralised and vulnerable to inaccuracies, facts distortion, and abuse, in addition to cyber-assaults. Environmental tracking statistics, for instance, is regularly managed by centralised authorities bodies with vested hobbies. they have got the capability to steer records-pushed choice-making [21,22].

The blockchain era is used to keep facts and records generated by using many actors and stakeholders throughout the total cost-brought process of making an agricultural product, from seed to sale. It guarantees that all recorded facts is unchangeable and that the facts and facts are transparent to all relevant actors and stakeholders [22, 23]. conventional technology depend upon "safety of obscurity," while blockchain technology gives security via decentralisation. records loss and distortion are much less in all

likelihood whilst facts is distributed to stakeholders' pcs rather being stored on centrally maintained servers. A blockchain is a database that shops timestamped batches of product transactions and pastime. facts saved on centrally controlled servers is greater susceptible to loss and distortion than facts allotted to internet-based servers. The database is extremely beneficial for creating records-driven cellular packages that resource in agricultural optimization. moreover, the blockchain tackles the problem of developing a complete IoT infrastructure and integrating a spread of technology utilised in ICT e-agriculture [24].

Many businesses are operating on blockchain applications for smart agriculture. Farm groups also are the use of blockchain to improve their farming practises. the general public's participation in irrigation management is evoked, and attempts to enhance water useful resource utilization are increased because of the transparency. The longitudinal database generated with blockchain can be used to guide decision-making in regions like irrigation canal development and renovation through the years [27].

Smart agriculture the usage of blockchain does no longer lower, if whatever, the technological barrier to entry for farmers. Importantly, massive farms are greater motivated to gather reliable statistics for uploading to the blockchain than smallholders. big farmers are more likely to participate in and profit from blockchain-based totally smart agriculture. As a end result, the disparity between big farmers and smallholders can be created or exacerbated [26, 28].

4.3 Supply Chain for Food

Food supply chains have grown longer and more complex than ever earlier than because of growing globalisation and fierce market contention. food deliver chain inefficiencies, which include meals traceability, meals safety and first-rate, food accept as true with, and supply chain inefficiency, all pose sizeable hazards to society, the economic system, and human fitness [28,29].

Through publicly exposing character product information at the blockchain, blockchain generation allows manufacturers develop a agree with relationship with clients and increase the popularity in their merchandise. corporations might also beautify their competitiveness via better attaining the value in their items. this would make it not possible for fraud and low-quality product providers to hold in commercial enterprise, and it'd drive all providers inside the agricultural and food industries to improve product first-rate [30]. From the point of view of purchasers, the blockchain provides accurate and sincere facts approximately how meals is produced and traded. It contributes to addressing client concerns approximately food protection, first-class, and environmental friendliness. because customers can recognise the meals production process extra easily and in greater element thanks to the usage of blockchain, they'll talk with farmers. It enables clients by way of lowering boundaries to the exchange of commodities so as to beautify their relationship and, as a end result, client believe and self-belief in meals safety. From the standpoint of regulatory our bodies, blockchain offers them with truthful and correct records that lets in them to make educated and green choices [30,32].

The cutting-edge country of blockchain era inside the food supply chain continues to be in its infancy. on the identical time, there are numerous immature and mistaken regions in the blockchain generation deployment system. furthermore, the implementation of blockchain technology in the meals supply chain necessitates large engagement and collaboration from all stakeholders worried, that is essential for it to play its full function. Blockchain generation lets in for the monitoring of food first-rate data throughout the supply chain due to the fact to its characteristics of transparency, safety, and decentralisation [31]. This aids inside the prevention of meals fraud and the reduction of meals supply chain control fees. As a end result, all events can income, inclusive of producers, customers, and government regulatory authorities.

4.4 Agricultural and E-Commerce

The e-commerce and agricultural product trade face having many problems that should be somehow addressed. Customers now a days prefer to buy online, because they have trust in that. So far fundamental statistics on agricultural products is difficult to verify and trust. Meanwhile, the most significant problems encountered by e-commerce firms, particularly in developing nations, are cash on delivery and logistics service. Furthermore, e-commerce businesses must deal with time consuming small orders including a variety of products, resulting in significant operational expenses [31, 32].

