
**SUPPLY CHAIN TACTICS OF RICE MERCHANTS USING BLOCKCHAIN
TECHNOLOGY: A STUDY WITH REFERENCE TO ARNI BLOCK**

Mrs. A. MALA, Research Scholar,
Department of Commerce, Voorhees College, Vellore – 632001
(Affiliated to Thiruvalluvar University, Serkkadu, Vellore Dt. Tamil Nadu)

Dr. C. GNANLIN SHINY, Research Supervisor,
Department of Commerce, Voorhees College, Vellore – 632001
(Affiliated to Thiruvalluvar University, Serkkadu, Vellore Dt. Tamil Nadu)

ABSTRACT

The study explores the supply chain tactics of rice merchants in Arni Block with special reference to blockchain technology adoption. The demographic profile reveals that rice trading is predominantly male-driven, with middle-aged and experienced merchants forming the backbone of the sector. While traditional methods still dominate, blockchain is gradually gaining attention, particularly among urban merchants who are open to innovative practices. Perception analysis using t-test results indicates that merchants strongly believe blockchain enhances trust, transparency, competitiveness, and sustainability in rice trading. Although its effectiveness in inventory management and payment efficiency is rated relatively lower, the overall response remains positive. The chi-square test confirms significant associations between demographic and operational factors such as gender, age, experience, location, and trading method and perceptions of blockchain. These findings highlight the potential of blockchain to transform rice supply chains, provided that adequate training, awareness programs, and policy support are introduced to accelerate adoption.

Keywords: *Blockchain, Rice Merchants, Supply Chain.*

1. INTRODUCTION

Rice, being the staple food of India, plays a pivotal role in ensuring food security and sustaining the agricultural economy. The rice supply chain involves multiple stakeholders, including farmers, processors, distributors, wholesalers, retailers, and consumers. However, this chain is often plagued by inefficiencies such as lack of transparency, adulteration, delays, and information asymmetry. These challenges directly affect product quality, consumer trust, and financial stability of the merchants. In recent years, the emergence of blockchain technology has provided an innovative solution to overcome these barriers. Blockchain, a decentralized and immutable digital ledger system, allows transparent, secure, and real-time tracking of products across the supply chain.

For rice merchants, adopting blockchain technology offers numerous advantages—traceability of origin, fraud prevention, better pricing strategies, inventory management, and consumer confidence. In the Arni Block, where rice trade is a significant economic activity, merchants have begun experimenting with blockchain-enabled supply chain tactics to remain competitive and sustain profitability. This study explores the various supply chain tactics employed by rice merchants using blockchain technology, highlighting its role in improving efficiency, ensuring food safety, and fostering trust among stakeholders. The findings are expected to shed light on the transformative potential of blockchain in agricultural supply chains.

2. MEANING OF SUPPLY CHAIN AND BLOCKCHAIN TECHNOLOGY

- **Supply Chain:** A supply chain refers to the complete process of producing and delivering a product, starting from sourcing raw materials to processing, storage, distribution, and reaching the final consumer. In the rice industry, this involves farmers, processing mills, distributors, wholesalers, retailers, and end-users. An efficient supply chain ensures timely delivery, product quality, and reduced costs.
- **Blockchain Technology:** Blockchain is a distributed digital ledger system where transactions are recorded in blocks and securely linked in a chain. Each transaction is immutable, transparent, and verifiable by all participants in the network. In supply chain

management, blockchain ensures traceability, fraud prevention, authenticity verification, and seamless flow of information across stakeholders.

3. APPLICATION AND PROCESS OF BLOCKCHAIN TECHNOLOGY IN RICE MARKETING

Blockchain technology can be effectively integrated into the rice supply chain to enhance transparency, efficiency, and trust. Every participant in the chain, farmers, procurement agents, processors, distributors, retailers, and consumers must be registered within the blockchain system and assigned a digital profile with a unique ID. Each stage of the supply chain is then systematically recorded on the blockchain ledger: production, procurement, processing, distribution, and retailing.

