



Working Paper 2025.1.5.9

- Vol. 1, No. 5

## ỨNG DỤNG CÔNG NGHỆ BLOCKCHAIN TRONG CHUỖI CUNG ỨNG GẠO TẠI VIỆT NAM: NGHIÊN CỨU VỀ AGRIDENTIAL

Trần Đình Tú<sup>1</sup>, Phạm Mai Trang, Lê Hương Thảo, Bùi Như Quỳnh, Hoàng Thị  
Thảo Nguyên

Sinh viên K61 CLC Kinh tế đối ngoại - Viện Kinh tế & Kinh doanh quốc tế

*Trường Đại học Ngoại Thương, Hà Nội, Việt Nam*

Nguyễn Thị Yến

Giảng viên Bộ môn Quản lý Chuỗi cung ứng – Viện Kinh tế và Kinh doanh quốc tế

*Trường Đại học Ngoại Thương, Hà Nội, Việt Nam*

### Tóm tắt

Chuỗi cung ứng gạo của Việt Nam đang đối mặt với nhiều thách thức như kém hiệu quả, thiếu minh bạch và gian lận thực phẩm. Báo cáo này nghiên cứu công nghệ blockchain như một giải pháp nhằm nâng cao khả năng truy xuất nguồn gốc và cải thiện hiệu quả hoạt động. Nội dung báo cáo bao gồm tổng quan về chuỗi cung ứng gạo, đánh giá các ứng dụng của blockchain, và đưa ra ví dụ thực tiễn về việc thực hiện blockchain thông qua app Agridental. Đồng thời, phân tích các cơ hội và thách thức của blockchain, nhấn mạnh những lợi ích cũng như rào cản trong quá trình ứng dụng. Cuối cùng, báo cáo đưa ra các khuyến nghị cho các bên liên quan về việc tích hợp blockchain vào ngành gạo tại Việt Nam. Việc áp dụng blockchain có thể giúp nâng cao tính minh bạch, tăng cường khả năng cạnh tranh trên thị trường quốc tế và thúc đẩy một chuỗi cung ứng gạo bền vững hơn.

**Từ khóa:** công nghệ blockchain, chuỗi cung ứng gạo

## BLOCKCHAIN TECHNOLOGY APPLICATION IN RICE SUPPLY CHAIN MANAGEMENT IN VIETNAM: THE CASE OF AGRIDENTIAL

### Abstract

<sup>1</sup> Corresponding Author, Email: k61.2212150151@ftu.edu.vn

Vietnam's rice supply chain currently faces challenges such as inefficiencies, lack of transparency, and food fraud. This report explores blockchain technology as a solution to enhance traceability and improve efficiency. It provides an overview of the rice supply chain, how blockchain applications improve the chain and a case study of Agridental. The report evaluates blockchain's opportunities and challenges, highlighting its potential benefits and adoption barriers. Finally, it offers recommendations for the related parties to smoothly adopt blockchain into Vietnam's rice industry. Implementing blockchain can enhance transparency, strengthen global competitiveness, and promote a more sustainable rice supply chain.

**Keywords:** blockchain, rice supply chain

---

## **1. Introduction**

The rice supply chain plays a crucial role in Vietnam's agricultural economy, contributing significantly to national food security and exports. However, there are still some challenges such as inefficiencies in logistics, traceability, and transaction transparency. This report explores the potential of blockchain technology in decreasing the challenges, exploiting the benefits, and enhancing the rice supply chain in Vietnam.

The study begins with an overview of the rice supply chain industry in Vietnam. Next is an overview of blockchain fundamentals and how this technology is applied, specifically in the rice sector. The core section of the report examines reality implementations of blockchain, including a case study of Agridental, a blockchain-based solution designed for the agricultural supply chain from Vietnam and for Vietnam. The app has been developed and successfully applied to improve the supply chain of rice in some areas of the country, and acts as a role model for blockchain adoption in this sector. Additionally, an evaluation of blockchain's threats and opportunities provides a balanced perspective on its adoption in Vietnam.

By analyzing blockchain's impact on the rice supply chain, this report aims to provide insightful knowledge into its potential for enhancing efficiency and transparency. The study also offers recommendations for policymakers, businesses, and peasants to facilitate blockchain adoption in Vietnam's rice industry.

## **2. Overview of rice supply chain industry**

### ***2.1. Current Status of Rice Production and Export in Vietnam***

Vietnam's geographical advantages for rice cultivation are evident in its 3,000 km coastline and diverse topography, leading to three primary rice cultivation regions: the Red River Delta, the Central Coastal Plains, and the Mekong Delta. According to Nguyen & Tran (2004), the majority of farming households in the country are engaged in rice cultivation, highlighting its crucial role in national agriculture.

