Research on Improvement Pathways for the Cross-Border Trade Value Chain of Green Agricultural Products for Emerging Markets

Jun Jiang*

Yunnan College of Finance and Economics, Kunming, 650000, China
**Corresponding author: jiangjuntifa@hotmail.com*

Abstract: *Under the global wave of sustainable development, cross-border trade in green agricultural products is reshaping the agricultural economic and trade landscape. As crucial suppliers, the upgrading of the value chain in emerging markets is vital for trade efficiency and sustainable development. This paper constructs an analytical framework integrating value chain theory and sustainable development concepts to systematically examine the pathways for enhancing cross-border trade of green agricultural products in emerging markets. The study reveals structural bottlenecks in this value chain, such as limited upstream influence and insufficient value-adding capacity in the midstream and downstream segments. Accordingly, it proposes a systematic enhancement pathway comprising objectives and principles, key elements, and coordination mechanisms, clarifying a three-pronged optimization approach: ecological and smart development upstream, greening and digitalization midstream, and branding and community-building downstream. This provides theoretical reference and practical guidance for emerging markets to gain new competitive advantages in the global green agriculture sector.*

Keywords: *green agricultural products, cross-border trade, value chain, emerging markets, enhancement pathways, sustainable development.*

Introduction

Against the backdrop of global green transition, the cross-border trade of green agricultural products in emerging markets faces both opportunities and the risk of being locked into low-end segments due to weak value chain governance capabilities. This study constructs an analytical framework integrating value chain theory and sustainable development concepts to systematically analyze the foundational and operational status of the cross-border trade value chain for green agricultural products in emerging markets, thereby proposing scientifically grounded enhancement pathways. The research not only contributes to deepening the application of global value chain theory in the field of green economy but also provides an integrated analytical framework and action plan for promoting the transformation of agricultural industries in emerging markets toward green and high-value directions, holding significant theoretical value and practical guiding significance.

1. Theoretical Foundation of the Cross-Border Trade Value Chain for Green Agricultural Products

1.1 Conceptual Connotation and Characteristics of the Cross-Border Trade Value Chain for Green Agricultural Products

The cross-border trade value chain for green agricultural products is a composite concept. Its core lies in deeply embedding elements of environmental sustainability into global value-creating activities that span from production to final consumption. This value chain not only encompasses the series of stages inherent in traditional cross-border trade of agricultural products-including research and development, production, processing, logistics, marketing, and after-sales service-but, more importantly, emphasizes the implementation of the core principles of ecological friendliness, resource conservation, and social responsibility at every stage. Its connotation is reflected in the environmental management of agricultural products across their entire lifecycle, extending from the greening of inputs and the cleaning-up of production processes, to the low-carbon transformation of circulation links, and finally

to the resource recovery of post-consumption waste.

Compared to the value chain of traditional agricultural product trade, the cross-border trade value chain for green agricultural products exhibits several distinctive characteristics. The first is the complexity of its value composition: value originates not only from the use value and exchange value of the agricultural products but also derives from their environmental and health values. The second is the stringency of standards: all activities within this value chain are strictly constrained and guided by internationally recognized green standards, certification systems, and eco-labels[1]. The third is the internalization of externalities: through specific institutional designs, this value chain seeks to absorb and transform the negative environmental externalities generated by agricultural production and trade activities, turning them into sources of value-added within the chain. These characteristics collectively define the unique attributes of the cross-border trade value chain for green agricultural products, forming the logical starting point for its theoretical analysis.

1.2 Analysis of the Applicability of Value Chain Theory in Green Agricultural Product Trade

Global value chain theory provides a powerful analytical tool for deconstructing the activities involved in cross-border trade of green agricultural products. This theory shifts the perspective from the isolated production of a single enterprise or country to the holistic value creation network formed through cross-border and inter-firm collaboration among multiple participants. Within the context of green agricultural product trade, the application of value chain theory aids in identifying the core links where value is added and in analyzing the role positioning, power dynamics, and benefit distribution mechanisms among different participants-including farmers, cooperatives, processing enterprises, exporters, multinational distributors, and retailers-within the chain. Its applicability is particularly evident in the analysis of how the "green" attribute influences value chain governance models. Due to the strict standards and certifications involved with green agricultural products, their value chain typically exhibits a higher degree of vertical coordination and tighter on-chain governance.

