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Research Article

Design And Development of Customized Block Chain Application for Traceability of Farm Produces

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ABSTRACT

Blockchain technology is one of the most important technologies used in agricultural supply chain management. It is used in the farm-to-consumer traceability paradigm to establish a genuine and transparent supply chain for agricultural products. This paper presents an overview of the proposed model with flow diagrams, general concepts of application, and transaction technologies. This model allows customers to follow the journey from farm to store or home, knowing the authenticity of the products in the process. Hence, the outcomes highlight the benefits of the suggested approach. The use of blockchain in the agriculture and food sectors can help manage and reduce known risks while ensuring ecosystem affordability.

Keywords: traceability, transparency, tagging, blockchain, supply chain, cybersecurity

1. INTRODUCTION

Agriculture is a considerable contributor to GDP in any agrarian economy. India is the world's second-largest producer of agricultural goods, with $375.61 billion in production. India produces 7.39% of all farm output in the world. Agriculture makes a much more substantial contribution to the Indian economy than the global average (6.4%) as per statistics of Sector-wise GDP. Farmers in developing countries, such as India, struggle to receive a proper payoff from their crops due to a lack of technical knowledge, financial resources, and marketing skills. Because there is no direct communication medium between the two entities, namely farmers and consumers, a portion of their profit goes to intermediaries. Farmers do not receive what they are meant to because of massive human interference throughout each stage of supply chain management [1]. Also, today's consumers look for food safety and quality assurance regardless of price; they want the best based on the certified origin of products. Thus, intend to spend more money on food items. Transparency and traceability are the key factors to consider when devising a solution to eliminate them. In terms of information sharing and functionality, the present methodologies utilized in most traceability systems are centralized, implicit, and obsolete. Current solutions lack transparency and customer confidence since there is no quick and reliable way to obtain product authenticity information [2].

For the benefit of real users, it is necessary to employ technology to speed up processes and minimize the time spent on them. Blockchain is one of these technologies that could aid in integrating several non-trusting authorities on a single platform with general traceability and secure information [1]. This is especially helpful when several parties are participating in a transaction yet there is a lack of trust among them. All participants can have access to the same information by using blockchain technology to create a shared digital ledger, which can promote transparency and trust in the system. Participants in the supply chain can unleash new levels of efficiency and innovation while lowering costs and risks by utilizing the special capabilities of the blockchain.

In the current research paper we have identified, compiled, and presented currently used technologies in agriculture, research initiatives by government and companies, and a proposed platform adopting blockchain for traceability in agricultural supply chain management. The primary goal of this paper is to analyze the research projects that have

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been undertaken in recent years to gain an understanding of the issues with present agricultural technologies and to lay the groundwork for a solution.

2. LITERATURE REVIEW

Most small-scale producers receive only a small portion of the ultimate market value of their output. Farmers become extremely poor because of this. This exploits kids at the agricultural level through child labour enslavement and unsafe work conditions. Currently, the integrity of the food supply is frequently called into doubt because of occurrences such as adulteration, dilution, tampering, or counterfeiting. Food fraud causes damage, yet the source is difficult to identify due to the opacity of food supply networks. The concerns raised above highlight the difficulties in our agri-food supply chain. The challenge is to ensure traceability and transparency. There is a world trend of consumer demand for commodities e.g. (for organic food). The government aims to secure a food supply that is both safe and sustainable while also guaranteeing that the food supply serves as an economic as well as threat resilient resource or asset

India has seen significant food safety challenges due to non traceability in its agri-food supply chain, for example the case in 2017, when a top certification body discovered fake organic certifications, putting question on genuinity of organic labeling. In the same way, the fallout over the 2015 tomato contamination scandal, due to the use of dangerous pesticides, and the challenges associated with tracking produce from where it came further illustrates the necessity for a clear and transparent system.

Challenges in traceability:

1. The development of third-party certifications, however, diminishes openness in the certification market. This makes it difficult to evaluate the credibility of the certification.
2. These companies use these third-party certifications which challenges the consumer confidence in the third-party certification.
3. These certificates are expensive and may exclude small scale farmers from accessing the Market [3].

Due to all these challenges in the market the government need to set regulatory requirement in the market to ensure trust for the consumer. The regulations help the firm in formalizing the mechanism of the process and participating nationwide agri-food market [4].

In Malaysia, for example, the Malaysian Sustainable Palm Oil (MSPO) certification system supports smallholder growers and environmental conservation. Unlike the Roundtable on Sustainable Palm Oil (RSPO), a global certification process based on voluntary participation, the MSPO adapts RSPO lessons to local communities, enhancing its efficacy. The enforcement capacities of governments might aid in the acceleration of the use of traceability solutions in the supply chain [5].