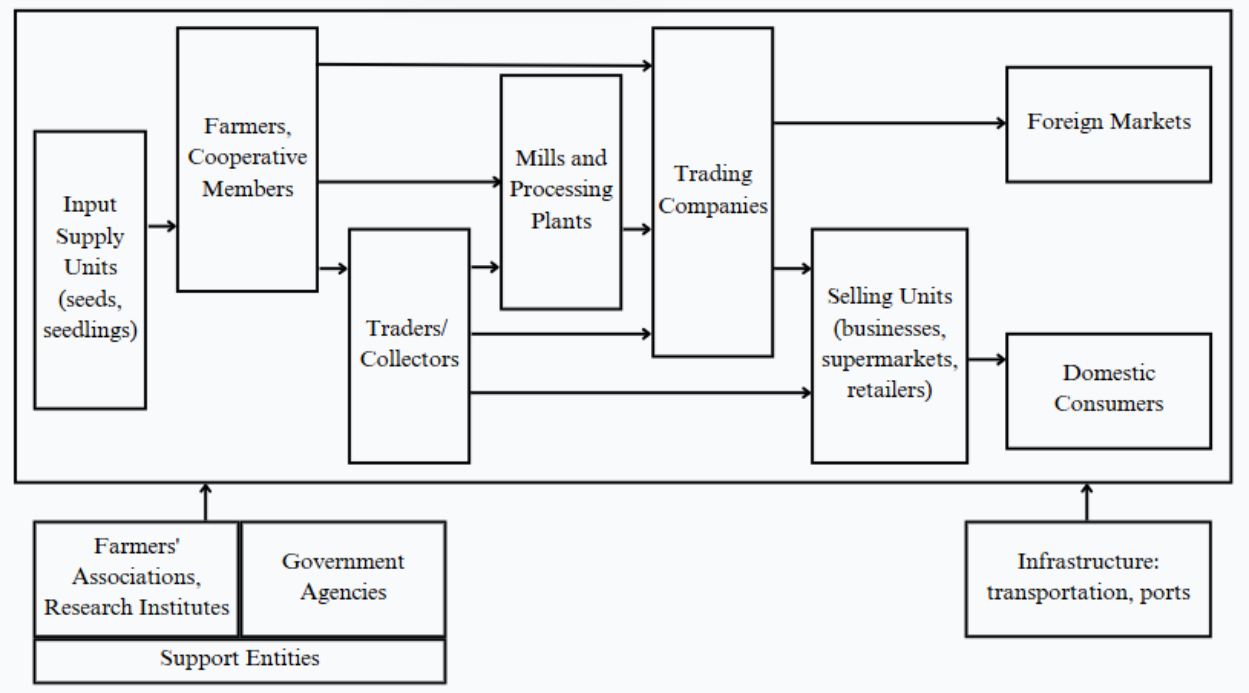
Rice production is vital to Vietnam's agriculture, with 80% of 11 million farming households engaged in cultivation. Despite global food market fluctuations in 2023, Vietnam exported a record 8.1 million tons of rice, valued at nearly \$4.7 billion—an increase of 14.4%

in volume and 35.3% in value from 2022 (Directive No. 10/CT-TTg, March 2, 2024). The country aims to sustain 7.1 million hectares of rice fields, ensuring over 43 million tons of paddy, with an export target of 8 million tons in 2024. In 2024, exports surpassed 9.03 million tons, generating nearly \$5.67 billion, reinforcing Vietnam’s position as the world’s third-largest rice exporter.

Vietnam’s rice industry has notable strengths. The government’s irrigation investments cover 85% of rice fields—the highest in the region. Strategic rice breeding ensures high yields (90-110 days per cycle) and quality, making Vietnam’s rice globally competitive. In 2023, its export price surpassed Thailand, Pakistan, and India. Productivity also improved, averaging over 6 tons per hectare, with the winter-spring crop reaching 7 tons.

However, the rice sector in Vietnam currently struggles with numerous challenges that need fixing. The first issue lies in managing input resources, because farming supply prices often change unpredictably and the use of machines varies between production steps, making operations less stable. A big problem comes from crop losses after harvest, which greatly reduces production results. Also, the loose connections between farmers and trading businesses weaken supply chain links. The heavy reliance on old export markets creates limits that might slow down future growth and restrict chances to reach new markets.

**2.2. Vietnam's Rice Supply Chain Model**



**Figure I:** Rice Supply Chain Model in Vietnam

**Source:** Economy and Forecast Review

The supply chain comprises five distinct but interrelated components:

- (i) *Primary Producers:* Rice farmers managing cultivation from seed selection to harvesting, putting in the most effort but making the smallest share of profit.

(ii) *Purchasing Units*: Traders connecting farmers with food companies and distributors, with their growing numbers in the market leading farmers to become overly dependent on these middlemen.

(iii) *Processing Units*: The current rice milling and polishing facilities are primarily small-scale operations using outdated technology.

(iv) *International Markets*: Experienced importers and distributors focusing mainly on procurement and distribution, representing a small proportion of the value chain.

(v) *Domestic Retail Units*: Businesses, supermarkets, and retail stores serving local consumers, operating with modest profit margins despite their crucial role in product delivery.

Vietnam's rice supply chain starts with seed suppliers providing inputs to cooperative farmers. Farmers sell harvested rice through three main channels: (1) direct sales to traders, who supply milling plants, (2) direct sales to milling plants, or (3) transactions with rice trading companies. Processed rice is distributed through two main pathways: the domestic market (via retailers) and export markets (via transport and port infrastructure). The supply chain benefits from institutional support, including farmer associations, research institutes, and government agencies, which provide policy and technical assistance to enhance efficiency.

