Blockchain Technology in Banana: An Experience from FPO Farmers

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Keywords: Block Chain, Traceability, QR Code, Supply Chain, Consumers.

Abstract: Block chain technology ensures food safety and quality for customers while streamlining operations for stakeholders by improving supply chain transparency, traceability, and efficiency. Since consumers are looking for food sources that are more dependable and transparent, it is critical to integrate cutting-edge technologies to maintain the integrity of the agricultural supply chain. In Tamilnadu, Block chain technology has been used to banana farms, giving the fruit a digital identity and optimizing its value chain—that is, how it is grown, processed, and sold to customers. After the fruits are collected, they are packaged in boxes, and each batch has its own QR code. The creation and consumption of a banana are re-enacted via the QR code. The banana boxes are delivered to nearby marketplaces and are also exported. The implementation of block chain technology in the banana supply chain transforms the industry by providing a secure, transparent, and efficient platform. This not only addresses consumer concerns about food safety and quality but also brings operational benefits to farmers, distributors, processors, and retailers

1 INTRODUCTION

Block chains are a kind of database that often hold data that can be accessed by scanning a QR code. Blockchain technology has been applied to solve problems in many different industries. However, Abeyratne and Monfared (2016) noted that because they have responsible shopping habits, customers today demand the supply chain to be more transparent. Block chain is being utilized in agriculture to record each growing stage of agricultural products that are difficult to modify, therefore speeding up transactions and improving food safety. Consumers are better equipped to understand the social and environmental implications of the products they buy when the origin and production process of the product are transparent.

Maintaining an open dataflow throughout the supply chain has proven to be quite challenging in focus should be placed on the political and scientific agri-food value chains, nevertheless and greater agendas (Abeyratne & Monfared, 2016). Especially considering that supply chains are become increasingly opaque and complex due in part to globalization (Baker & Steiner, 2015). In an effort to increase supply chain transparency, products are being handled by new tracking technologies (such RFID, GPS, GIS, and NFC) more and more in product chains (Thiruchelvam et al., 2018). With the aid of these technologies, stakeholders can store, share, and access product data within centralized data management systems tailored to their particular industries (Abeyratne & Monfared, 2016; Meyer et al., 2009).

The data will give information on the manufacturer, production process, means of storage, and modes of transit of the goods. As a result, it can be used to assess how a product affects the

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A, J. R., P, M. P., R, A., R, S. and Hariraj, N.
Blockchain Technology in Banana: An Experience from FPO Farmers.
DOI: 10.5220/0012886000004519

In *Proceedings of the 1st International Conference on Emerging Innovations for Sustainable Agriculture (ICEISA 2024)*, pages 161-167
ISBN: 978-989-758-714-6

environment and society. Furthermore, as customers demand more ethical industrial practices, the significance of ensuring that these obligations related to social and environmental responsibility are fairly assessed is growing (Fowler, 2017). Information asymmetries between data copies are made possible by the current supply chain management techniques, while every participant produces a portion of the product data. Data is updated and accessible by various stakeholders across various software platforms and information management systems as products move through the supply chain. According to Mattila et al. (2016), this can cause data to become erroneous or out-of-date, which reduces transparency and produces less-than-ideal outcomes throughout the supply chain. Because it necessitates chain-wide monitoring, the verification of certification criteria is already an expensive and time-consuming operation. These discrepancies in product information make it even more perplexing.

Furthermore, certification procedures regarding the effects on society and the environment are less credible due to the inequalities. This is particularly valid for the labeling of products manufactured in countries that are prone to corruption (Abeyratne & Monfared, 2016). In the context of certification programs like Fairtrade, a decentralized data system developed on the block chain technology creates greater potential for verification by enhancing the transparency and traceability in nearby future. (White, 2017A consensus-based cryptographic protocol enables all parties participating in BT to exchange and store transaction data without the requirement for middlemen (Risius & Spohrer, 2017). According to Verhoeven et al. (2018), this can save costs, increase processing speed and quality, and lessen administrative labor and data mistakes. It creates the opportunity to follow or retrace a product from manufacturer to consumer along the entire supply chain (Baker & Steiner, 2015). This could cover the full supply chain or the effects of production on the environment and society.

