

# Blockchain: An Emerging Paradigm in Rice Supply Chain Management

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**Abstract:** India is a vast country with most of its people consuming rice as their basic food. Rice always has a significant demand in the market and Rice supply chain management system plays a vital role in getting rice from farmers and supplying it to consumers. With the rapid growth in modern internet technologies so many new techniques have been introduced in the functioning of rice supply chain management so that to meet the demand of rice in market and an efficient product is delivered to public. But all those techniques are turning out to be futile because of their opaque, monopolistic and asymmetric nature. Everything is governed and maintained by a central authority which leads to problems like tampering and falsifying information regarding supply of rice and its processes. Blockchain a revolutionary technology which is decentralized and distributed is not governed by any central authority and provide distributed databases such that creating transparency in the network of supply chain. In this paper we will build a rice supply chain system model by integrating Blockchain technology into the system, hence providing transparency, neutrality, reliability and security for all the operations involved in rice supply chain.

**Keywords—** rice supply chain management system, blockchain, decentralized, distributed and transparency.

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## 1. INTRODUCTION

From the past few years, food safety has become a major concern for society. Some kind of scandals like plastic rice, using paints in vegetables to appear it fresh and creating artificial eggs has made people lose their trust on domestic markets. An efficient supply chain system which ensures bringing a quality product to consumer is only way to rebuild the trust of public on food safety in markets. With rapid growth of internet, a lot of advance technologies have been applied in supply chain management system to trace the flow of products between the intermediaries in supply chain. But all these techniques are centralized and governed by a central authority which is opaque, monopolistic and asymmetric thus creating trust problems such as tampering, corruption and fraud. Hence, adapting “The Blockchain” an innovative technology in our traditional rice supply chain system is the key to address all the problems in rice supply chain management. In 2008, a person known by his pseudo name Satoshi Nakamoto has created “Bitcoin” A full distributed digital currency and introduce it to the world through his white paper “Bitcoin : a peer to peer electronic cash system” . In his white paper he explained how a digital currency can function without the involvement of any governing body. Bitcoin is an electronic peer to peer electronic cash system which does not require any intermediaries like banks or central authority to transfer money from one person to other person. Everyone thought the online cash system was innovative as it is, but the technology or the mechanism

on how it really works is truly revolutionary, which we call as The Blockchain. Bitcoin is one of the thousandth applications, which built using Blockchain technology. For several years this technology was unnoticed by the society, but with the breakthrough of Bitcoin it has driven attention of many scientists and developers throughout the world. Blockchain is a decentralized and distributed ledger which keeps records of all the transactions in such a way that they are accessible to everyone while keeping them secure. As Blockchain is decentralized and no one governs it or rules it once the data uploaded on to the Blockchain it becomes immutable not allowing any person to tamper or falsify the data. As Blockchain is distributed every node present on Blockchain network has his own copy of databases which is replicated and synchronized via the internet. Blockchain is simply a data structure which contains series of blocks and record transactions in an expanding chain of blocks that are extremely difficult to tamper. If a hacker tries to break into one block, he should have to tamper independently with all the blocks, which are linked to each other in a time stamp chronological order for which hacker needs half the world resources. So this ability of Blockchain makes it immutable and impossible to hack. As everyone getting to know the potential of Blockchain technology the businesses of all kinds are getting creative with incubating this technology into their functioning. One such application leads to integrating Blockchain technology into our regular traditional rice supply chain management so that it helps in fighting frauds and minimizing the issues related to rice supply chain

management. As India being a vast country and most of its people depending on agriculture as livelihood, there raises many concerns of maintaining and introducing a corruption free supply chain management system. As we see current situation of agricultural industry can be described as challenging, there are various difficulties relating to transparency, security and visibility in various operations of supply chain and transportation. The proposed model will help in proper communication and helps in building mutual cooperation between the entities involved in the system. The main objective of this paper is to create a transparency in the processes of rice supply chain by using Blockchain technology and addressing all the issues related to management and logistics in rice supply chain management system.