### 3. Literature review

#### 3.1. Overview of Blockchain

Blockchain is a distributed, decentralized, public ledger for securely exchanging digital currency and transaction information. Blockchain was invented in 2008 by Satoshi Nakamoto as public ledger for cryptocurrency bitcoin. Blockchain allows the participants to verify the transactions independently. What makes blockchain particularly valuable is its immutability—once a transaction is recorded, it cannot be modified, ensuring trust and data integrity. The system verifies through validation mechanisms such as Proof of Work and Proof of Stake, which validate transactions and maintain network security. Over time, blockchain development has progressed through three distinct phases: Blockchain 1.0, which introduced cryptocurrencies like Bitcoin; Blockchain 2.0, which enabled smart contracts and automated agreements; and Blockchain 3.0, which expands blockchain applications beyond finance into industries such as healthcare, supply chain management, and governance. As technology continues to evolve, blockchain is expected to play an even greater role in shaping the future of secure digital transactions.

**Table I:** Three tiers of blockchain technology

| Blockchain 1.0   | Blockchain 2.0   | Blockchain 3.0   |
|--|--|--|
| This Blockchain is basically used for cryptocurrencies and it was introduced with the invention of Bitcoin. All the alternative coins as well as Bitcoin fall into this tier of blockchain. It also includes core applications as well | Blockchain 2.0 is used in financial services and industries, which includes financial assets, options, swaps, bonds, etc. Smart Contracts were first introduced in Blockchain 2.0 that can be defined as the way to verify if the products and services are sent by the supplier during a transaction process between two parties. | Blockchain 3.0 offers more security as compared to Blockchain 1.0 and 2.0 and it is highly scalable and adaptable and provides sustainability. It is used in various industries such as arts, health, justice, media, and in many government institutions. |

**Source:** Iansiti, M., & Lakhani, K. R. (2017)

According to Sarmah (2018), blockchain is a database of records of transactions which is distributed, and which is validated and maintained by a network of computers around the world. It is shared across a network of participants, where up-to-date information is available to all participants at the same time.

There are three primary types of blockchain technology: public, private, and hybrid. Public blockchains, also referred to as permission-less, non-restrictive distributed ledger systems, are completely decentralized. Anyone who has access to the internet can sign in on a blockchain platform to become an authorized node and be a part of the blockchain network. Private blockchains, which are more restrictive or permission blockchains operative only in a closed network, are deployed for voting, supply chain management, digital identity, asset ownership, etc. Hybrid blockchains function as a hybrid, where a group of organizations collectively manages the network.

Blockchain is being applied in many industries rather than financial services, including digital identity verification, supply chain management, and healthcare. It could reduce fraud risks and ensure product authenticity in supply networks by improving transparency and traceability. Similarly, blockchain-based digital identity solutions lower the danger of identity theft by providing safe and unchangeable records.

Although blockchain brings many advantages to users, it still faces serious security issues, including consensus protocol flaws, network intrusions, and smart contract exploits. Furthermore, scalability remains a significant challenge due to the slower transaction processing speeds of blockchain networks compared to traditional financial systems (Sarmah, S. S., 2018).

### **3.2. Blockchain in rice supply chain**

Blockchain technology has emerged as a transformative tool in rice supply chain management, particularly in enhancing traceability and ensuring compliance with processing standards. Given the complexity and challenges of the rice supply chain—including inefficiencies, fraud, and lack of transparency—blockchain offers a robust solution to track rice products from cultivation to final distribution.

According to Farooq et al. (2023), blockchain enhances traceability by providing real-time tracking of each batch of rice as it moves through the supply chain. By leveraging a decentralized and immutable ledger, blockchain ensures that records remain tamper-proof, allowing all stakeholders—including farmers, processors, and retailers—to access accurate and verifiable information about product origin and processing history. This transparency plays a crucial role in addressing food fraud and strengthening consumer confidence in rice quality.

Peng et al. (2022) emphasize that blockchain applications improve the efficiency of rice supply chains by automating compliance verification through smart contracts. These contracts enforce predefined processing and safety standards, ensuring that all handling stages—from milling to packaging—adhere to national and international regulations. Blockchain also minimizes information bottlenecks and optimizes data storage, facilitating a seamless flow of critical supply chain data.

One et al. (2022) emphasize that blockchain applications improve the efficiency of rice supply chains by automating compliance verification through smart contracts. These contracts enforce predefined processing and safety standards, ensuring that all handling stages—from milling to packaging—adhere to national and international regulations. Blockchain also minimizes information bottlenecks and optimizes data storage, facilitating a seamless flow of critical supply chain data.

Despite these benefits, the transition to a blockchain-enabled rice supply chain faces challenges. Kumar and Iyengar (2018) note that shifting from traditional, centralized systems to decentralized blockchain networks requires significant technological investment and stakeholder collaboration. Scalability and security also remain critical concerns, as blockchain platforms must process large transaction volumes while maintaining data integrity.

Several blockchain-based frameworks have been developed to address these challenges. Farooq et al. (2023) propose a blockchain-enabled rice supply chain model that enhances real-time monitoring and compliance verification. Yakubu et al. (2022) introduce the "RiceChain" framework, which focuses on traceability and ensuring product authenticity. These studies highlight the transformative potential of blockchain in revolutionizing rice supply chains by improving security, streamlining compliance, and strengthening trust among stakeholders.