This way, for instance, consumers or other stakeholders can confidently verify that a product has the carbon footprint disclosed on its packaging. Customers that purchase Fairtrade certified goods do so at a higher cost, but in exchange, they are assured that the goods are made in socially and environmentally responsible ways (Shreck, 2002). Therefore, as BT would lend credibility to a certification label and maybe increase chain efficiency, it could be advantageous for both conventional commodity supply chains and fair trade certified ones.

According to Awaysheh & Klassen (2010), increased supply chain openness encourages suppliers to adopt socially conscious business practices, which in turn affects customer purchasing decisions. Moreover, BT may serve as a marketing platform for certification programs to guarantee that customers are making informed purchases felt by Galvez et al., 2018. To be more precise, this would mean that vendors and buyers could swiftly assess all pertinent product information, learning more about the history of a product.

The abundance of nutrients and minerals found in bananas makes it one of the main staple crops consumed in India. Society is very concerned about the integrity and quality of bananas during their growth. Every step in the banana fruit's growing process is essential. Because banana fruit quality is dependent on how well it is supervised throughout its whole growth cycle, fruit protection is essential from the planting stage to the marketing stage.

Negative effects of banana cultivation, such as increased water use, biodiversity loss, and environmental degradation, put strain on modern banana supply chains (Roibás et al., 2015; Worobetz, 2000). Additionally, the unequal distribution of income from the profits of the banana trade was created by social inequality amongst stakeholders along the supply chain (Fairtrade Foundation, 2014; Roibás et al., 2015; Shreck, 2002). Produced in more than 135 tropical and subtropical nations, bananas are one of the important and most traded among the fruits in the world, with a $52 billion total commercial value (Kema & Drenth, 2018 of the whole crop, Eighty-five percent is consumed on the continent, with the remaining portion being transferred to nations with less hospitable growing conditions (Fair trade Foundation, 2009). Notwithstanding, the Fairtrade Foundation (2009) notes that there is limited capacity for investing in sustainability enhancements because to the low retail expenses. Businesses who reduce these issues by putting money into more environmentally friendly operations may want to increase supply chain transparency as a means of encouraging customers to purchase their goods. It is unclear how tracking technology like BT can affect the sustainability of imported items like bananas. (Hull & Liu, 2018). Block chain technology is employed as a method to store the characteristics of every stage of a banana's growth. Block chain technology offers a safe way to manage and store data, which promotes the creation and use of data-driven transformation for intelligent farming systems.

2 NEED OF THE STUDY

To evaluate the real-world effects of applying BT in the banana supply chain management, a case study was carried out.

3 METHODOLOGY

The current investigation was conducted in Erode district of Tamil Nadu, India where FPO members have used BCT in red banana farming to sell their products with traceability. To raise farmers' income and enhance their level of living, Kazhani-FPO, situated in the Erode district, focuses on organic farming, smart IoT-based agriculture, block chain-based traceability, and banana exports. Myrada Krishi Vigyan Kendra (KVK) founded the Kazhani Farmer Producer Company in 2016, with its headquarters located in Gobichettipalayam. Case study method was employed for in-depth analysis of Kazhani FPO since it is an intensive investigation method which study in-depth rather than breadth. Case study is one of the most popular technique of qualitative analysis which involves careful and complete observation of any institution, a person, enterprise or social unit and gathers qualitative information rather than quantitative information. Kazhani FPO was selected in particular as it implemented block chain technology in banana among its farmers.

According to Stuart et al. (2002), this type of research is suitable when there is a lack of theory, which is the case with blockchain application in (agricultural) supply chains. So far, its success has mostly come from its bold experimentation with other business models, particularly exporting bananas. Given that FPO supports the organic farming practices and Low External Input Sustainable Agriculture), the low input sales should not be shocking. The Madurai Agribusiness Incubation Forum is a business incubator that helps and promotes the expansion of agribusiness. Kazhani FPC has included BCT into the cultivation of red bananas with the help of red banana growers. BCT users input data into the food sign mobile application on harvesting details, cultural customs, and red banana crop cultivation. Bulk farmer's food was purchased by Kazhani FPC, who then provided shops with QR codes to scan. Information about the banana, from its cultivation to its consumption, was produced by the QR codes. Customers were able to track down Red Banana information by using their smartphone's scanner to scan the QR codes.

