

Three-dimensional promotion path and benefit analysis of RMB settlement in cross-border fruit trade: a multi-agent collaborative perspective based on individual businesses, banks, and governments

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Abstract. As global agricultural trade grows and Chinese yuan (RMB) internationalization speeds up, the combined growth of cross-border fruit trade and RMB settlement has become an important topic in international trade and finance. This paper studies how different groups work together to examine how RMB settlement interacts with cross-border fruit trade and the real problems they face. The research shows cross-border fruit trade is now expanding in scale and adding more product types. RMB settlement helps trade by lowering exchange rate risks and making processes simpler. But small and medium-sized businesses still face high costs and struggle to get credit, banks are not creating enough new financial tools for cross-border trade, and government policies and regulations need to be better. To solve this, the paper offers a three-step plan: opening financial markets, improving policies and rules, and using new technologies. This includes expanding offshore RMB markets, creating special settlement systems, and applying blockchain technology. Studies show RMB settlement can make supply chains more stable, lower costs for small businesses, and support RMB internationalization.

Keywords: cross-border fruit trade, RMB settlement, multi-agent collaboration, three-dimensional promotion path, social benefits, economic benefits

1. Introduction

1.1. Current status of cross-border fruit trade

Global merchandise trade dropped to \$19 trillion in 2020 during the pandemic but rose to about \$25 trillion in 2023. Growth rates changed because of geopolitical conflicts and inflation. Traditional manufacturing trade has shrunk. Digital products, new energy, and service trade now drive growth. Cross-border fruit trade has grown steadily in recent years. Global consumers care more about healthy diets. Demand for fresh fruits has risen sharply. This boosts cross-border fruit trade. Trade volume and growth rates for cross-border fruit trade show positive trends, especially with neighboring countries and regions [1]. Main partners include fruit-producing countries in Southeast Asia and South America. Markets are wide and varied.

From 2018 to 2023, global cross-border fruit trade grew by 5.2% yearly. Trade volume rose from \$145 billion to \$187 billion. The first quarter of 2020 saw a 15% drop due to pandemic logistics issues. Trade recovered after 2021 as cold chain technology improved and regional trade agreements advanced. During this time, trade volume grew 3.8% yearly. Markets expanded in both volume and price. In 2023, Southeast Asia's fruit exports topped \$20 billion, making up over 60% of global tropical fruit trade. China-Vietnam fruit trade grew rapidly. In 2023, fruit import-export volume at Guangxi's Pingxiang Port hit 3.25 million tons, representing 60% of total China-Vietnam fruit trade [2]. In the first nine months of 2024, Vietnam imported over 5 billion Chinese yuan (RMB) of Chinese fruits, up 24% yearly. Chinese temperate fruits held a 42% market share in Vietnam due to lower prices. These numbers show China-Vietnam fruit trade is large and has room to grow. But China's fruit exports to Southeast Asia face challenges like local competition, logistics problems, policy barriers, weak branding, exchange rate changes, and settlement risks. These issues slow cross-border fruit trade growth.

1.2. The application of RMB settlement in cross-border trade

RMB settlement means using Chinese yuan instead of US dollars or Vietnamese dong for pricing and payments in China-Vietnam trade. This method aims to simplify payments, cut exchange rate risks, and lower costs by using RMB directly [3]. It has slowly expanded in China-Vietnam fruit trade, especially in cross-border deals. RMB settlement in cross-border trade has developed over time. Early on, global trade relied on strong currencies like the US dollar, so RMB settlement was rarely used. But as China grew stronger in global trade, RMB settlement became more common. In countries trading closely with China, RMB settlement is now a clear trend [4].

In RMB settlement, first, both sides sign a contract. The contract states each party's responsibilities and names RMB as the payment currency. Next, the seller ships goods as agreed, following customs rules and ensuring smooth cross-border transport. After goods arrive, the buyer checks them to confirm quality and quantity match the contract. If approved, the buyer pays RMB to the seller using systems like CIPS or direct bank transfers. Once paid, the buyer's bank processes the RMB funds. The buyer can then convert RMB to Vietnamese dong or keep it as RMB. The funds are deposited, finishing the settlement [5].