## **4. Application of blockchain in the rice supply chain**

### ***4.1. Application scenarios***

Regarding the global agricultural industry, Vietnam is considered one of the most prominent players in the global rice trade and has accomplished many noteworthy milestones in recent years. Since 2022, Vietnam has exported \$3.18 billion tons of rice and become the world's third-largest rice exporter (Siesta Stats, 2024). This accomplishment highlights Vietnam's increasing influence on the agricultural industry. As a leading global producer and exporter, Vietnam is expected to continue to strengthen in the following period.

However, in early 2025, Vietnam's rice export market has faced challenges. In accordance with the Vietnam Food Association (VFA) report, rice export prices experienced a sharp decline with the price of 5% broken rice falling to \$399 per ton by February 2025. This downturn is primarily driven by a surplus in global supply and a shift in major importing nations. To maintain and strengthen its competitive edge in the global rice trade, Vietnam must focus on enhancing its supply chain. A well-managed supply chain is critical to ensure the efficient transportation and distribution of goods, thereby sustaining the country's export capabilities.

The innovation of supply chain management through technological advancements is imperative for enhancing logistical efficiency. In recent years, Vietnam has taken significant steps with a view to embracing sustainable supply chain practices. Among the various emerging innovations, blockchain technology stands out as a transformative solution. Blockchain enables real-time tracking and improves traceability, fosters trust among stakeholders, and reinforces Vietnam's standing as a reliable rice exporter. The integration of blockchain technology into supply chain management not only enhances efficiency but also strengthens compliance with international food safety and quality standards.

Currently, Vietnam is at a critical turning point in developing various industries by incorporating advanced technologies in agriculture, industry, and services. As a pioneer among ASEAN countries, Vietnam has been at the forefront of implementing blockchain technology to enhance traceability and transparency in agri-food products. According to *VnExpress* (2023), blockchain-based supply chain management can help optimize costs in international money transfers while also enhancing transparency. Since mid-2018, Vietnamese ICT enterprises have been actively developing blockchain platforms to serve the specific needs of the agricultural sector. This has led to the introduction of several blockchain-based traceability initiatives as Wowtrace, FruitChain, and Agridental 11. These initiatives have been implemented in southern Vietnam, particularly in key agricultural hubs like the Mekong Delta and Central Highlands regions. By enhancing the ability to track the origin and quality of agricultural products, these platforms contribute to greater consumer confidence, facilitate international trade, and mitigate risks associated with food fraud and supply chain inefficiencies.

As Vietnam continues to embrace digital transformation, the widespread adoption of blockchain technology will serve as a cornerstone to build a more transparent, efficient, and globally competitive agricultural sector. By fully leveraging blockchain technology and modernizing its supply chain infrastructure, Vietnam has the opportunity to enhance

agricultural resilience, fortify its position in the global market, and ensure long-term sustainability in the rice trade and beyond. Sustained investment in technological advancements and supply chain optimization will be crucial for Vietnam to maintain its competitive edge and expand its influence in the global agricultural landscape.

## **4.2. A case of Agridental**

### *4.2.1. Overview of Agridental*

Agridental.vn is a blockchain platform for traceability and production management according to the value chain, researched and developed by Vietnam Blockchain Corporation (VBC), helping to increase value and protect product brands. Through Agridental.vn, VBC contributes to building sustainable agriculture in Vietnam, helping to limit the problem of substandard, unknown-origin foods, and promoting international integration through Free Trade Agreements (FTAs) under many strict requirements on product origin. Some main activities of Agridental can be listed below (Agridental, 2022).

Firstly, Agridental, together with other stakeholders in the Vietnamese market, plays a crucial role in the digitization of the “Made in Vietnam” certification for global trademarks. This project not only promotes Vietnamese agricultural products on the global scene and improves Vietnam's reputation in the marketplace but also enhances the credibility of Vietnam's rice and other agricultural goods by meeting the traceability requirements of the international market.

Secondly, Agridental provides reliable and transparent management of company supply chain data regarding import and export activities. One of Agridental’s primary activities is supporting companies by providing them with a blockchain-based supply chain data management system that is both transparent and secure. This makes it easier for global trade to be conducted because there is a digital record that can be authenticated and that documents the farming, production, and distribution functions.

Thirdly, Agridental assists producers in maintaining production logs and protecting the integrity of Vietnamese product quality in accordance with the prescribed standards. Agridental also enables producers, especially rice farmers and processors, to record their production digitally so that they can protect their reputation as quality producers.

