BLOCKCHAIN-BASED SOLUTION FOR THE PROCESS OF OBTAINING AND MAINTAINING OF THE RAINFOREST ALLIANCE CERTIFICATION IN THE SRI LANKAN TEA SUPPLY CHAIN

Kavitha Wickramaarachchi[1], Amila Thibbotuwawa[2], Madushan Fernando[3]
Department of Transport Management and Logistics Engineering, Faculty of Engineering, University of Moratuwa.
[1]*kavithachamod@gmail.com*, [2]*amilat@uom.lk*,
[3]*madushanfernando69@gmail.com*

ABSTRACT – The tea industry in Sri Lanka holds a significant position in the global market, as it is the fourth largest tea producer worldwide, and renowned for its premium brand name, "Ceylon Tea." However, despite the positive economic impacts, the industry encounters several sustainable challenges, such as inadequate agricultural practices, labour wage disparities, deforestation, and soil erosion, among others. This study aims to propose a blockchain-based framework to address these sustainability issues and streamline the process of obtaining and maintaining the Rainforest Alliance certification in the Sri Lankan tea supply chain. The Rainforest Alliance is a voluntary certification program that is widely adopted in the tea industry as a mark of sustainability.

Keywords: Blockchain framework; Rainforest alliance; Sustainability certifications; Supply chain; sustainability

1. INTRODUCTION

1.1. Sri Lankan Tea Industry

The Sri Lankan tea industry is a vital contributor to the country's economy and Sri Lanka is one of the world's leading producers and exporters of tea, accounting for 17% of global tea exports in Sri Lanka[1]. Despite the industry's positive economic impact, the Sri Lankan tea supply chain faces several sustainability challenges. Lower profit margins often compel tea suppliers to reduce investments in technology, soil quality management, and wages, leading to long-term negative effects on the quality of tea production [2]. Moreover, smallholders, who account for 70% of tea production, play a significant role in contributing to the Sri Lankan economy [2]. The expansion of tea cultivation has also led to the deforestation of hill slopes above 900 m, severely affecting soil quality, moisture, and water table. This deforestation, along with tea cultivation, leads to soil erosion, which results in silting of waterways, streams, rivers, and reservoirs [2].

1.2. Significance of Rainforest Alliance Certification

Rainforest Alliance Certification is a crucial factor in promoting sustainability within the tea industry, as demonstrated in various studies. Ochieng et al. [3,4] found that Certifying tea sites in Kenya with the Rainforest Alliance Certification resulted in positive environmental and social outcomes for the certified farms. [4] . In line with DeFries et al.[5], it has been demonstrated that voluntary certification programs, such as Rainforest Alliance, can contribute to the achievement of sustainable goals. These certifications strive to establish stronger connections between consumers and producers, promoting ethical consumer choices that facilitate the adoption of sustainable production practices[6].

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1.3. Usage of Blockchain Technology

The use of blockchain technology has gained increasing attention in recent years, particularly in the context of digital transactions. As a distributed digital ledger, blockchain technology provides a secure and decentralized mechanism for recording transactions that are resistant to tampering and fraud [8]. The application of blockchain technology exhibits the potential in transforming the fundamental aspects of digital certificates, encompassing public key infrastructure (PKI) and certificate authority (CA)[9]. Researchers have proposed new blockchain-based solutions with system designs and prototypes for the application of these technologies [9]. By utilizing the decentralized and tamper-proof characteristics of blockchain technology, it is possible to enhance the security and reliability of digital certificates and contracts [9]. With the integration of blockchain, digital certificates and smart contracts could be more easily verified and authenticated, while also reducing the risk of fraudulent activity.

2. MATERIALS AND METHODS

This research aims to propose a blockchain framework to bring key stakeholders involved in the process of obtaining and maintaining Rainforest Alliance certification in the tea supply chain onto a single platform. Stakeholders will be certification bodies (auditors), tea smallholders, Tea Small Holding Development Authority (TSHDA), warehouses, transport, tea estates, manufacturers, and testing labs. Therefore, unstructured interviews have been done with representatives from the stakeholders. Certificate holders are required to record their transactions as the Rainforest Alliance strictly monitors the traceability of the certified products, and they need to provide specific data to the Rainforest Alliance's traceability platform. This research study aims to analyze how success factors introduced by Grida et al. (2023) [10] affect the proposed blockchain framework that intends to enhance the process of obtaining and maintaining Rainforest Alliance certification in the Sri Lankan tea supply chain using the method of interpretive structural modelling (ISM) [11]. The ISM model will be developed using expert interviews. The success factors for blockchain implementation include efficiency, effectiveness, speed, quality, transparency, security, disintermediation, trust, immutability, reliability, decentralization, data accuracy, traceability, integrity, cost reduction, and energy savings.

3. RESULTS AND DISCUSSION

As the result of unstructured interview sessions with Tea smallholders, tea estates, auditors, manufacturers, warehousing, and transportation able to identify stakeholders encounter distinct challenges in obtaining and maintaining Rainforest Alliance certification. Limited resources and technical knowledge hinder smallholders' sustainability efforts, while estates face the complexities of coordinating departments and ensuring supply chain traceability. Auditors struggle with resource-intensive data collection, and manufacturers face adjustments to meet standards. Addressing these challenges through targeted interventions and collaborative efforts is essential for successful certification and promoting responsible practices throughout the supply chain. A consortium blockchain network is more suitable as a solution for optimizing the process of obtaining and maintaining Rainforest Alliance certification, compared to public and private blockchain networks.

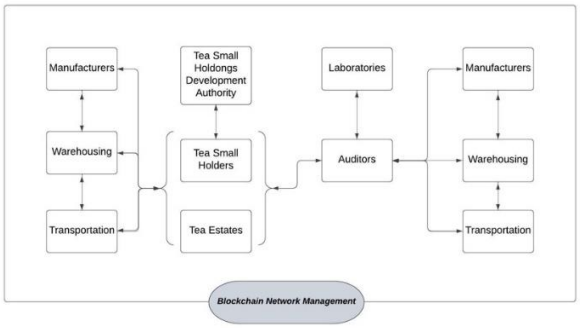

Figure 1. Proposed blockchain framework

The ISM analysis reveals three categories of success factors bottom-level (immutability, security, data accuracy, quality) intermediate-level (integrity, traceability, decentralization, transparency), and top-level (efficiency, disintermediation, reliability, operational speed, cost reduction, saving energy, trust, effectiveness). Bottom-level factors significantly impact others and form the foundation of the blockchain network's success. Intermediate-level factors act as connectors between the bottom and top levels, supporting factor flow. Top-level factors are essential for success but depend on lower levels' support and alignment to reach their full potential. Understanding and addressing each level's factors is critical for establishing a strong and successful blockchain system.

4. CONCLUSION

The research findings add to the academic discussion on blockchain in certification processes and provide valuable insights for practitioners, policymakers, and industry stakeholders. Embracing blockchain's potential can transform certification systems, enhancing trust, transparency, and sustainable practices across industries. As a collective responsibility, we should explore, innovate, and adapt emerging technologies to build a more transparent, accountable, and sustainable future.

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