RMB settlement has clear benefits. First, it cuts exchange rate risks. Using RMB reduces losses from US dollar fluctuations, especially when rates swing sharply. Second, it saves conversion costs. Skipping US dollar steps lowers fees and losses. Third, it speeds up trade. RMB settlement makes cross-border payments simpler, shortens transfer times, and boosts efficiency. Fourth, it supports RMB internationalization. More RMB use raises its global role and pushes its global adoption. But challenges exist. Globally, RMB acceptance in finance still needs work, requiring more cooperation and promotion. Also, systems supporting RMB settlement—like cross-border payment tools and global financial services—must improve.

The Chinese government keeps pushing RMB internationalization. Projects like the Belt and Road boost global cooperation. These efforts suggest RMB settlement in cross-border trade has a strong future [5]. In areas like cross-border fruit trade, RMB settlement will likely spread further. This could help businesses, banks, and governments by making trade easier and cheaper.

1.3. Research on the development of cross-border fruit trade and RMB settlement

The combined growth of cross-border fruit trade and RMB settlement matters for regional economic cooperation. Trade policies and better logistics between China and major fruit areas like ASEAN and Oceania create chances to use RMB settlement widely. For example, Southeast Asia's durian and mangosteen trades increasingly use direct RMB payments. This cuts risks from USD exchange rate changes and speeds up supply chains by shortening payment cycles. But financial infrastructure struggles to adapt. Even though China's CIPS system expanded, small ASEAN fruit exporters still use old banking methods. In 2022, RMB settlement made up only 18% of China-ASEAN farm trade, far less than in bulk goods [6].

Tech innovation helps solve settlement efficiency problems. The digital yuan (e-CNY) uses "payment as settlement" and smart contracts in trials like Thai longan trade. Added to supply chain platforms, it allows "automatic payment on delivery." Blockchain tracks cold chain temperature data, giving proof for trade disputes and reducing information gaps. But RMB internationalization faces risks. Fruit trade's seasonal price swings and exchange rate changes may increase cross-border money flow instability. Better financial tools are needed to help small businesses manage risks. Differences in anti-money laundering costs and foreign exchange policies also limit RMB settlement use.

Past studies show local currency settlement in farm trade started with East Asia's currency plans in the early 2000s. Progress was slow because USD use was deeply rooted. After 2010, China-ASEAN currency swap deals built a system for RMB settlement in fruit trade. Research finds RMB use in fruit trade links to how much partner countries rely on exports to China and their financial market openness. But exporter bargaining power limits this.

Case studies show big regional differences in RMB settlement use. In Myanmar and Laos, where financial systems are weak, cash RMB makes up 40% of small border fruit trades. In Vietnam and Thailand, banks handle more settlements. This split comes from host countries' financial rules, local banks' cross-border skills, and trader willingness to accept RMB. Latin American fruit exporters, tied to USD financing, use little RMB, showing how currency habits lock in farm trade. Recent studies say farm trade funding problems push new settlement tools. Yunnan's Free Trade Zone tests a "Letter of Credit + Blockchain" model. It links durian orders to cold chain data, letting banks give RMB credit based on real-time shipping info. This helps small importers with little collateral. Some scholars want an RMB price index for farm trade to cut deal friction. Others warn RMB settlement faces "institutional bias" issues. For example, some ASEAN countries back RMB trade but limit local banks' RMB holdings to protect foreign reserve stability. The U.S. uses the Indo-Pacific Economic Framework (IPEF) to tie tech standards to the USD in farm trade, creating hidden barriers [8].

2. The multi-agent collaborative perspective of individual businesses, banks, and the government

2.1. The role and challenges of individual businesses in cross-border fruit trade

Individual businesses are key in cross-border fruit trade. They start the trade chain by buying fruits from farmers and selling to big distributors or exporting directly. Their business model is flexible, letting them react fast to market needs. But they face many challenges. Being small, they often lack resources and experience in buying, moving, storing, and selling goods. This weakens their position in cross-border trade. Handling foreign exchange risks, trade barriers, and complex rules is hard for them.