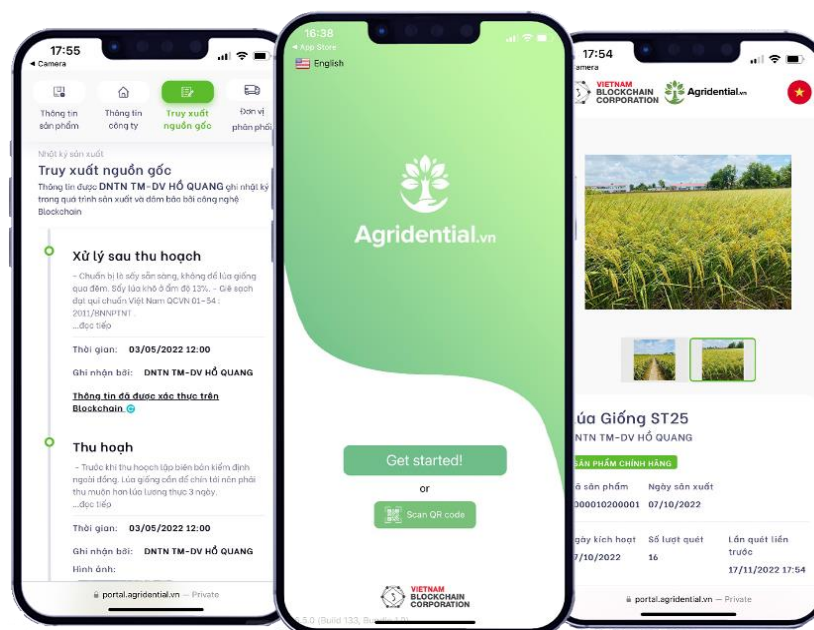
Finally, Agridental provides consumers trust in quality with the ability to trace back every product to the farm that grows it. Consumers can scan the QR code on the products and view details on where and how the product was grown, how it was processed, and what safety measures were taken. Such transparency gives confidence to both local and foreign consumers, improves brand loyalty, and helps justify higher prices for Vietnamese agricultural goods in valuable commodity markets.

### *4.2.2. Application in rice supply chain*

The pilot project of Agridental in rice supply chain management involves the renowned ST25 rice - the winner of the World’s Best Rice Award 2019. After winning the award, Ong Cua ST25 rice was heavily affected by the widespread appearance of “fake” products



throughout many provinces and cities and even in the international market (Agridental, 2022). To prevent this situation, Agridental launched a traceability pilot to activate QR codes and print them on the product packaging for all ST25 rice products. Since the Agridental.vn traceability pilot was put into place, all product, supplier, and certification information as well as processes from planting, tending, and harvesting to processing, packaging, and market distribution are accurately recorded on the blockchain platform in accordance with the designated execution time.



**Figure II:** Interface of Agridental

**Source:** Agridental (2022)

#### *a. Cultivation and harvesting*

Implementing VietGAP (Vietnamese Good Agricultural Practices) standards in rice cultivation still faces many challenges. While the certification aims to enhance food safety, farmers still struggle with applying these standards in the cultivation and harvesting process. One of the challenges in adopting VietGAP standards is the low level of knowledge and technical skills of rice farmers. In Vietnam, smallholders are used to growing rice using traditional practices, which can lead to the overuse of fertilizers and chemicals that are not in compliance with VietGAP certification. Another significant problem for compliance with VietGAP standards is the absence of traceability, which makes it impossible for business or regulatory stakeholders to ascertain whether the rice was produced in an environmentally friendly and safe manner.

In order to prevent this problem, Agridental provides a feature that helps managers assign pre-established data fields related to cultivation requirements that comply with safety standards. This enables farmers to manage each stage of the cultivation process in accordance with the business goals. In addition, the blockchain system enables stakeholders to have precise information regarding the origin of the rice and the farming practices that are used which leads to transparency and helps in building trust and compliance with safe standards.

### *b. Processing*

Processing plays an important role in determining the quality and market value of final outputs, yet the after-harvesting handling process still remains a challenge that impacts both producers and consumers. Maintaining the premium characteristics of high-quality rice requires precise processing techniques, but many facilities, particularly smaller-scale ones, struggle with inefficient practices. A lack of standardized processing methods might increase the risk of mixing lower-quality grains with higher-quality ones, which leads to fake labeling and a reduction in the product's quality. Furthermore, traditional record-keeping methods do not provide sufficient transparency, making it difficult for stakeholders to trace the handling process to ensure that best practices are consistently followed.

To ensure the final products meet the requirements, enterprises can give out standardized processing methods for the facilities to follow. Agridental should also provide information about the national requirement of production, preliminary processing, processing, packaging, and labeling, this will help the products meet regulatory standards and be fully prepared for both domestic sales and export. Moreover, each batch of rice is also tagged with a unique digital identifier, enabling stakeholders to track its journey through every stage of processing. The blockchain system will provide real-time monitoring of the product, which helps managers to immediately detect any defects, allowing for quick corrective actions.

### *c. Storage and warehousing*

With the large amount of rice products comes a need for sufficient storage; therefore, managing warehouses is an important part of the rice supply chain management process. Additionally, inconsistent warehouse management practices often result in stock mismanagement, where rice batches are not properly labeled or tracked, increasing the likelihood of expired or lower-quality rice being distributed. In many cases, the absence of suitable warehouse tracking systems can seriously hinder a business's ability to meet food safety compliance standards, consequently impacting the brand reputation and resulting in a market backlash both domestically and internationally.

As each batch of rice can be assigned a digital identifier, managers can monitor the condition and the storage location of the rice units and consequently can track their movement to the point of final distribution. With Agridental, managers can carry out suitable rotation whereby old products are issued first to mitigate loss from stale products. Furthermore, the system provides protection from fraud by enhancing the recordkeeping of the rice brand where blending or mislabeling with inferior goods is prohibited.

