# EMPOWERING THE MILLET SUPPLY THROUGH SMART COLLABORATION

## Dr. Parthasarathi P<sup>1</sup>, Ms. Subasri V<sup>2</sup>, Ms. Umamaheswari M<sup>3</sup>

<sup>1</sup>Assistant Professor Level – III, Computer Science and Engineering & Bannari Amman Institute of Technology

<sup>2</sup> UG Scholar, Electrical and Electronics Engineering & Bannari Amman Institute of Technology <sup>3</sup> UG Scholar, Computer Science and Engineering & Bannari Amman Institute of Technology

## Abstract

In an era marked by a growing emphasis on sustainable agriculture and consumer demand for authenticity and transparency in food supply chains, the project of empowering the millet supply through smart collaboration emerges as a pioneering endeavor poised to revolutionize the industry. Leveraging the transformative potential of blockchain technology, this project envisions a comprehensive ecosystem where every step of the millet journey is meticulously tracked and authenticated, ensuring the integrity and quality of the final product. At its core, this initiative operates on the principle of transparency, utilizing blockchain's immutable ledger to create a seamless network connecting millet manufacturers, distributors, retailers, and end customers. Through the implementation of decentralized consensus mechanisms, the platform establishes trust among all stakeholders, eliminating the possibility of fraudulent practices and counterfeit products. Each millet product is assigned a unique digital identity, encompassing detailed profiles encompassing origin, production methods, quality standards, and certifications. Manufacturers are required to input comprehensive data at every stage of production, from cultivation to packaging, enabling real-time traceability and verification. Distributors and retailers seamlessly access this information, confident in the authenticity and provenance of the millet they handle. For end customers, the platform offers unprecedented transparency, allowing them to make informed choices aligned with their values and dietary preferences. Furthermore, the project fosters collaboration and knowledge exchange among stakeholders, facilitating the sharing of best practices, market insights, and sustainability initiatives.

Keywords: Transparency, Blockchain, Immutable Ledger, Digital Identity, Smart Collaboration

## **1. INTRODUCTION**

In an era characterized by dynamic technological advancements and evolving consumer preferences, the global food supply chain faces various challenges. Among these challenges, ensuring food security, promoting sustainable agricultural practices, and supporting small-scale farmers are of paramount importance. In this context, the millet supply chain stands out as a crucial element in addressing these challenges. Millet, often referred to as a 'smart crop', possesses remarkable nutritional qualities, resilience to adverse environmental conditions, and requires minimal water and input resources for cultivation.

The project titled "Empowering the Millet Supply Chain through Smart Collaboration" aims to address these challenges by leveraging the power of technology, strategic partnerships, and community engagement. Through innovative approaches and collaborative efforts, this project endeavors to enhance the efficiency, transparency, and inclusivity of the millet supply chain, ultimately benefiting small-scale farmers, consumers, and stakeholders across the entire value chain. This introduction provides an overview of the project's objectives, highlighting the need for transformative interventions in the millet supply chain. By fostering smart collaboration among various stakeholders, including farmers, producers, retailers, and policymakers, this initiative seeks to unlock the full potential of millet as a sustainable and nutritious food source while promoting economic development and environmental stewardship.

Despite these advantages, the millet supply chain faces significant inefficiencies and barriers that hinder its full potential to contribute to food security and sustainable agriculture. The project titled "Empowering the Millet Supply Chain through Smart Collaboration" aims to address these challenges by leveraging the power of technology, strategic partnerships, and community engagement. Through innovative approaches and collaborative efforts, this project endeavors to enhance the efficiency, transparency, and inclusivity of the millet supply chain, ultimately benefiting small-scale farmers, consumers, and stakeholders across the entire value chain.

This introduction provides an overview of the project's objectives, highlighting the need for transformative interventions in the millet supply chain. By fostering smart collaboration among various stakeholders, including farmers, producers, retailers, and policymakers, this initiative seeks to unlock the full potential of millet as a sustainable and nutritious food source while promoting economic development and environmental stewardship.