Leading enterprises, such as major retailers or brand owners, often drive the entire chain to adhere to green standards by establishing private standards, implementing source traceability, and conducting oversight. This governance model not only ensures product quality and environmental compliance but also reshapes the power structure within the value chain. Under the framework of value chain theory, upgrading analysis holds significant guiding importance for understanding how green agricultural product exporters can ascend from purely production-based functions to higher-value segments such as the application of eco-friendly technologies, participation in standard-setting, and even brand marketing.

1.3 Theoretical Underpinning of Sustainable Development Concepts for the Cross-Border Trade Value Chain

The concept of sustainable development provides a profound philosophical foundation and theoretical guidance for the construction and evolution of the cross-border trade value chain for green agricultural products. This concept emphasizes the harmonious integration of three pillars: economic development, environmental protection, and social equity, which aligns closely with the multiple value objectives pursued by the green agricultural product value chain. From an environmental perspective, the sustainable development concept demands that trade activities must operate within the boundaries of Earth's ecological carrying capacity. This directly supports the inherent requirements of the green agricultural product value chain for efficient resource utilization, pollution minimization, and biodiversity conservation. It promotes the application of tools such as lifecycle assessment and carbon footprint accounting in value chain management, thereby making environmental cost a core variable in decision-making[2].

From a social perspective, the concept emphasizes intra-generational and inter-generational equity, providing an ethical framework for examining issues such as benefit distribution within the value chain, livelihood security for smallholder farmers, community development, and consumer rights protection. It compels the operation of the value chain to pursue not only economic efficiency but also social inclusivity. Therefore, the concept of sustainable development is not merely an external constraint on the value chain; rather, it fundamentally reshapes the philosophy and paradigm of value creation, driving cross-border trade activities to shift from a singular focus on economic value toward the integrated creation of economic, environmental, and social value. This theoretical underpinning ensures that the development trajectory of the cross-border trade value chain for green agricultural products

aligns with the long-term well-being of human society.

2. Examination of the Current State of the Cross-Border Trade Value Chain for Green Agricultural Products in Emerging Markets

2.1 Basic Composition of the Cross-Border Trade Value Chain for Green Agricultural Products in Emerging Markets

The composition of the cross-border trade value chain for green agricultural products in emerging markets exhibits the complex network characteristics of multi-agent collaboration and multi-stage linkage. The upstream segment of this value chain is primarily composed of various entities engaged in green agricultural production, including plantations, agricultural cooperatives, and contract farmers that hold organic or green certifications. Their core function is to strictly adhere to specific environmentally friendly production standards to supply primary products. The midstream segment aggregates processing enterprises, exporters, as well as quality inspection and certification bodies. These actors are responsible for the green processing of agricultural products, quality control that meets the market access standards of destination countries, and the crucial provision of third-party certification services.

The downstream segment involves importers, distributors, retailers, and even e-commerce platforms that sell directly to consumers, performing functions such as cross-border logistics, green brand marketing, and end-market sales. Supporting this network of entities is a service system that operates throughout the entire chain, encompassing specialized green logistics providers focusing on cold chains, financial institutions offering green trade finance services, and technology solution providers responsible for information integration and traceability. These participants are collectively embedded within an institutional environment constituted by international standards, private standards, and market norms, forming a dynamically evolving value creation system for the cross-border trade of green agricultural products[3].

2.2 Assessment of the Development Level of Cross-Border Trade in Green Agricultural Products in Emerging Markets

Currently, the cross-border trade of green agricultural products in emerging markets is in a stage characterized by accelerated expansion in scale yet uneven development overall. Observing trade flows, the export value of green agricultural products originating from emerging markets shows a steady growth trend. The range of exported categories has expanded from traditional items such as tea, coffee, and spices to include fruits, aquatic products, and high-value cash crops, which indicates a trend towards product diversification. However, market concentration remains high, with export destinations still heavily reliant on mature consumer markets such as North America and Europe. The potential for green agricultural product trade within emerging market regions themselves has yet to be fully tapped. Analyzing supply capacity, the number of production bases and products that have obtained globally recognized green certifications continues to increase, signaling a fundamental improvement in production capabilities.