### *d. Distribution*

One of the concerns is the risk of contamination or spoilage because of the way the commodities have been handled while in transit. Many problems arise out of the shipment of goods, such as the chances of delays and insufficient storage conditions, and so a comprehensive set of rules and precautions must be developed that will minimize loss of quality in transit. Additionally, companies need to have a reliable system for tracking their goods during

the different stages of the distribution process to be able to anticipate and take action when unforeseen issues arise.

Agridental's blockchain technology makes it possible for managers to monitor the distribution of rice batches in real time, enabling a fully traceable and transparent supply chain. Managers can also use the information system to record any regulations related to the handling of the commodity so that the rice batches are delivered in the best possible conditions. Another benefit for Agridental is regarding compliance in the distribution and logistical aspects of the international trade of agricultural products. By ensuring products meet international requirements in the early stages of the supply chain, businesses can easily meet import/export conditions of the distribution stage.

#### *e. Retail*

Acts like misrepresenting lower-quality rice as a high-grade product might spoil the credibility of clients and damage the reputation of rice brands. Similarly, retailers are subject to strict food safety standards but may find it difficult to manage product safety and authenticity without an adequate traceability system. These days, consumers are increasingly interested in where the food comes from, including its cultivation, processing, and storage before consumption. However, these detailed requirements are increasingly difficult to satisfy using traditional supply chain models. As a result, retailers have a tougher job, having to align with ever-growing consumer demands.

By tracking each batch of rice with a unique digital identifier, Agridental allows retailers to check claims of quality and authenticity. The consumers can utilize their mobile devices to scan the QR code that is printed onto the packaging, which will grant them access to information related to the rice's lifecycle, from cultivation and harvesting to processing, storage, and transportation. Customers who are unable to scan the QR code and obtain information are likely dealing with a counterfeit product. This cross-product tracking capability, thus, not only promotes confidence in consumers regarding the authenticity of the product but also assists the retailers in differentiating their products from other brands.

### **4.3. Evaluation**

The successful implementation of Agridental in Vietnam's rice supply chain shows the potential of blockchain technology in enhancing the transparency, efficiency, and traceability of the rice industry. While Agridental serves as a case study of how blockchain can address industry challenges, it also raises broader questions about the scalability and applicability of this technology across the global rice supply chain. To fully understand its potential, it is essential to evaluate both the opportunities and threats associated with adopting blockchain technology in the rice supply chain industry as a whole.

#### *4.3.1. Opportunity*

Firstly, applying a blockchain system to rice supply chain management helps to increase customer trust. Nowadays, concerns around food safety and product genuineness are increasing, especially among the younger generation. Therefore, it is crucial to have a blockchain-

supported tracing system that gives buyers access to the complete life cycle of the rice products, from cultivation to their point of sale. This is especially useful for consumers of high-quality rice products that struggle with counterfeiting. Additionally, while enhancing authenticity, the blockchain system enhances trust between the producer and consumer, increasing demand and brand loyalty.

Secondly, the blockchain system can help to enhance traceability and improve food safety. With blockchain technology, businesses now have a comprehensive and clear record of all activities in the rice supply chain from cultivating and harvesting to processing and distributing. This record provides help in tracing contamination and implementing effective control measures within the food supply chain. Moreover, if a foodborne illness outbreak occurs, blockchain helps to trace and isolate the contaminated batches, thus significantly reducing the risks of adverse health issues for consumers.

Thirdly, many global markets, such as the European Union, have lots of strict requirements about the origin and safety of imported food. Vietnamese rice exporters have a lot of difficulties trying to enter these value markets. This is caused by the lack of a coherent and trustworthy supply chain, especially in the context of the growing influence of international agreements. With the help of a blockchain digital record, companies can ensure compliance with international standards relative to these processes throughout the rice supply chain. This feature ensures that rice exporters can comply with strict requirements for exportation, obtain certifications, and gain competitiveness in international markets.

Finally, integrating a blockchain system helps to improve operational efficiency. Traditional supply chain management in rice production often relies on paper-based records and manual tracking, leading to inefficiencies, data loss, and errors. By digitalizing the entire supply chain, all stakeholders can have access to real-time data on harvesting, processing, and distribution. This helps to reduce paperwork, minimize human errors, and improve coordination between farmers, processors, distributors, and retailers, ultimately leading to faster and more efficient operations.

#### 4.3.2. *Threats*

The first problem with applying blockchain systems is that the legal landscape surrounding this technology is still developing, and we still lack clear regulations governing its use in supply chains. Enterprises face difficulties in fully integrating new technology into their supply chains because of data privacy concerns and cross-border trade regulatory issues. The potential implementation of future restrictive policies keeps some companies from making long-term investments in blockchain technology. In addition, inconsistencies in regulatory frameworks between different markets may complicate the global adoption of blockchain-based traceability solutions in the rice industry.

Another problem is that, despite being known for its security, blockchain is not entirely immune to cyber threats. Important information could be exposed to external parties through cyber threats like hacking or data breaches. Therefore, businesses need to make careful judgments when selecting data for server publication while protecting sensitive information for

business confidentiality. Businesses need to establish an appropriate blockchain solution that guarantees transparency while protecting essential trade secrets.