## 2. LITERATURE REVIEW

A Supply Chain Sustainability Framework (Sarkis & Cohen, 2018), in this paper, the authors propose a comprehensive framework for evaluating and enhancing sustainability within supply chains. They discuss the interconnectedness of environmental, social, and economic factors in supply chain management and highlight the importance of adopting sustainable practices. The framework provides guidelines for assessing sustainability performance, identifying areas for improvement, and implementing strategies to achieve long-term sustainability goals.

An Agri-food Supply Chain Traceability System for China Based on RFID & Blockchain Technology (Tian, 2017), this research paper presents a novel approach to traceability in the agri-food supply chain using RFID and blockchain technology. It addresses the challenges of food safety and quality control in China by leveraging blockchain-enabled traceability to track the movement of food products from farm to table. The proposed system ensures transparency, authenticity, and accountability throughout the supply chain, enhancing consumer trust and confidence in food safety.

Utilizing Blockchain Technology to Enhance the Traceability of Organic Products (Bovensiepen, Eckhardt, & Schulze, 2018), in this paper, the authors explore the application of blockchain technology to improve the traceability of organic products. They discuss how blockchain enables transparent and immutable record-keeping, providing consumers with assurance regarding the authenticity and organic certification of food products. By leveraging blockchain-enabled traceability, stakeholders can address challenges related to fraud, counterfeit products, and supply chain transparency in the organic food industry.

## **3. METHODOLOGY**

The design of the blockchain framework is a critical step in leveraging technology to enhance the millet supply chain. The framework should be designed to prioritize transparency, security, scalability, and interoperability. Selecting the appropriate blockchain platform, consensus mechanism, and data structure is essential for ensuring the framework's effectiveness and compatibility with the millet supply chain requirements. Additionally, designing smart contracts to automate and enforce predefined business rules streamlines operations and enhances trust among stakeholders. To maintain data integrity and prevent tampering, implementing cryptographic hash functions is essential. Hash functions generate unique fingerprints (hashes) for each transaction and data entry, ensuring that any unauthorized alterations are detectable. By integrating hash functions into the blockchain framework, the authenticity and immutability of records are preserved, providing stakeholders with confidence in the integrity of the supply chain data. Algorithms such as SHA-256 are commonly used to ensure robust security and data integrity.

Continuous monitoring and optimization are essential for ensuring the effectiveness and efficiency of the blockchain-enabled millet supply chain. Monitoring tools and analytics dashboards provide stakeholders with insights into key performance indicators such as transaction throughput, cost savings, and inventory turnover.

Analyzing data metrics enables

bottlenecks,

identify

inefficiencies, and areas for improvement within the supply chain. Iterative optimization ensures that the blockchain framework evolves

Fig.1 Stakeholders Collaboration

to

stakeholders



to meet changing market dynamics and stakeholder needs.

# 4. PROPOSED WORK

# 1) Authentication and Authorization

One of the foundational modules of the application is Authentication & Authorization, which ensures secure user access to the system. This module involves the implementation of robust authentication mechanisms, such as multi-factor authentication and role-based access controls, to prevent unauthorized access and protect sensitive information. By authenticating users and assigning appropriate access privileges, the application safeguards the integrity of the traceability data and mitigates the risk of unauthorized tampering or manipulation.

## 2) Product Identification

Central to the traceability process is the Product Identification module, which assigns unique identifiers to millet products to facilitate their tracking throughout the supply chain. These identifiers, such as Electronic Product Codes (EPCs) or QR codes, serve as digital fingerprints that encode essential information about each product, including its





origin, production methods, and quality attributes. By leveraging advanced labeling technologies and encoding standards, this module ensures the accurate and reliable identification of millet products at every stage of their journey, from cultivation to consumption.

## 3) Traceability and Blockchain

At the core of the application lies the Traceability & Blockchain module, which harnesses the transformative power of blockchain technology to establish a secure and transparent record of product movements and transactions. By leveraging blockchain's decentralized ledger and cryptographic algorithms, this module immutably records each interaction and transfer of millet products across the supply chain.