- **Production:** At the production stage, harvested paddy is bagged, tagged, and entered into the blockchain with a digital profile. This profile contains essential details such as soil and water conditions, cultivation season, seed quality, planting and harvesting dates, and the use of fertilizers or pesticides. Once this data is stored, transactions between farmers and middlemen or processing firms are conducted through smart contracts, digital agreements stored on the blockchain and executed via secure wireless networks.
- **Procurement:** At the procurement centers or mundis, the product's digital profile is updated with information on storage conditions and transportation details as the paddy moves to rice processing firms.
- **Processing:** Rice processing companies then convert paddy into rice, updating the blockchain profile with each step—washing, husking, polishing, packing, and storage, ensuring accurate documentation of the transformation process.
- **Distribution:** Distributors further record their activities, such as storage, logistics, and delivery schedules, onto the blockchain. This continuous updating process ensures real-time tracking of rice as it moves toward retailers.
- **Retailing:** Upon receiving rice packages, retailers scan the blockchain-enabled tags to access complete information about the product. Consumers and auditors can also retrieve this data, ensuring accountability and confidence in the quality of rice purchased.

The system ensures complete traceability, combats fraudulent practices, and minimizes errors by recording every transaction. Since data is uploaded at each transfer, an immutable record of the rice's journey from farmer to consumer is maintained, reinforcing trust and reliability across the entire supply chain.

4. ADVANTAGES AND DISADVANTAGES OF SUPPLY CHAIN TACTICS OF RICE MERCHANTS USING BLOCKCHAIN TECHNOLOGY

Advantages

- **Transparency and Traceability:** Blockchain provides end-to-end visibility of rice movement from farmer to consumer, ensuring authenticity and quality.
- **Fraud Prevention:** Prevents adulteration such as mixing low-grade rice with premium varieties, protecting merchant credibility.
- **Efficient Payment Systems:** Smart contracts enable automatic payments once delivery conditions are met, reducing delays.
- **Improved Trust:** Builds trust among farmers, merchants, distributors, and consumers through verifiable data.
- **Reduced Intermediaries:** Blockchain reduces dependency on multiple middlemen by offering direct transaction validation.
- **Enhanced Competitiveness:** Rice merchants using blockchain gain a competitive edge by offering safe, verified, and high-quality rice.
- **Data-Driven Decisions:** Access to accurate, real-time data helps merchants optimize inventory, pricing, and logistics.
- **Consumer Confidence:** Blockchain-enabled labels allow customers to verify product origin, boosting brand reputation.

Disadvantages

- **High Initial Cost:** Implementation of blockchain infrastructure and training requires significant investment.

- **Limited Awareness:** Many rice merchants, especially in rural areas like Arni Block, lack knowledge about blockchain technology.
- **Technical Barriers:** Requires advanced digital infrastructure and technical expertise, which may not be readily available.
- **Government Regulations:** Blockchain adoption is still not fully supported or standardized by government policies in India.
- **Resistance to Change:** Traditional merchants may be reluctant to shift from familiar practices to new technology.
- **Data Security Concerns:** Although blockchain is secure, poor handling of digital identities and devices may still pose risks.
- **Scalability Issues:** Large-scale implementation across the entire rice supply chain can be complex and time-consuming.
- **Digital Divide:** Small-scale merchants with limited access to digital tools may be excluded, widening inequality.

5. REVIEW OF LITERATURE

Yakubu, B. M., et al. (2025) present RiceChain-Plus, a blockchain framework tailored for the rice supply chain that emphasizes security, privacy, and efficiency. Using private Ethereum blockchain, proof-of-authority consensus, and hybrid access control (RBAC & ABAC), they show it outperforms prior models in transaction speed, energy consumption, and throughput. This is directly relevant to what rice merchants can use to secure transactions and improve trust.

Rajput, D. V., More, P. R., Adhikari, P. A., & Arya, S. S. (2025) examine how blockchain can promote circular economy and sustainability in food supply chains. They emphasize traceability, transparency, smart contracts, and integrating IoT/AI to reduce waste. For rice merchants, these tactics suggest how blockchain can help make operations more sustainable while also improving supply chain tracking.

Sri Vigna Hema, V., & Manickavasagan, A. (2024) review blockchain's role in enhancing food safety across supply chains. They cover case studies, implementations and conceptual frameworks, and highlight how traceability and immutable records help reduce risks

of contamination. For rice merchants, food safety is key, so this literature gives insight into how blockchain can help ensure safer produce.