Finally, the successful implementation of blockchain technology requires stakeholders, including farmers, processors, distributors, and retailers, to understand and correctly use the system. Many rice farmers together with supply chain operators currently do not have suitable technical knowledge or digital literacy skills to fully integrate blockchain into their current operations. Additionally, a traditional industry like rice farming often shows resistance to changes as stakeholders show hesitation in adopting new technology-driven solutions over their familiar practices.

## **5. Recommendation**

### **5.1. For authorities**

Government support plays a significant role in the adoption of blockchain technology, especially in the supply chain and logistics sector (AlKubaisy et al., 2023). With a view to *fostering an environment that supports blockchain adoption* in the logistics sector, it is essential for authorities to establish a well-structured regulatory framework. To ensure blockchain solutions comply with existing regulations, authorities should concentrate on developing clear guidelines on data security and the legal recognition of digital transactions to ensure blockchain solutions comply with existing regulations.

Besides regulatory assistance, authorities are recommended to *encourage collaboration between various stakeholders* in the logistics sector, including transport companies, suppliers, regulators, and technology providers. Fostering partnerships can help create a unified ecosystem where blockchain can be implemented more effectively. Moreover, authorities should also offer incentives, such as tax relief or financial assistance so that small and medium-sized enterprises (SMEs) have more chances to adopt advanced systems.

Last but not least, in order to promote blockchain adoption, authorities must *invest in education and capacity-building programs*. Training logistics professionals on the benefits and practical applications of blockchain technology will equip the workforce with the necessary skills. Authorities can help overcome resistance to promote widespread adoption across the industry. In the long run, these efforts will enhance transparency, efficiency, and accountability in the logistics sector, paving the way for a more sustainable future.

### **5.2. For firms**

To make sure that the blockchain system can be fully utilized, enterprises must ensure their *employees and supply chain partners are well-trained* and fully understand the system. Different stakeholders should be trained on how to input, verify, and retrieve the data effortlessly. Aside from that, enterprises need to work with technology providers for guidance and incorporate blockchain systems into their current supply chain management system for seamless progress toward digital traceability. With the proper training, these companies will be

able to greatly enhance the quality of the supply chain and comply with the international and domestic standards of the end products.

As blockchain technology continues to evolve, governments and regulatory bodies are developing new policies and guidelines to govern its application in food supply chains. Therefore, enterprises must always *update new information about these changes* to utilize the most out of the blockchain adoption. Collaborating with government agencies and working with industry associations is a good way to stay up to date with the latest trends and practices. Moreover, companies should keep track of changes in global trade regulations since applying blockchain traceability systems for food imports will be more common in the future. By staying up to date with regulatory changes and industry advancements, businesses can plan for future operations and maintain a competitive edge in the evolving and competitive rice supply chain industry.

Entering accurate data is very important for the blockchain system to work to its best potential. A *strict set of rules must be established* to prevent errors in input that might disrupt and reduce the credibility of the traceability system. A special team should also be formed to regularly check the data so that all supply chain bodies align with VietGAP and international standards, such as HACCP, ISO 22000, and GlobalGAP. Having precise and standardized information enables companies to export rice to elite markets like the EU, the US, and Japan which have strict traceability requirements.

### **5.3. For farmers**

Acquiring the necessary knowledge and skills is crucial for farmers to benefit from blockchain technology. Many farmers in Vietnam are too reliant on traditional documentation methods, which makes it challenging to adapt to blockchain-based systems. By investing effort into *learning blockchain technology*, farmers can improve their ability to participate in modernized agricultural supply chains. This knowledge will enable them to meet safety standards as well as build trust with buyers and stakeholders.

In the realm of 4.0 technology, it is essential for farmers to apply modern innovations in their agricultural practices. This will not only reduce the manual labor involved in traditional farming methods but also provide them with tools to boost productivity. A key recommendation for farmers is to *adopt blockchain technology in tracking agricultural products*. By utilizing blockchain to document production, and distribution on a decentralized ledger, farmers can guarantee that their products are of high quality and sustainably sourced. This approach serves as a safeguard against fraud and contamination, ensuring the integrity of the products.

Additionally, farmers can alter traditional documents by implementing smart contracts to streamline transactions. With blockchain's secure and tamper-proof data storage, farmers can maintain a precise, verifiable record of their operations while complying with regulations. By embracing blockchain, farmers can not only improve their operations but also participate in a more equitable, modernized, and efficient agricultural supply chain that benefits all involved parties.

## 6. Conclusion

The incorporation of blockchain technology into Vietnam's rice supply chain gives us a transformative opportunity to enhance transparency, efficiency, and trust among stakeholders. By addressing key challenges such as traceability, fraud prevention, and supply chain inefficiencies, blockchain has the potential to reform the industry.

Providing an analysis of the rice supply chain landscape and a review of blockchain applications, this report has demonstrated how innovative technologies can lead to positive change. The case study of Agridental highlights the practical implementation of blockchain, illustrating its benefits and challenges. While blockchain offers remarkable opportunities, drawbacks such as lack of knowledge in the field, technological risks, and regulatory uncertainties must be carefully addressed.

To fully exploit the benefits of blockchain in the rice supply chain, collaboration among the government, businesses, and farmers plays a significant role. Strategic investment, supportive policies, and capacity-building initiatives will be crucial for successful adoption. As Vietnam is on its way to modernizing its agricultural sector, embracing blockchain technology can strengthen the country's position as a leading rice exporter while ensuring greater food security and sustainability.