Fig.3 Traceability

Through smart contracts and consensus mechanisms, the module ensures the integrity and authenticity of the traceability data, enabling stakeholders to verify the provenance and authenticity of millet products with confidence. Moreover, the transparency afforded by blockchain enhances accountability and trust among supply chain participants, fostering greater collaboration and efficiency.

## 4) Supplier and Vendor Management

Another integral aspect of the application is Supplier & Vendor Management, which facilitates the onboarding and tracking of relationships with suppliers and vendors within the millet supply chain. This module streamlines the process of supplier registration, verification, and qualification, enabling organizations to establish reliable partnerships and ensure adherence to quality standards and regulatory requirements. By maintaining comprehensive records of supplier information, certifications, and performance metrics, the module enables proactive supplier management and risk mitigation strategies, thereby enhancing supply chain resilience and reliability.

## 5) Consumer Interface

Finally, the application features a user-friendly Consumer Interface module that provides consumers with seamless access to product traceability information. Through intuitive web or mobile interfaces, consumers can scan product labels or input product identifiers to retrieve detailed information about the millet products they intend to purchase or consume. This information may include details about the product's origin, cultivation practices, certifications, and sustainability attributes, empowering consumers to make informed purchasing decisions aligned with their values and preferences. By fostering transparency and consumer engagement, this module promotes trust and accountability throughout the millet supply chain, ultimately driving demand for sustainably produced millet products.

## 6) Blockchain-Based Product Identification

Another critical aspect of the Blockchain Integration module is the implementation of blockchain-based product identification mechanisms. This involves assigning unique identifiers, such as Electronic Product Codes (EPCs) or QR codes, to millet products at various stages of the supply chain. These identifiers serve as digital fingerprints that are securely recorded on the blockchain, linking each physical product to its digital representation. By scanning these identifiers, stakeholders can access detailed information about the product's origin, production history, quality attributes, and sustainability credentials, enhancing transparency and consumer trust.

## 5. RESULTS AND DISCUSSION

The results of the performance analysis underscore the need for optimization efforts to enhance the efficiency and effectiveness of the millet supply chain project. Addressing the discrepancies in transaction throughput and latency will be crucial to meeting the real-time requirements of supply chain operations. Strategies to improve scalability, such as network optimization and alternative consensus mechanisms, should be explored to accommodate increasing transaction volumes effectively. Additionally, mitigating network bandwidth constraints and optimizing resource utilization will be essential to enhance overall system performance.



Fig.4 Product Verification



Fig.5 Fake Product Identity

Strengthening security measures and ensuring compliance with industry standards will bolster data integrity and protect against potential threats. Continuous monitoring and iteration based on performance insights will be necessary to maintain and improve the system's performance over time, ultimately enhancing its ability to manage the millet supply chain efficiently and securely.

## 6. CONCLUSION

The complexity of a supply chain makes product safety or quality issues extremely difficult to track, especially for the basic agricultural millet supply chains of people's daily diets. The existing millet supply chains present several major problems, such as numerous participants, inconvenient communication caused by long supply chain cycles, and data distrust between participants and the centralized system. The emergence of blockchain technology effectively solves the pain-point problem existing in the traceability system of millet supply chains. We proposed a framework for tracking and executing transactions by using smart contracts, which changes the centralized model, eliminates intermediaries and intermediate nodes, and realizes the decentralized model of the millet supply chain, thus meeting the demand for traceability of agricultural millet. The framework created a digital ledger that contained information about quality, transaction information, stakeholders' information, and other relevant information. Besides, each particular shipment of items was digitally recorded and controlled. Concerning millet safety problems, this paper expounds on the importance of millet safety traceability, summarizes related research, introduces blockchain and consortium chain, and presents a framework using smart contracts to track and implement the millet trade; it presents system architecture design and describes the relationship between the millet supply chain entities and the interaction between entities.

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