Many parts of these issues, for instance information security, may be addressed through blockchain technology. Private key encryption, which is one of the strongest tool to meet authentication needs, which provides through blockchain technology. It may therefore securely and irreversibly link data on all elements of agricultural product planting and harvesting [34, 35, 36]. Management of the supply chain. If signal cost is decreased for each party, then blockchain technology might make supply chain management extra efficient than present monitoring techniques. If we speak about payment methods The Methods blockchain offers us zero-rate payment option. It means, use of bitcoin in sale of agricultural products this will then cut the transaction costs. Consumer trust is the most important one [36, 37]. The disseminated accounting system of blockchain is a time- stamped but thanks to the decentralised system, that's make every single information on the chain, which is not only visible but also unmodifiable. Consumers is then free from frauds and so we can restore faith of consumers in e-commerce. The cost of Farmers' is now reduced. Households overall generate large number of agricultural products. Old or outdated system of e-commerce is unable to provide services for Farmers because of their low transaction volume and tiny scale, which slowly finish them from the market. Blockchain technology is the best option which has the potential to cut the transaction costs so that they can re-join themself into the market [38].

If we talk about the use of blockchain technology in the field of e-commerce and agricultural commodity trading they are still in its very early stages, that is why the current situation is far from the ideal of real. Just take an example, it is still a challenge to ensure the integrity of the data which is in uploading procedure into a blockchain remains still a challenge. The Internet of Things (IoT) might be a future answer. Furthermore, the distributed, non-tamperable, and traceable properties of blockchain should be investigated more broadly and thoroughly so that we can increase not only the productivity but also the efficiency of agricultural production and trading [39,40].

V. LIMITATIONS

The blockchain technology allows us for information traceability in the chain of food supply, that helps to improve food safety [41,42]. It also supports in the creation and execution of datadriven technologies for hi tech smart farming and index-based agriculture insurance through providing a safe means of managing and storing data. Besides, it has the potential of lower transaction costs, which will improve farmers access to the markets and it will provide them new revenue sources. In spite of its huge potential benefits, blockchain technology is having its significant limits in agriculture and food. [43, 44].

First, more study is to be needed into the motivations of the transacting parties to give accurate and real data to the blockchain ledger. It is mainly relevant in the case of small-scale farming. Individual farmers own and disseminate the knowledge created throughout the farming process. The benefits of blockchain technology may vary for farmers it is depending on the size of their farm. On the one Side, blockchain-based insurance market might be easily accessed by smaller farms [46]. Larger farms, on the other hand, may find it more use to, to gather and integrate onfarm data. As outcome, upcoming study should focus on predicting which farms would profit and which will not give any profit as a result of the implementation of blockchain-based solutions [46, 26].

Second, to get the data that is posted to a blockchain could be highly expensive, which might be a barrier to blockchain acceptance in the industry [47]. On the other hand, the setup of a distributed ledger may be not that much costly, but gathering data necessary to make the ledger effective, such as DNA from farm animals, may be highly expensive. It is right to say Sampling can save money, but it requires a large population of items to collect data on. This shows that the average cost to collect data is cheaper for bigger farms than for smaller farms, thus widening the income gap [48].

Third, blockchain we cannot link with older systems in a very smoother manner. The technology must be suitable with an existing database and legacy systems such as warehouse management, enterprise resource planning, and manufacturing execution systems in order to be effective [49]. It will take a long time in future to set up an extra infrastructure to leverage blockchain technology. Middleware and communication protocols that can bring two different systems together will be vital [50,51].

VI. CONCLUSION

Blockchain is a rapidly developing technology. Even while technology has started to transform several sectors, it still has a long way to go. However, it is becoming increasingly obvious that blockchain technology has applications in the agriculture business. The global agriculture sector is currently valued more than 2.4 trillion dollars and employs more than one billion people. There is more possibility for creativity now than ever before.

Blockchain has enormous potential to significantly impact the way agricultural business is done. Blockchain technology can increase trust between parties, facilitate information sharing throughout the supply chain and significantly reduce agricultural transaction costs. As the public and private sectors work toward addressing the practical and legal challenges facing the technology, blockchain seems poised to be the disruptive force that propels the agricultural industry into the 21st century

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