## References

“Agridental.vn – A Blockchain platform for made in Vietnam product traceability and production management by High-quality value chain”. (n.d.), Available at: <https://vietnamblockchain.asia/post/5663875/agridential-blockchain-for-agriculture>.

“Chỉ thị số 10/CT-TTG của Thủ tướng Chính phủ: về việc đẩy mạnh sản xuất, kinh doanh, xuất khẩu lúa, gạo bền vững, minh bạch, hiệu quả trong tình hình mới”. (2024), Cổng Thông Tin Điện Tử Chính Phủ - <http://chinhphu.vn>, Available at: <https://chinhphu.vn/?pageid=27160&docid=209837>.

“Người Nông Dân có cần thiết Truy Xuất Nguồn Gốc cho Nông Sản không?” (n.d.), Available at: <https://vietnamblockchain.asia/post/5663526/truy-xuat-nguon-goc-rat-can-thiet>.

“The truth about blockchain”. (2024), *Harvard Business Review*, 30 July, Available at: <https://hbr.org/2017/01/the-truth-about-blockchain>.

“Triển khai Thí điểm Giải pháp Truy Xuất Nguồn Gốc Blockchain hướng đến Bảo vệ Thương hiệu Gạo ST25 – Thuộc Dự án USAID LinkSME<sup>FOBJ</sup>”. (2022), Available at: <https://agridential.vn/blogs/5667750/truy-xuat-nguon-goc-gao-st25>.

“TTWTO VCCI - (Tin tức) Lúa gạo Việt Nam hội nhập mạnh mẽ với thế giới”. (2024), Available at: <https://trungtamwto.vn/chuyen-de/26279-lua-gao-viet-nam-hoi-nhap-manh-me-voi-the-gioi>.

AlKubaisy, Z.M. and Al-Somali, S.A. (2023), “Factors influencing blockchain technologies adoption in supply chain management and logistic sectors: cultural compatibility of blockchain solutions as moderator”, *Systems*, Vol. 11 No. 12, p. 574.

Farooq, M.S. et al. (2023), “A Blockchain-Based framework to make the rice crop supply chain transparent and reliable in agriculture”, *Systems*, Vol. 11 No. 9, p. 476.

*Kinh Doanh Và Phát Triển* (2019), “Agridental: Giải pháp mới về truy xuất nguồn gốc nông sản”, 29 August.

Kumar, M.V. and Iyengar, N.Ch.S.N. (2017), “A framework for blockchain technology in rice Supply Chain Management plantation”, *Advanced Science and Technology Letters*.

Nam B.N.N.V. (2023), “Rice industry suffers from technological limitations”, *Báo Nông Nghiệp Việt Nam*, 8 November.

Nguyen, N.Q. and Tran, D.T. (2004), “Ngành lúa gạo Việt Nam”, *Agro.Gov.Vn*, Available at: [http://agro.gov.vn/vn/chitiet\\_nghiencuu.aspx?id=132](http://agro.gov.vn/vn/chitiet_nghiencuu.aspx?id=132).

Nguyen, V.T. et al. (2024), “The role of blockchain technology in ensuring food safety of Vietnamese culinary firms”, *Advances in Intelligent Systems Research/Advances in Intelligent Systems Research*, pp. 494–507.

Peng, X. et al. (2022), “Research on the Cross-Chain model of rice supply chain supervision based on parallel blockchain and smart contracts”, *Foods*, Vol. 11 No. 9, p. 1269.

Sarmah, S.S. (2018). “Understanding blockchain technology”, *Scientific & Academic Publishing*, Vol.8 No.2, pp. 23 - 29.

Tect. (2018), “Ứng dụng blockchain vào nông nghiệp: Cơ hội nhiều, thách thức lớn”, *Tạp Chí Công Thương*, 31 March, Available at: <https://tapchicongthuong.vn/ung-dung-blockchain-vao-nong-nghiep--co-hoi-nhieu--thach-thuc-lon-52851.htm>.

Tư T.C.K.T.V.D.B.-B.K.H.V.Đ. (2024), “Nâng cao hiệu quả chuỗi cung ứng gạo xuất khẩu ở Việt Nam trước nguy cơ khủng hoảng lương thực toàn cầu hiện nay”, *Tạp Chí Kinh Tế Và Dự Báo - Bộ Kế Hoạch Và Đầu Tư*, 17 June.

Vfa. (2025), “Giá lúa gạo hôm nay ngày 14/2/2025: Lúa tươi đảo chiều giảm - Hiệp hội Lương thực Việt Nam”, *Hiệp hội Lương thực Việt Nam*, 14 February, Available at: <https://vietfood.org.vn/gia-lua-gao-hom-nay-ngay-14-2-2025-lua-tuoi-dao-chieu-giam/>.

Vu, T.T. and Trinh, H.H.H. (2021), “Blockchain technology for sustainable supply chains of agri-food in Vietnam: a SWOT analysis”, *Science & Technology Development Journal - Economics - Law and Management*, Vol. 5 No. 1, p. first.

Yakubu, B.M. et al. (2022), “RiceChain: secure and traceable rice supply chain framework using blockchain technology”, *PeerJ Computer Science*, Vol. 8, p. e801.