Another challenge in traceability is that the current record of the agri-food supply chain largely done manually and paper based. There needs to be change in the concept and revised methods should be used instead. These large companies use ERP system to keep record of the data up to the date. But the problem is the opacity in the data due to the centralized mechanism the companies follow. This subject to risk of false and inaccurate repression of the records Figure 1 represents the traceabilty system product and information flow used right from production to consumption stage.

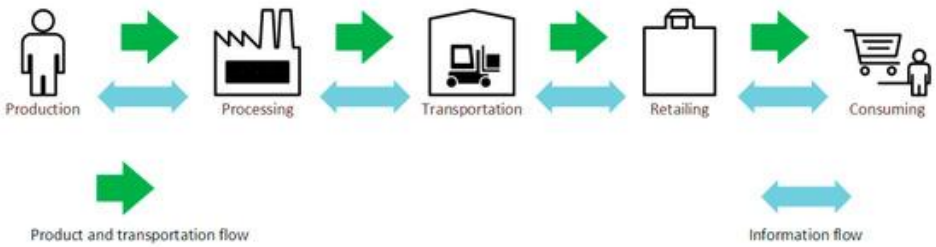

Figure 1: Traceability System Product and Information Flow

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3. METHODOLOGY

This paper presents a new application based on a traceability approach. To manage food traceability throughout the agricultural supply chain, blockchain technology and smart contracts are used. The conventional blockchain-based supply chain is enhanced by the adoption of this model. This model consists of 5 phases which includes production, manufacturing, distribution, payments and Government regulations. Figure 2 illustattes the various components used in tracebilty of farm products using blockchain technology.

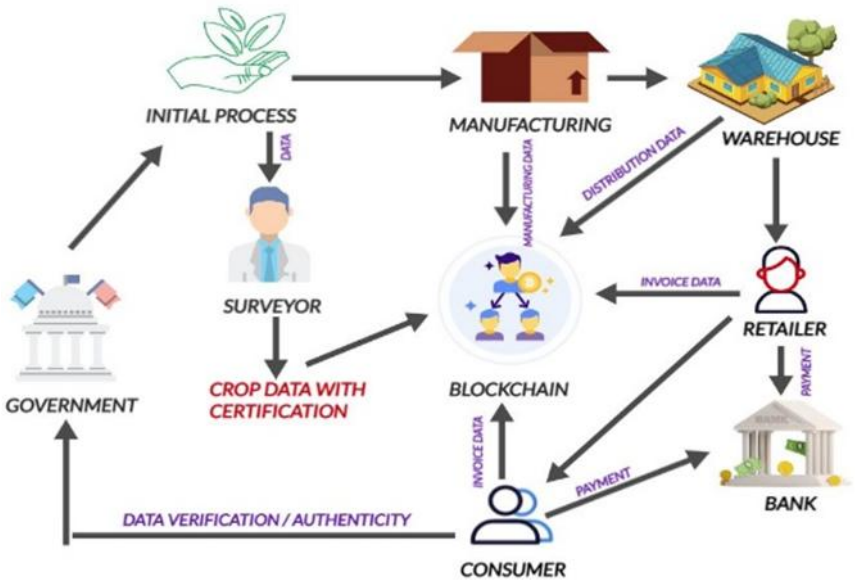

Figure 2: Components and its interlinkages used in farm products tracebilty using blockchain technology

The distribution phase is majorly carried out from the warehouse where all the goods are stored. Customers can buy the products through a retailer listed in the contacts or directly from the farmer. The goods may be tracked through the supply chain using the tag, allowing customers to confirm that the item they are buying is genuine and has not been tampered with. Here is a methodology for using blockchain technology to improve the agri-food supply chain through the steps of production, manufacturing, distribution, payment, and records in Government database for effective traecibility. Figure 3. Illustrates the initial processes used using various information like seed quality, environmental factors, demand supply and prices and harvest yield and data submission to surveyor.