Individual businesses struggle with language differences, poor knowledge of global markets, limited funds, and logistics. They use translation services to talk to foreign buyers, raising costs and causing misunderstandings. They may not grasp global market needs well, leading to missed chances or too much stock. In funding and logistics, they lack the discounts and scale big firms get, making competition tough. In RMB settlement, they face risks like exchange rate changes, cash flow issues, policy shifts, and mistakes. Some Vietnamese traders prefer USD over RMB, making it hard to push RMB settlement [9].

Banks and governments must help individual businesses more. Banks can offer flexible loans and easier cross-border payments to cut costs. Governments can create better trade policies and share market info to help businesses enter global markets. To manage risks, businesses can use currency tools, pick banks with good cash flow, watch policy updates, get training, and check buyer credit.

2.2. The role of banks in supporting and facilitating cross-border fruit trade

Banks play a central role in cross-border fruit trade by offering financial services for individual traders. These services go beyond basic tasks like loans and currency exchange. They include extra support like market studies, risk checks, and trade advice. Using global networks and expert teams, banks help traders do cross-border deals, lower costs, and compete better.

Banks give individual traders services like issuing letters of credit and delivery guarantees for importers to make deals safer. They provide export financing tools like bill purchases and packing loans to ease exporters' cash problems. Banks also share market trend data and price changes through professional analysis. This helps traders make smarter decisions.

Real cases show how banks aid traders. For cross-border payments, ICBC worked with Vietnam's Foreign Trade Bank to start direct RMB-VND settlement. Traders can use RMB without USD conversion. For exchange rate risks, Bank of China's Guangxi branch offers hedging products to Chinese-Vietnamese fruit traders. These lock in rates and reduce fluctuation risks. For trade financing, banks give tools like letters of credit and factoring in RMB to solve cash flow issues [10].

2.3. Government policies and roles in cross-border fruit trade

Governments shape cross-border fruit trade through policies. Their rules affect how smoothly and efficiently trade happens. For example, improving import/export rules, cutting tariffs, and easing trade steps can lower costs for businesses in cross-border fruit trade. This boosts trade profits. The government also sets strict quality and safety standards for imported and exported fruits. This protects buyers and improves the country's global reputation. China and Vietnam launched policies to boost cross-border trade and RMB settlement, like the China-Vietnam Cross-border Economic Zone Plan and their currency swap deal. After RCEP took effect, China and Vietnam worked closer on tariff cuts and trade ease, helping RMB settlement grow [11].

Besides policies, governments help link businesses and banks. They can push banks to fund cross-border fruit traders by offering guarantees, loan subsidies, and other support. This eases money pressure on traders. Banks' professional services also make trade more standard and efficient. Governments create platforms like bank-business meetings to let traders and banks talk directly. This builds trust and teamwork.

Governments act as rule-makers, supervisors, and supporters in cross-border fruit trade. They design helpful trade policies, enforce quality checks, and connect businesses with banks. These steps help cross-border fruit trade grow steadily.

3. Three-dimensional pathway for promoting RMB settlement in cross-border fruit trade

3.1. Strategies from the financial market dimension

In cross-border fruit trade, the pathway for promoting RMB settlement is crucial, with the financial market dimension playing a pivotal role. To effectively expand the use of RMB in international trade, the primary task is to improve the RMB cross-border payment system. This optimization involves not only technological upgrades but also the enhancement of policy and regulatory frameworks to ensure the efficiency, security, and compliance of cross-border payments. By increasing the convenience of RMB cross-border payments and reducing transaction costs, more domestic and international market participants can be encouraged to choose RMB as the settlement currency, thereby advancing the internationalization of the RMB.

Specifically, the strategies from the financial market dimension should include the following aspects: 1. Strengthen financial infrastructure to enhance the processing capacity and coverage of the RMB cross-border payment system. 2. Optimize cross-border payment processes by leveraging the CIPS system or bilateral bank cooperation channels to simplify RMB settlement procedures, shorten fund transfer times, and improve settlement efficiency. 3. Strengthen financial cooperation with major trading partners to promote bilateral local currency settlement arrangements. Banks can provide Vietnamese traders with hedging tools, such as forward exchange contracts and options, to help them lock in exchange rates and mitigate exchange rate volatility risks. 4. Improve

the RMB repatriation mechanism by offering more investment channels for overseas RMB holders, thereby enhancing the international appeal of the RMB. 5. Provide Vietnamese traders with one-stop RMB settlement services, including account opening, fund clearing, and exchange rate risk management, to reduce operational complexity [12].