## II. LITERATURE REVIEW

In 2008, Satoshi Nakamoto has created Bitcoin, a digital currency, which doesn't need any intermediaries like central authority or banks to transfer money from one person to other person [1]. Satoshi Nakamoto in his paper "Bitcoin: A Peer-to-Peer Electronic Cash System", has explained how this digital currency which was built on Blockchain platform could challenge the existing financial systems and eradicate the problems related to high transaction fees, global transactions, double spending, inflation etc [2]. Blockchain technology is not limited only to Bitcoin as there are various applications which can be built upon this framework. Blockchain groups all the digital transactions into a block and all the blocks are arranged in chronological order thus forming a chain of blocks which is Blockchain [3]. Blockchain uses some cryptographic functions to encrypt the data so that anonymity of a person or data is maintained throughout the Blockchain network [4]. Blockchain network can be public and accessible to any person in the world and also can be private with restricted membership as well. There are different types of Blockchain such as Public, Private and Consortium Blockchain based on necessity of an organization or individual want to use [5]. A Public Blockchain is completely decentralized allowing its connected users to read or write data onto the Blockchain. Whereas in Private Blockchain, permissions to read or write data onto the Blockchain are controlled by one organization which is highly trusted by other users. Consortium Blockchain is hybrid of public and private Blockchain. Instead of allowing any person to participate in validation process Consortium Blockchain here allows group of organizations to form together to have full control over Blockchain and users ought to participate are

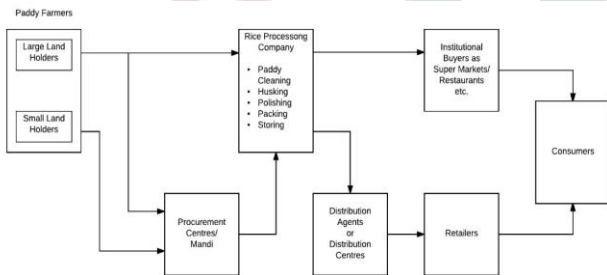
predetermined. Hence, depending on the necessity and type of data to be uploaded anyone of these Blockchain models is to be used [6]. Ethereum which is considered to be second generation Blockchain was developed by Vitalik Buterin in 2014 [7]. It was designed is such a way that even a person with minimum computer skills can develop and deploy DAPP(Decentralized Application) onto the Blockchain. Same as the Bitcoin Blockchain, Ethereum is also decentralized not governed by any central entity. Ethereum has its own cryptocurrency called "Ether" and also has its own virtual machine called EVM (Ethereum Virtual Machine). Ethereum also has a programming language called "Solidity" which is used in coding the decentralized applications. Other than this Ethereum gives an ability to build a "Smart Contract" and deploy it on Blockchain so that everyone can access it. A Smart Contract is an autonomous computer system, written in code that manages executions between individuals on to the Blockchain [8]. Blockchain is also used in developing a security framework for smart cities [9]. Blockchain technology is integrated with smart devices to provide a secure communication platform. [10]. Blockchain can also be used in creating a decentralized network in various supply chain management systems such that it provides transparency, security, neutrality and reliability of all the operations taking place in a supply chain [11]. Medium.io is a start-up company which proposed a technique of combining IoT sensor devices with Blockchain technology to regulate the efficient functioning of pharmaceutical supply chain [12]. There are many use cases where Blockchain technology is used in other supply chain management systems, hence providing an effective and efficient surveillance on products in supply chain between productions, processing, warehousing, distribution links and retailing [13]. As rice is an essential commodity and being majorly consumed as food, everyone's priority is to buy a rice of premium quality. Rice supply chain here plays a major role in supplying rice, bringing from farmers to the plates of every individual [14].