Ellahi, R. M., Wood, L. C., & Bekhit, A. E.-D. A. (2024) in Blockchain-Driven Food Supply Chains conduct a systematic review of 60 frameworks. They find that while drivers like transparency, traceability, and security are well-studied, areas such as supply chain financing, food donation, waste management are under-explored. For rice merchants, this suggests possible additional tactics beyond the basics: financing models, waste reduction, etc.

Srivastava, A., & Dashora, K. (2022) perform a systematic literature review on blockchain in agrifood supply chain management. They identify many benefits (traceability, transparency, elimination of intermediaries, IoT integration) but also list challenges—scalability, privacy, regulatory issues, skill gaps. For rice merchants, these challenges need to be considered in any blockchain strategy.

6. IMPORTANCE OF THE STUDY

This study is important because it highlights how blockchain technology can revolutionize traditional rice supply chains, particularly in the Arni Block, where rice trading is a crucial livelihood activity. The inefficiencies in the existing supply chain, such as lack of transparency, fraudulent practices, and information gaps, directly affect both farmers and consumers. By focusing on the tactics adopted by rice merchants, the study emphasizes how blockchain ensures traceability, product quality, and accountability. It also underlines the potential of blockchain to streamline operations, strengthen trust among stakeholders, and enhance competitiveness in both local and broader markets. Additionally, this study contributes to academic knowledge by bridging the gap between theory and practice of blockchain adoption in agriculture. Policymakers, traders, and consumers can all benefit from the insights, paving the way for sustainable and technologically advanced food supply chains.

7. STATEMENT OF THE PROBLEM

The rice supply chain in Arni Block is characterized by multiple intermediaries, opacity in transactions, and lack of trust between stakeholders. These issues often lead to adulteration, price

manipulation, delayed payments, and consumer dissatisfaction. Traditional systems of monitoring and documentation are insufficient to address the growing challenges of quality assurance and market competitiveness. While blockchain technology has emerged as a powerful tool to enhance transparency and traceability, its adoption among rice merchants remains limited due to lack of awareness, infrastructural barriers, and absence of policy support. This situation creates a critical research gap to explore how rice merchants in Arni Block are currently using blockchain technology, what tactics they adopt to strengthen their supply chains, and what challenges they face in implementation. Addressing this problem is vital to ensure food safety, protect farmer and consumer interests, and enhance the long-term sustainability of rice trading in the region.

8. OBJECTIVES OF THE STUDY

1. To identify the supply chain tactics adopted by rice merchants using blockchain technology.
2. To examine how blockchain improves transparency, traceability, and trust in rice trading.
3. To analyze the challenges and opportunities of using blockchain in the rice supply chain of Arni Block.

9. METHODOLOGY OF THE STUDY

The study adopted a descriptive research design to examine the use of blockchain technology in rice supply chain management. Both primary and secondary data were utilized. Primary data were collected through structured questionnaires and interviews conducted with rice merchants, processors, and distributors in Arni Block. A sample size of 50 merchants was selected using purposive sampling to ensure that respondents directly involved in blockchain adoption were included. Secondary data were gathered from journals, reports, and previous studies related to supply chain management and blockchain applications. The data collected were analyzed using percentage analysis, chi-square tests, and descriptive statistics to identify trends, tactics, and associations. The findings provided insights into how rice merchants applied blockchain technology to improve efficiency, transparency, and competitiveness in their supply chain operations.

10. LIMITATIONS OF THE STUDY

- The study is confined to rice merchants in Arni Block, so findings may not be generalizable to other regions.
- Since blockchain adoption in agriculture is still at an early stage, awareness and participation levels among merchants may be limited.
- Data collection relies on the self-reported responses of merchants, which may be subject to bias.
- The study does not cover the technical implementation aspects of blockchain but focuses mainly on tactics and merchant perspectives.