The implementation of these strategies will help build a more efficient, convenient, and secure RMB cross-border payment environment, providing robust financial support for cross-border fruit trade. Simultaneously, as the RMB's role in international trade grows, the international competitiveness of China's fruit industry will be further strengthened.

3.2. Support measures in the policy and regulation dimension

In the policy and regulation dimension, a series of policies conducive to RMB settlement should be formulated to promote the development of RMB settlement in cross-border fruit trade. Firstly, the government can introduce policies to encourage and support individuals and enterprises in using RMB settlement for cross-border fruit trade, such as providing tax incentives and reducing transaction fees, to enhance the attractiveness of RMB settlement. At the same time, strengthening financial cooperation with trade partner countries is crucial. By signing bilateral settlement agreements with trade partner countries, trade between the two nations can be facilitated more smoothly, offering favorable exchange rates, such as providing more advantageous exchange rates for RMB settlement, thereby reducing the exchange loss for Vietnamese traders and lowering exchange rate risks and transaction costs. Additionally, the government can promote closer cooperation between domestic financial institutions and overseas financial institutions, expanding the international influence of RMB and enhancing its position in global trade settlement. Professional exchange rate consulting services can also be provided to help foreign traders understand exchange rate trends and formulate reasonable settlement strategies. These supportive policy and regulation measures will contribute to the widespread adoption of RMB settlement in cross-border fruit trade, further driving the internationalization of China's fruit industry. Individual enterprises can offer a 2%-5% price discount to Vietnamese traders who use RMB settlement, incentivizing them to try RMB settlement, and prioritize shipment arrangements for clients using RMB settlement, shortening delivery cycles and improving customer experience [13].

3.3. Solutions from the perspective of technological innovation

In the process of advancing RMB settlement in cross-border fruit trade, the dimension of technological innovation plays a crucial role. Combining existing technologies, cross-border digital RMB settlement is the future trend. Digital RMB possesses unique advantages: in terms of legal tender status and sovereign credit, it is backed by the People's Bank of China, enabling it to circumvent third-party currency sovereign risks. Its technical features include: 1. Real-time settlement: Eliminating intermediary bank layers, transactions are completed in seconds. 2. Programmability: Supporting smart contracts to enable conditional payments. 3. Low cost: Cross-border transaction fees are nearly zero, lowering the participation threshold for small and medium-sized enterprises. Among these, blockchain technology, with its unique characteristics of decentralization, data immutability, and transparency, combined with mature encryption algorithms and mobile payment technologies, provides strong support for developing a convenient cross-border digital trade settlement platform. By adopting "controlled anonymity" blockchain technology, it significantly simplifies the cumbersome processes in traditional settlement, reduces transaction costs, and notably increases transaction speed while meeting regulatory requirements [14].

Specifically, blockchain technology can establish a secure and efficient distributed ledger system in cross-border fruit trade. This system can record all transaction information during the trade process and ensure the authenticity and integrity of the information. Through the automatic execution of smart contracts, trading parties can complete settlement without third-party intervention, greatly enhancing settlement efficiency. Additionally, blockchain technology can effectively address trust issues in cross-border trade, strengthen cooperation intentions among trading partners, and further promote the development of cross-border fruit trade. Digital RMB views blockchain as a technological tool to enhance trust and collaboration rather than an underlying architecture. Its core remains centralized control by the central bank, incorporating blockchain's advantages such as traceability, security, and smart contracts to achieve a balance between efficiency, security, and regulation. In the future, as technology evolves, the integration between the two may deepen further, but the sovereign currency attribute will always remain a design prerequisite.

To fully leverage the advantages of blockchain technology in cross-border fruit trade RMB settlement, governments, banks, and individual businesses need to work together. Governments should actively issue relevant policies to encourage and support the innovative application of blockchain technology in the cross-border trade field. Banks should actively explore the integration paths of blockchain technology with the existing financial system, providing individual businesses with more convenient and efficient cross-border trade settlement services. At the same time, individual businesses should proactively embrace new technologies to enhance their competitiveness in cross-border trade.