## III. EXISTING RICE SUPPLY CHAIN MODEL

The regular rice supply chain includes farmers, procurement centers or mundi, rice processing companies, distributors, wholesalers and retailers. During the rice supply many operations are performed at different places in supply chain. Each stage affects the functionality of next stage. Hence, cooperation is needed between different stages to perform activities in customized manner. Figure 1 explains the multiple stages involved in

rice supply chain and their functioning in detail. First stage starts with farmers cultivating the paddy. Basically farmers are categorized into two types which are “Small Land Holders” and “Large Land Holders” based on area of lands they hold. Large land holders cultivate paddy in large quantity so that they can sell their paddy directly to rice processing companies. Purchasing paddy directly from Small Land Holders is not profitable for rice processing companies as their cost of logistics and procuring is not favorable to rice processing companies. Sometimes rice processing companies or markets approach farmers and give their requirements in advance such that the customer demands are met. After receiving paddy from farmers rice processing companies convert paddy to rice. Converting paddy to rice includes many stages like husking, cleaning, polishing, storing and packing. Later on this rice is being sold to distributors and wholesalers from where local retailers buy it and further sell it to public. In case industrial buyers like super markets, restaurants and hotels they directly purchase rice from rice processing companies, Thus rice reaches to public after passing through all stages in supply chain.

**IV. PROBLEMS WITH THE EXISTING RICE SUPPLY CHAIN**



*Figure 1 Rice Supply Chain in India.*

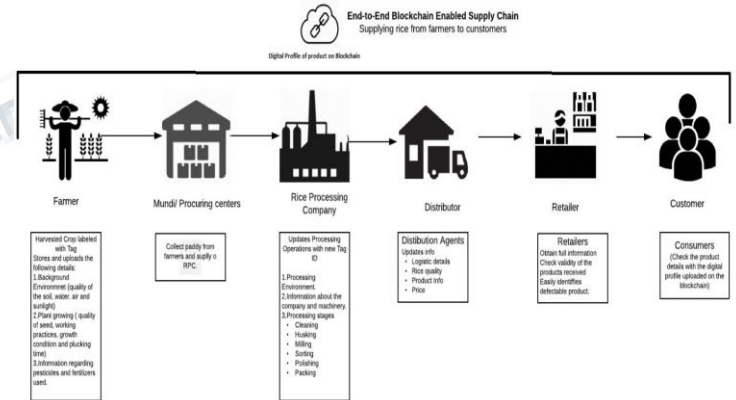
One of the main reasons to lack efficiency in traditional rice supply chain is existence of many intermediaries between the farmers and rice processing companies and again between rice processing companies and the consumers, which result in greater complexity and lower efficiency in rice supply chain. Lack of mutuality and co-operation between the members involved in rice supply chain is also the one of the main reason behind the inefficiency in supply chain management. A proper supply chain management requires better understanding and co-operation among its members from upward stream to downward stream such that problems relating to supply and demand could be minimized.

**V. APPLICATION SCENARIO**

Here we discuss an example scenario that how Blockchain can be employed and integrated into rice supply chain management system and transparency is created in the network of supply chain. A decentralized traceability system is provided to track the supply of rice during the processes involved in rice supply chain. Firstly, all the participants involved in the supply chain should be registered on to the Blockchain network with a Unique ID such that they can upload data related to product on to the Blockchain. The proposed supply chain system consists of different phases like production, procurement, processing, distribution and retail.

**A. Production**

In production phase harvested paddy is packed into bags and those bags are labeled with specific tags. Digital profiles of the rice bags are created on to the Blockchain and key information regarding paddy is uploaded. The key information could be planting time, plucking time, type of seeds used, type of pesticides used, soil, season, farmer details etc. After selling paddy to processing companies or at local yields a digital agreement (Smart Contract) is exchanged between the farmers and the buyers and uploaded on to the Blockchain.