4 FINDINGS AND DISCUSSION

Mr.Saravananan, Farmer and member of Kazhani FPO shared the experience on Block Chain Technology Mr.Saravananan told that the Gobichettypalayam, Erode district smallholder farmers faced many challenges in the cultivation of banana, crop management, harvest and selection of fruits, marketing etc., The major Banana varities prevailing are Nendran, ,G9, Karpuravalli, monthan, kathali, poovan, and sevvazhai /Red Banana. The supply chain requires a lot of resources, and manual record-keeping is done.

Claims and practices pertaining to sustainability must be validated, procedures must meet quality yield standards, and export regulations must be met. In the marketing industry, intermediaries and traders (90%) hold a significant position in setting prices and promoting produce, among other tasks. The intermediary has the farmers in its grip. Only roughly 30 to 35 percent of the produce produced by primary producers is valued. Farmers are getting nearly Rs.50,000/- as advance from the middleman. The whole harvest process is done by middleman and traders. Further for one kilo Banana they are getting Rs.1 as commission. With 1200 members, the Kazhani

Farmer Producer Company was founded during 2016 by Myrada KVK based in Gobichettipalayam after it became apparent that farmers needed a more effective alternative marketing method. Kazhani has been working to give the approximately 500 banana growers who would otherwise be forced to participate in the conventional middleman-controlled marketing system. The Kazhani FPC has been actively looking for alternate marketing method for the produce to its members. These channels range from establishing its own grocery store to directly supplying vegetables to consumers and exporting bananas for bulk sale.

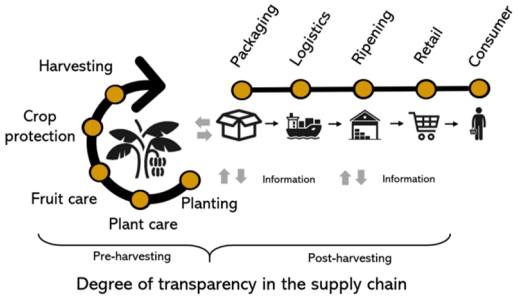

Figure 1: Supply chain Management (Conventional).

Figure 2: Smart contracts and Simplified Block Chain (Badzar, 2016 & Galvez et al., 2018).

At the global level, opaque supply chains frequently leave consumers in the dark about the provenance of goods and the methods used in their manufacture (Badzar, 2016). The Transparency and food traceability are interrelated. Food authentication entails adhering to the label specifications that specify its origin, processing method, and composition (Galvez et al., 2018). Nowadays, this information about the quality of a product is a target of fraud, especially for expensive food products. Globally, consumers demand the origin, content and quality of the food to be in line with the provided information on the label (Galvez et al., 2018). A global concern beyond provenance, food safety damages people's health and erodes trust in food markets. (Tian, 2018).

One of the main initiatives carried out by MYRADA KVK prior to Kazhani's registration was exposure visits to successful FPOs. The purpose of these visits was to familiarize the local farmers with the concept of FPOs and help them comprehend the potential for value addition and marketing in the main commodities especially in bananas, which are grown widely in the region. Exposure visits to FPCs in Theni and Thottiyam made a shape to the FPO's vision, which was centered on the banana industry. Understanding the various economic opportunities and advantages that farmers receive from FPCs was made easier by these visits. In 2017, Kazhani began operating in the banana industry following a meeting with Waycool at an exhibition. As part of a one-year CSR program, Kazhani received an order for the delivery of bananas to Chennai. For the school lunch program, almost three tons of cleaned and graded bananas had to be provided every day for five days a week.

When the one-year contract ended, Kazhani tried to continue the banana business by selling on the local market. FPO faced difficulty to engage with the local market, in contrast to the previous approach of delivering to a single institutional buyer. Aside from payment collection, they had problems with logistics and pricing, which dealers could handle because they formulated network of buyers, something it did not have. Despite being an organization, FPO has obstacles obtaining supplies at the farmer level as well since, typically, dealers give farmers an advance payment in exchange for the right to reserve their standing banana plantations and harvest them when the time is right. Due to a lack of funding to provide growers these kinds of advances, as well as a competitive market with razor-thin margins locally, Kazhani was unable to compete on price and was forced to change its approach to the banana industry.