4. Analysis of the benefits of RMB settlement in cross-border fruit trade

4.1. Economic benefit analysis

RMB settlement in cross-border fruit trade brings economic benefits in two areas: cutting costs and boosting efficiency. First, using RMB avoids losses from exchange rate swings. This lowers currency exchange costs and risks for both sides. Data shows RMB settlement cuts currency costs by about 1.5%-3%, raising trade profits. Second, RMB settlement makes transactions simpler and speeds up payments. This improves how funds are used. After switching to RMB, payment time dropped from 5 days to 2 days. Faster payments let firms reuse money sooner, earning more.

RMB settlement also helps the trade surplus. Simpler currency steps and lower costs push more importers to choose RMB. This boosts Chinese fruit exports, lifting the trade surplus.

4.2. Social benefit analysis

In cross-border fruit trade, RMB settlement not only simplifies the transaction process and reduces currency exchange costs but also further enhances the international competitiveness of China's fruit industry. From the perspective of social benefits, the promotion of RMB settlement in cross-border fruit trade has played a positive role in advancing the internationalization of the RMB. As the use of RMB in international trade increases, its international status gradually rises, undoubtedly accelerating the pace of RMB internationalization. At the same time, this settlement method has brought significant international competitive advantages to China's fruit industry. By reducing currency conversion steps, transaction costs are lowered, and transaction efficiency is improved, making Chinese fruits more price-competitive in the international market. Furthermore, RMB settlement reduces exchange rate risks, providing a more stable operating environment for individual businesses and enterprises, thereby enhancing the profitability of the entire fruit industry. In summary, RMB settlement in cross-border fruit trade not only promotes the internationalization of the RMB but also adds an important advantage to the international competitiveness of China's fruit industry.

5. Conclusion

With the deepening of global agricultural trade and the acceleration of the internationalization of the Chinese yuan (RMB), the coordinated development of cross-border fruit trade and RMB settlement has become a significant issue in the fields of international trade and finance. From a multi-stakeholder collaborative perspective, this paper systematically analyzes the interaction mechanisms and practical challenges of RMB settlement in cross-border fruit trade. The research finds that the current cross-border fruit trade is characterized by scale expansion and product diversification. RMB settlement significantly enhances trade facilitation by reducing exchange rate risks and simplifying transaction processes. However, small and medium-sized merchants still face high settlement costs and credit barriers in the RMB settlement process, while banks are insufficient in innovating cross-border financial products. Additionally, policy support and regulatory systems urgently need improvement.

To address these issues, this paper proposes a three-dimensional advancement path: "financial market opening—policy and regulation optimization—technological innovation empowerment." Specific measures include developing the offshore RMB market, establishing specialized settlement mechanisms, and promoting the application of blockchain technology to improve the efficiency and security of RMB settlement. Benefit analysis shows that RMB settlement not only enhances the stability of the industrial chain and reduces financing costs for small and medium-sized enterprises but also provides substantial support for the internationalization of the RMB. Furthermore, the promotion of RMB settlement helps optimize the financial environment of cross-border fruit trade, facilitating further expansion of trade scale.

Finally, this paper suggests optimizing top-level design, strengthening risk prevention and control, and deepening international cooperation to promote the high-quality integration of cross-border fruit trade and RMB settlement. This will not only contribute to serving the new "dual circulation" development paradigm but also inject new momentum into global agricultural trade and the internationalization of the RMB, providing strong support for enhancing the international competitiveness of China's fruit industry.

Authorship

Xiaozhu Zhou undertook the initial drafting of the paper, with a focus on presenting the research findings in a clear, accurate, and logically rigorous manner. During the writing process, attention was paid to the structure and language expression of the paper to ensure that it complies with academic standards and journal requirements. Additionally, Xiaozhu Zhou was responsible for writing the introduction and discussion sections, elaborating in detail on the research background, objectives, significance, as well as comparisons and distinctions with existing studies.

Kun Yi conducted a comprehensive review and revision of the initial draft, offering numerous constructive suggestions regarding the completeness of the content, coherence of the logic, and accuracy of the language. The experimental methods and results sections were particularly emphasized and revised to make them more detailed, accurate, and easy to understand.

Xiaozhu Zhou and Kun Yi contribute equally to this research.

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