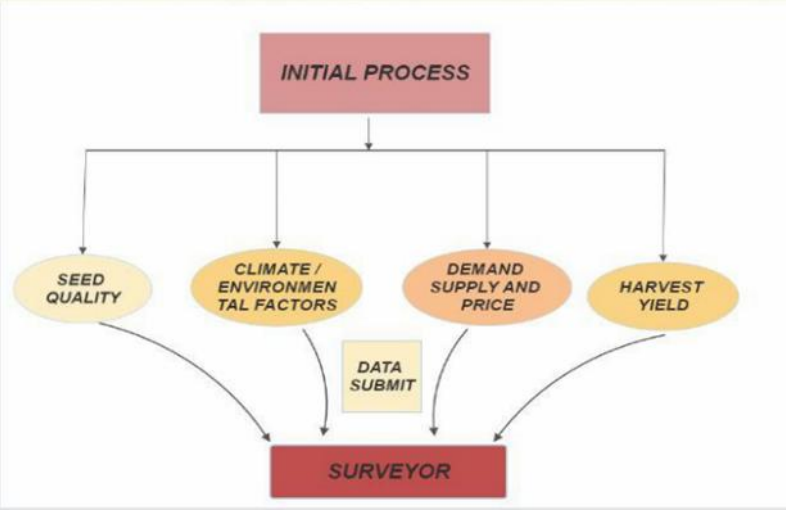

Figure 3: Initial Process of developed Blockchain Technology

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3.1. Phase 1: Production

3.1.1. Identify each participant in the production process, including farmers, suppliers, and processors.

3.1.2. The producing phase records the place, quality and quantity of the produce, including all agricultural activities in the farm. For certification, farmers need to charter out information on quality of seed and climate and demand for crops and prices and yield required for certifying to surveyors. Confirmed crop information is then written onto the blockchain according to the surveyor's findings.

3.1.3. Create a smart contract to record the details of the transaction between participants, including the terms and conditions of the agreement.

3.1.4. Deploy the smart contract on a blockchain for transparency and lasting storage of information.

3.2. Phase 2: Manufacturing

Detail every person involved in the production chain - processors, packers and shippers. This will allow you to gather information about how the product is made, along with information on the product itself, including ingredients, how it was made and the quality controls in place. Figure 4 represents the manufacturing process used in blackchain technology that uses Packing and Tagging emphasized in the Production step. After packaging, a special tag or label is added-incorporating blockchain as a technology containing information (such as the source, date of production and quality) that is attached onto the blockchain. Smart contracts can create decentralised processes that verify compliance with packaging and tagging standards and law.

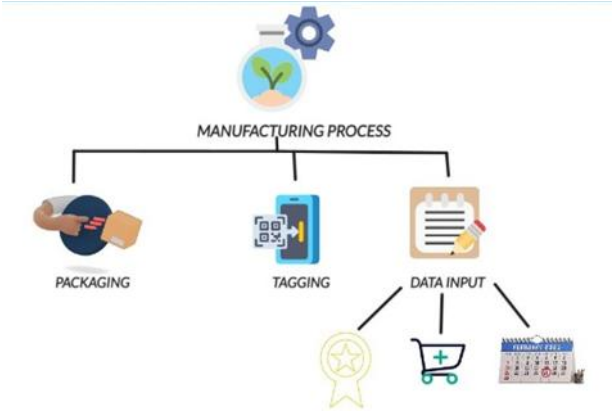

Figure 4: Manufacturing Process using packing and tagging in blockchain technology

3.2.1. TAGGING PROCESS:

A produce processing system, which comprises tagging farm products using barcodes, QR canons for quality information and RFID sensors for tagging.

Step 1: Extraction and Retrieval- Once harvested (and with farm origin, harvest date and other various attributes) each Agri-Food product is given a unique ID in the form of a barcode. Such information is saved in the system.

Step 2: Processing- The product is processed from sorting, grading, bath, cutting to package. Throughout the process, progress is tracked with barcode scanners, and RFIDs can travel along to watch temperature and location.

Step 3: Quality Control- Quality products start with quality data. QR codes, for example, can offer information such as the source of meat and treatments used. Items are scanned and compared against base data logs during quality control. Traceability, safety, and quality from processing to retail is guaranteed thanks to barcodes, QR codes and RFID tags. Traceability, safety and quality can be ensured and helped through processing to retail by using barcodes, QR codes, and RFID tags. Implementing a smart contract to record the transaction information of the participants and the terms of agreement. Deploy the smart contract on the blockchain for transparency and that data is not able to be deleted.

3.3. Phase 3: Distribution

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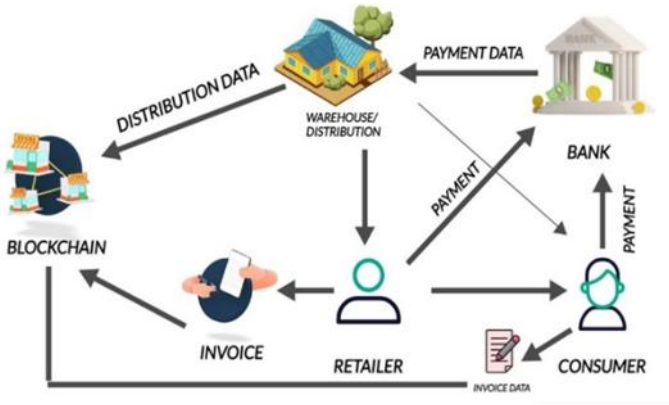

Figure 5: Distribution Process

Distribution is centralized through a single warehouse where all products are stored. Customers can buy items from listed retailers, directly from the farmer, or at the farm store. Tags on products enable tracking through the supply chain, ensuring authenticity and preventing tampering.