During 2020, Kazhani took a major step forward in its efforts to improve bananas by entering the export market. Initially, Kazhani partnered with Green Agro (a banana and mango exporter) in Cochin to supply bananas for export markets because it lacked expertise and infrastructure required for export. The majority of the export destinations were European nations as well as Southeast Asian nations. Bananas cultivated by the growers were attached to FPO are normally exported to other countries and some of the produce is sold locally in the markets. The quality of the product is important as it is an export product and banana production and yields are affected by many factors.

The Agri business forum linked with TraceX technologies initiated as a pilot project as block chain for the red bananas, simplifying the Banana value chain and developing a digital brand for the product with NABARD financing as a test project. The harvested fruits are packed in boxes and the QR code is generated for the batches. The QR code recreates the journey of the banana from production to consumption. The boxes of bananas are transported to local markets and are also exported. The business forum is able to showcase the traceability of the red bananas to satisfy consumers all around the world, assuring food safety, transparency, and sustainability of the product with TraceX's solutions. It is also a sense of satisfaction for TraceX to have helped the digitization of their product supply chain and bring trust and transparency among the various stakeholders in the supply chain. Information about the banana, from its production to its consumption, was produced by the QR codes. By scanning the QR codes with the scanner on their smartphone, customers were able to identify and locate Red Banana information.

Initially, under this arrangement, Kazhani sent 4 sample consignments of red bananas intended for the European market. Once they met the strict quality requirements of the European market with their third and fourth shipments, Based on experimental marketing and consumer response, the exporter gave

them the go-ahead for Red Banana. Every time, they were provided with comments and recommendations on quality standards by the exporter. For the Nendran variety, Kazhani has also been successful in getting export samples approved. After that, Kazhani and Green Agro signed a deal for the export of bananas. Kazhani's responsibility under this arrangement is to obtain, wash, sort, and package the product.

The packaging is provided by Green Agro. All logistics after packaging, including transportation and custom clearances is handled by Green Agro. Since the lockdown has interfered with routine container transit by ship, the supply has been provided via air. Kazhani receives a service charge in addition to the processing cost from the farmers for the red banana, which is purchased at the going rate in the market. Since its founding in 2016, the firm has grown its revenue steadily, reaching over 1.4 Cr in the current fiscal year (2020–21).

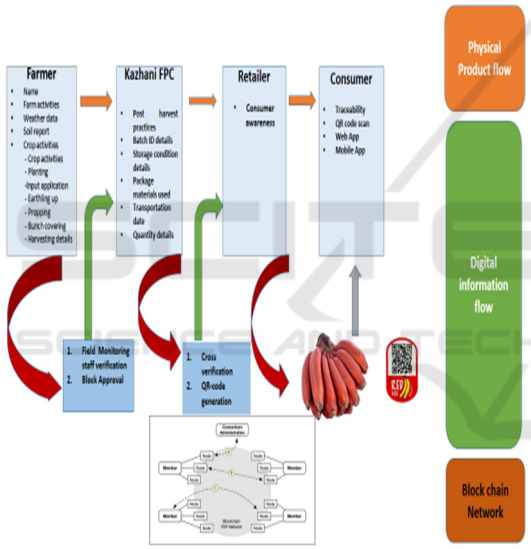

Figure 3: Network of Block Chain.

These contracts can regulate certification, approval, and process management in a blockchain-based supply chain based on conditional rules (Saberi et al., 2018). A basic blockchain diagram for the supply chain of bananas is shown in Figure 3. A smart contract governs transactions between parties, and the decentralized nature of the blockchain links all of them together. If the blockchain's design and user interface permit it, customers may be able to examine these contracts to confirm the supply chain's sustainability requirements.

In 2020–21, the FPO began demand-based red banana cultivation in collaboration with producers; however, lockdown issues prevented the export order from being fulfilled. The farmers sold the food on their own, and the company had no backup plan for local sales. However, the company and farmers are looking forward to a stronger season the following year, and the management and members are encouraged by the reception of the goods in export markets.