*Figure 2 Integration Blockchain in Rice Supply Chain*

**B. Procuring**

At procurement centers information regarding the warehouses, transportation, location and weather conditions in which rice is being stored is uploaded to the digital profile of product on the Blockchain.



### C. Processing

After receiving paddy, processing enterprise will read and enter a new data into paddy's digital profile on Blockchain by scanning their tags through tag reader. The information includes the processing environment, the stages of converting paddy to rice like cleaning, husking, polishing, storing and packing. After processing paddy is converted to rice and packed. During the processing, the inserted tags of the paddy may be destroyed but their digital profiles are keeps on updated. While sending rice packages for distributors they are labeled with new tags and are configured with their digital profiles on to the Blockchain.

### D. Distribution

At distribution link information regarding the quality of rice, logistics, prices and distribution is being uploaded on to the Blockchain at specific intervals such that unusual activities can be recorded and product can be tracked during the processes in distribution.

### E. Retail

At retailing link when retailers receive specific rice bags, they nearly obtain and can audit all the information regarding the activities involved in the supply chain of particular rice. Any customer who visits the retailer with particular software linked with the Blockchain can scan the installed tag on specific rice bag and gain all the information related to supply chain of specific rice. Furthermore, as entire supply chain network is transparent, the possibilities of frauds and scams to happen will be reduced to maximum.

### F. Authority Organizations

In different stages of rice supply chain, authority organizations such as audits, certifications will randomly visit the working fields and inspect if the rules and regulations are matched and whether the relevant data has been tampered or falsified before being updated by the participant. After that, inspecting results will be updated in digital profiles of the participants. And loyalty points are awarded in form of gratitude towards being loyal to the system and not indulging any frauds or scams. This loyalty points are uploaded in the digital profiles of the participants such that benefitting them in improving their business values and attracting more customers. It will also allow customers to trust certain people and other participants in the business to make fair trades. Integrating Blockchain technology in rice supply chain ensures integral traceability, as it provides traceability of rice by recording all the events happening in supply chain. It will fight fraud and limit the system errors. Every time rice changes the hand, the information could be digitally documented creating a permanent history of the rice from manufacturer to sale. All supply chain participants can access the real time information regarding the product safety.

## VI. CONCLUSION

In this paper, we discussed about the revolutionary technology i.e. Blockchain and how businesses of all kinds would get innovative by employing Blockchain into their business practices. To identify the appropriate demand and meet them properly in a profitable, efficient and secure way is always a primary concern of food supply chains. A proper supply chain management system is very essential for efficient production, processing, distribution and retailing thus meeting the customer demands without facing a situation of lost sales. Production and business of rice is one of the major concerns of Indian Economy but still there is no proper supply chain system developed to meet the consumer demands. Here we propose a supply chain management system for rice by regulating Blockchain into its functioning. Integrating Blockchain into rice supply chain may provide us a traceability system by which we can track and audit the safety and quality of rice throughout its processes. As food supply chain plays a major role in delivering eatables to public, hope they adapt this innovative technique into their mode of doing businesses and assures delivery of quality products to public.

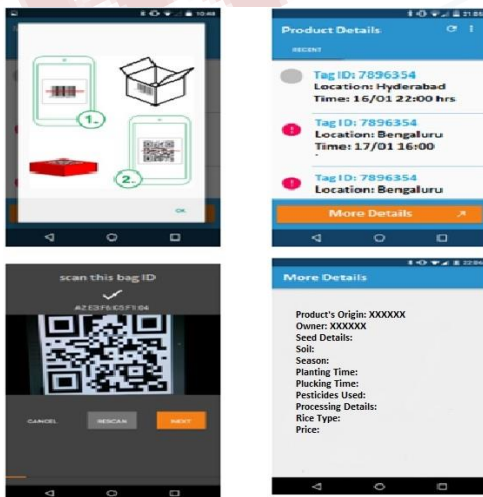


Figure 3 Blockchain Based Application for Product Details

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