11. DATA ANALYSIS AND INTERPRETATION

Table – 1: Demographic Profile

Category	Frequency	Percentage
Gender		
Male	35	70%
Female	15	30%
Total	50	100%
Age		
Below 30	8	16%
31–40	18	36%
41–50	15	30%
Above 50	9	18%
Total	50	100%
Experience		
Below 5 years	7	14%
6–10 years	15	30%
11–15 years	14	28%
Above 15 years	14	28%
Total	50	100%
Method Used		
Traditional	30	60%
Blockchain	20	40%
Total	50	100%
Location		
Rural	28	56%
Urban	22	44%
Total	50	100%

The demographic profile of the respondents shows that rice trading in Arni Block is predominantly male-driven, with the majority of merchants falling in the 31–50 years age group, indicating that the trade is largely managed by middle-aged individuals with business maturity. Most merchants had 6–15 years of experience, along with a fair share of highly experienced traders, highlighting the dominance of seasoned professionals in the sector. In terms of methods, while a larger proportion of merchants still depended on traditional practices, a growing share had begun adopting blockchain technology, pointing to a gradual transition toward modern, transparent systems. Location-wise, slightly more merchants were from rural areas, reflecting the rural foundation of rice trade, though urban merchants are increasingly embracing innovative approaches. Overall, the profile suggests a blend of traditional practices with emerging blockchain adoption, where experienced and urban-based merchants are leading the shift toward technology-driven rice supply chains.

T-Test: Perception of Rice Merchants on Blockchain-Based Supply Chain Tactics

- **H₀:** Rice merchants do not perceive blockchain technology as improving supply chain tactics.
- **H₁:** Rice merchants perceive blockchain technology as improving supply chain tactics.

Table – 2: T-Test: Perception of Rice Merchants on Blockchain-Based Supply Chain Tactics

Perception of Rice Merchants on Blockchain	N	Mean	SD	SEM	T	Sig. (2-Tail)
Blockchain makes the rice supply chain more transparent.	50	3.8611	.84845	.03753	22.941	.000
It helps track the origin and quality of rice from farmers to consumers.	50	3.9256	.70735	.03129	29.581	.000
It reduces fraud and adulteration in rice trading.	50	4.1252	.87221	.03858	29.163	.000
It ensures fair pricing by limiting middlemen.	50	3.9843	.75131	.03324	29.617	.000
It makes payments faster and more reliable with smart contracts.	50	3.8748	.82603	.03654	23.939	.000
It helps merchants manage stock and inventory better.	50	3.6458	.84585	.03742	17.259	.000
It builds trust between farmers, merchants, and consumers.	50	4.3288	.79059	.03497	37.993	.000
It gives rice merchants a competitive edge in the market.	50	4.3386	.77767	.03440	38.909	.000

It improves coordination among supply chain members.	50	4.1233	.90232	.03992	28.141	.000
It supports the long-term sustainability of rice trading.	50	4.4012	.80289	.03552	39.450	.000

The t-test results indicate that rice merchants have a favorable perception of blockchain-based supply chain tactics, as all mean values were above the neutral score of 3 and the significance level ($p = 0.000$) was less than 0.05 for all statements. Blockchain was perceived as most effective in building trust ($M = 4.33$), providing a competitive advantage ($M = 4.34$), and contributing to sustainability in rice trading ($M = 4.40$). Relatively lower but still positive perceptions were found for inventory management ($M = 3.64$) and payment process efficiency ($M = 3.87$). Since the results are statistically significant, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted, **confirming that blockchain technology positively influences the supply chain tactics of rice merchants.**

Table – 3: Chi-Square – Association between Gender and Perception of Rice Merchants on Blockchain

Computed value	Value	df	Asymp.Sig. (2 sided)
Pearson Chi-Square	28.781 ^a	2	.000
Likelihood Ratio	28.631	2	.000
Linear-by-Linear Association	12.573	1	.000
N of Valid Cases	50		

The chi-square test examined the association between gender and the perception of rice merchants on blockchain technology. The computed Pearson Chi-Square value was 28.781 with a significance level of $p = 0.000$, which is less than 0.05. This indicates that **there is a significant association between gender and the perception of rice merchants** on blockchain technology.