Step 1. Identify each participant in the distribution process, including distributors, wholesalers, retailers, and customers.

Step 2. Collect data on the distribution process and any relevant information about the product such as transportation, storage, and handling. Once the product is packaged, it's ready for distribution. It's re-inspected at this point by means of a barcode scanner, which captures the destinations and shipping information of the product. furthermore, RFID tags can be used to monitor the temperature and location of a product during the shipment.

Step 3. Develop a smart contract that writes the transaction between the player and the peer that describes necessary agreement terms and conditions.

Step 4. Deploy the smart contract on-the-chain for visibility and verifiability of the data.

Step 5. Once the product arrives at the retailer it's inspected once again using a bar code reader. Retailer or client who also reads the information through the QR law. Such information may include, for example, product related information such as product origin, quality and nutritive information.

3.4. Phase 4: Payment process

3.4.1. Specify payment service whether it is the retailer or the consumer. It is important to design a safe, efficient, and convenient payment system in agri-food supply chain. A longer payment system can also have methods for local bank transfers, cryptocurrencies, and similar alternatives for farmers and consumers to pay the retailers or distributors.

Step 1: Payment Initiation- When ripe to distribute, farmers can receive payments through bank transfer, mobile wallet or cryptocurrency. Bank and wallet information is traded with buyers or brokers to facilitate the transfer.

Step 2: Retail Payment- This will allow customers to pay with cash, cards or mobile phones at retail. Mobile payments could be based on scanning a QR code on the product itself, which could also keep pricing and product information in accordance with ISO standards.

Step 3: Distribution Payment- Distributors take payments with bank transfer, mobile or crypto. For small farmers who don't have experience with digital tools, options like cash or checks should also be allowed, with traceability.

Step 4: Digital Literacy- Digital literacy is crucial. By associating with distributors and retailers, untrained or non-regular customers can be trained or supported for digital payment Farmers: Majority of these are small, disorganized outlets.

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Step 5: Record Keeping- All payment details could be recorded on a system keeping track the product's journey, helping smooth the payment process as well as supply chain efficiency.

3.4.2. Write a smart contract which will contain important information about the payment transaction, such as the amount, currency, and condition of the agreement.

3.4.3. Deploy the smart contract into the blockchain, which guarantees data transparency and immutability.

3.5. Phase 5: Data generation and keeping in Government's record

3.5.1. Determine which government agency is responsible for the keeping of records.

3.5.2. Gathering data for the product and transaction process such as production data, manufacturing data, distribution data, payment data.

3.5.3. Deploy a smart contract which logs the history of the data transmission to the government authority.

3.5.4. Deploy smart contract on Blockchain to guarantee transparency and irreversibility of data.

Openness and transparency may be enhanced, and fraud and error reduced by using blockchain to trace and record the agri-food supply chain.

4. RESULTS AND DISCUSSION

Farmers experienced problems including lack of information on prices, misallocation in distributions and overvalued sales; retailers increased prices, and some consumers complained about the high prices and poor quality. Traceability of the supply chain was absent, making monitoring a challenge.

Blockchain addresses this issue by providing traceability, removing mediators, enabling real-time tracing and letting consumers validate the price, origin and quality of a product using barcodes or IoT devices. The system discusses various private, public, and consortium DLT models and models of blockchain network where under government direction farmers and consumers are connected, along a chain for government supervision and crisis management.

The key strengths of this technology include:

- Transparency is accomplished by sharing data with all stakeholders at each level of the process.
- By eliminating intermediaries and leveraging blockchain technology, farmers and consumers receive a fair share and fair pricing respectively.
- Payments in our methodology are made simple by utilizing cryptocurrency technology and a nationalized bank.
- Consumers can track the provenance of their items due to blockchain technology and smart contracts, which enable traceability.

Figure 6: Proposed User Interface for developed blockchain method

5. CONCLUSION

The agri sector needs an overhaul and traditional methods have gone obsolete, with problems like food safety concerns and diminished profits to farmers due to many middlemen. To meet those challenges, the authors present

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a blockchain implementation for traceability from farm to customer. This facilitates an open and credible supply chain, making it possible for the consumer to confirm the authenticity and origin of a product. With blockc hain, all ledgers are completely tamper-proof on a decentralized database, thereby enhancing credibility, reducing fraud, and delivering a more equitable profit by removing intermediaries. Compliance is enforced via smart contracts and agents who penalize users in case of rule breaches. Automated payments also simplify the flow of transactions and decrease latency and conflicts. This approach is a win-win for all: farmers, distributors, retailers, and consumers reaping efficiency, trust, and security.

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