FPO has planned to launch and incorporate its pilot programs, which include providing high-quality inputs, utilizing the technology for traceability, implementing organic production methods and obtaining certification, and providing financial services like crop insurance and credit for banana cultivation focused on exports after the export industry has stabilized. With banana exports expected to remain primary activity, the company hopes to become acquainted with all facets of the industry over the next three to five years. This strategy and shared vision are readily apparent to all stakeholders.

Table 1: Yield and Profit from Conventional & Block Chain.

Yield/acre	:	9 ton (750 bunches x 12 kg/bunch =9000kg)
Net Income	:	Rs.2,70,000/- (9000 kg x Rs.30/kg)
Expenses	:	Rs.63,750 (750 trees x Rs.85/tree)
Other expenses	:	Rs. 94,000/-
Profit (Conventional supply chain	:	Rs.1,76,000-
BCT supply chain and Export Benefits	:	Rs.2, 28,800 (Rs.1, 76,000x 30%)

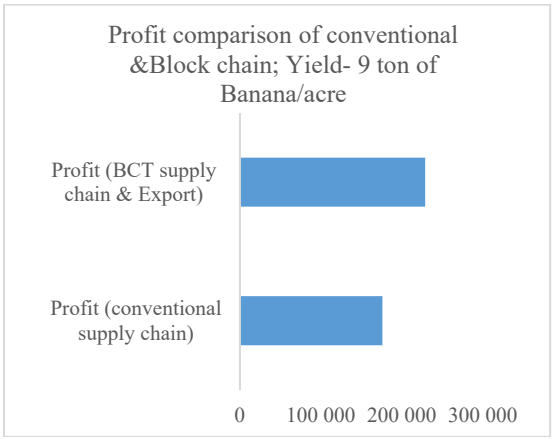

Figure 4: Profit comparison of conventional &Block chain supply chain management.

Table 2: SWOC of Block Chain Technology.

Strength	Traceability at any time–Farm to Fork. Transparency among the various stakeholder. Single source of truth that cannot be tampered with or changed. Customers were able to track down Red Banana information by QR codes.
Weakness	Quality parameters and stringent quality specifications in European countries. Quality of Red Banana reduced due to the dominance of Nendran and G9. Lack of skilled persons to work to meet the quality criteria for export. Lack of funding from NABARD.
Opportunity	Kazhani has got export samples accepted for Nendran variety. Trial marketing can be done to get the feedback from customers/buyers. 12,000 acre is available and the area can be increased in future. In the next 3-5 years' time, Kazhani is looking to familiarize itself with different aspects of banana exports and banana export is likely to be the main business.
Challenges	More than 200 brokers in the area difficult to overcome conventional Supply Chain. Providing high-quality inputs utilizing block chain technology for traceability. Implementing organic production methods and obtaining certification. Providing financial services like credit and crop insurance for export-based banana cultivation.

5 CONCLUSION

India is the largest producer of Banana (27%). Seven billion Indian Rupee worth fresh bananas exported during 2021-22.TamilNadu is the 3rd largest producer among the states. The export volumes are less due to domestic consumption. Strengthening export in Southeast Asian countries – Singapore, Malaysia, Maldives and European countries - Austria, Italy & UK. Hence Blockchain has been one of the solution for different supply chain management. Blockchain is being used in agriculture to speed up transactions and improve food safety. With an eye toward the future, Kazhani is preparing to introduce and integrate its pilot programs, which include supplying premium inputs, tracing supply using blockchain technology, certifying and implementing organic production practices, and offering crop insurance and credit as financial services for export-based banana cultivation once the export market stabilizes. Over the following three to five years, FPO focused to become more with various facets of the banana export industry, as it is anticipated to become the company's primary source of income.

All stakeholders are in agreement with this strategy and common point to achieve and the implementation of block chain in the supply chain is yet to achieve mainstream adoption as high-level expertise is required to reap the benefits. Additionally, because block chain technology is still in its initial stage, it is governed by various laws in many nations, which would affect supply networks. In future, it is anticipated that block chain-based solutions will slowly replace the role of traditional supply chain networks and processes. The only solution is to eliminate middlemen and focus on sustainability is Block chain Technology.

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