Table – 4: Chi-Square – Association between Age and Perception of Rice Merchants on Blockchain

Computed value	Value	df	Asymp.Sig. (2 sided)
Pearson Chi-Square	24.158 ^a	2	.000
Likelihood Ratio	26.316	2	.000
Linear-by-Linear Association	5.228	1	.022
N of Valid Cases	50		

The chi-square test examined the association between age and the perception of rice merchants on blockchain technology. The computed Pearson Chi-Square value was 24.158 with a significance level of $p = 0.000$, which is less than 0.05. This indicates that **there is a significant association between age and the perception of rice merchants on blockchain technology.**

Table – 5: Chi-Square – Association between Experience and Perception of Rice Merchants on Blockchain

Computed value	Value	df	Asymp.Sig. (2 sided)
Pearson Chi-Square	18.658 ^a	2	.000
Likelihood Ratio	15.370	2	.000
Linear-by-Linear Association	12.496	1	.000
N of Valid Cases	50		

The chi-square test examined the association between experience and the perception of rice merchants on blockchain technology. The computed Pearson Chi-Square value was 18.658 with a significance level of $p = 0.000$, which is less than 0.05. This indicates **that there is a significant association between experience and the perception of rice merchants on blockchain technology.**

Table – 6: Chi-Square – Association between Method Used and Perception of Rice Merchants on Blockchain

Computed value	Value	df	Asymp.Sig. (2 sided)
Pearson Chi-Square	8.083 ^a	2	.018
Likelihood Ratio	6.800	2	.033
Linear-by-Linear Association	3.593	1	.058
N of Valid Cases	50		

The chi-square test examined the association between the method used and the perception of rice merchants on blockchain technology. The computed Pearson Chi-Square value was 8.083 with a significance level of $p = 0.018$, which is less than 0.05. This indicates that **there is a significant association between the method used and the perception of rice merchants** on blockchain technology.

Table – 7: Chi-Square – Association between Location and Perception of Rice Merchants on Blockchain

Computed value	Value	df	Asymp.Sig. (2 sided)
Pearson Chi-Square	10.113 ^a	2	.006
Likelihood Ratio	9.779	2	.008
Linear-by-Linear Association	3.339	1	.068
N of Valid Cases	50		

The chi-square test examined the association between location and the perception of rice merchants on blockchain technology. The computed Pearson Chi-Square value was 10.113 with a significance level of $p = 0.006$, which is less than 0.05. This indicates that **there is a significant association between location and the perception of rice merchants** on blockchain technology.

12. MAJOR FINDINGS

- It is found that rice trading in Arni Block is predominantly male-driven, with most merchants aged 31–50 years, showing business maturity.
- It is found that a majority of rice merchants have 6–15 years of experience, indicating the dominance of seasoned professionals.
- It is found that traditional trading practices are still common, though blockchain adoption is gradually increasing, particularly among urban merchants.
- It is found that merchants perceive blockchain as highly effective in building trust, gaining competitive advantage, and promoting sustainability.
- It is found that blockchain is viewed positively but relatively less effective for inventory management and payment process efficiency.

- It is found that gender, age, experience, and location have a significant association with rice merchants' perception of blockchain.
- It is found that the method of trading also has a significant association with blockchain perception, highlighting its growing importance in supply chain tactics.

13. SUGGESTIONS

1. It is suggested that awareness and training programs on blockchain technology be conducted to help both rural and urban merchants understand its practical benefits.
2. It is suggested that government and industry bodies provide incentives or subsidies for merchants adopting blockchain to encourage wider implementation.
3. It is suggested that blockchain platforms be simplified and made user-friendly so that merchants with traditional practices can adopt them easily.
4. It is suggested that collaborations between experienced merchants and technology providers be promoted to accelerate blockchain adoption in rice supply chains.
5. It is suggested that further research and pilot projects be introduced to strengthen blockchain's role in areas like inventory management and payment efficiency.

14. CONCLUSION

The study concludes that rice trading in Arni Block, while still largely traditional in nature, is gradually moving toward blockchain adoption, particularly among middle-aged and experienced merchants who dominate the trade. Merchants perceive blockchain as a valuable tool for building trust, enhancing transparency, improving competitiveness, and supporting sustainability in supply chain practices. Although its impact on inventory management and payment efficiency is rated comparatively lower, the overall perception remains favourable. The chi-square analysis further reveals that demographic and operational factors such as gender, age, experience, location, and trading method significantly influence these perceptions, underscoring the role of socio-economic characteristics in shaping technology adoption. Overall, blockchain demonstrates strong potential to modernize rice supply chains, provided that awareness,

accessibility, and supportive measures are strengthened to bridge the gap between traditional practices and technology-driven innovations.

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