However, in terms of the depth of the value chain, most participating entities remain concentrated in foundational segments such as raw material supply and primary processing. Their involvement and control over high-end segments-including brand building, channel control, and core technologies-are relatively limited. At the level of consumer awareness, the domestic consumer culture for green agricultural products within emerging markets is still in a cultivation phase. While domestic market demand has begun to awaken, it has not yet formed a scaled driving force. This leads to a degree of path dependency in the development of the value chain, which remains largely driven by external markets.

2.3 Analysis of the Operational Mechanisms of the Cross-Border Trade Value Chain for Green Agricultural Products in Emerging Markets

The effective operation of the cross-border trade value chain for green agricultural products in emerging markets relies on the synergistic interaction of a series of key mechanisms. At its core is the standards transmission and certification mechanism. Internationally recognized green standards transmit environmental compliance requirements from downstream buyers upstream to producers through means such as certification audits and supply chain clauses, forming the governance

foundation of the value chain. The information transmission and traceability mechanism, leveraging digital technologies such as blockchain and the Internet of Things, achieves full-chain information transparency from farm to table. This mechanism aims to address information asymmetry and guarantee the authenticity of products' green credentials. The risk-sharing and financing mechanism faces particular challenges. Due to the high upfront investment and long certification cycles associated with green production, traditional financing models often poorly match the industry's characteristics. This gap has spurred demand for innovative financial instruments based on production data, future revenue streams, or green assets[4].

The value distribution mechanism reflects the bargaining power of different participants within the chain. Downstream enterprises that control end-market channels, core technologies, and brand influence typically secure a larger share of the value. Conversely, upstream producers face the enduring challenge of translating their additional environmental costs and efforts into fair economic returns. The interplay of these mechanisms collectively determines the operational efficiency, stability, and upgrading potential of the cross-border trade value chain for green agricultural products in emerging markets.

3. Constructing Enhancement Pathways for the Cross-Border Trade Value Chain of Green Agricultural Products in Emerging Markets

3.1 Overarching Objectives and Principles for Enhancing the Cross-Border Trade Value Chain of Green Agricultural Products

3.1.1 Establishing an Objective System Centered on Value Co-creation and Equitable Distribution

The ultimate goal of the enhancement pathway is to establish a trade system capable of continuously creating and equitably distributing comprehensive value. This implies that value addition within the chain stems not only from improved production efficiency and expanded market scale but, more importantly, from the premium-generating capabilities derived from green technologies, ecological branding, and sustainable development models. Concurrently, it is essential to establish transparent value accounting and distribution mechanisms. These mechanisms should ensure that primary producers, processing enterprises, and service providers participating in green production receive corresponding economic returns based on their environmental contributions and value inputs. This is fundamental to safeguarding the inherent dynamism and social inclusivity of the value chain's development.

3.1.2 Establishing Architectural Principles Characterized by Structural Resilience and Coordinated Evolution

The enhancement of the value chain must adhere to principles of structural resilience to strengthen its capacity to withstand external market fluctuations and internal risk shocks. The systematic principle requires viewing all stages-research and development, production, logistics, marketing, and consumption-as a dynamic network, where the optimization of any node must consider its network effects and feedback mechanisms. The principles of openness and modularity encourage the value chain, while maintaining unified core standards, to allow entities from different regions and of varying scales to connect in flexible ways. This facilitates knowledge spillover and innovation diffusion, ultimately forming a resilient structure capable of maintaining overall coordination while rapidly responding to localized changes.

3.1.3 Implementing an Ethical Orientation Based on Full Life-Cycle Environmental Sustainability

The principle of environmental sustainability must be internalized from an external constraint into the fundamental logic of value chain operations. This necessitates moving beyond end-of-pipe management thinking and integrating the Life Cycle Assessment methodology throughout the entire process, from raw material acquisition to product end-of-life disposal. The design of the enhancement pathway should guide the allocation of resource inputs toward conservation and circularity, promote the transition of energy use toward low-carbon and clean sources, and establish an environmental impact measurement and disclosure system aligned with planetary ecological boundaries. This ensures that the growth of the value chain does not come at the expense of exceeding environmental carrying capacity[5].

3.2 Key Elements and Synergistic Mechanism Design for the Enhancement Pathway

3.2.1 Strengthening the Central Role of Technological Enablement and Data-Driven Decision-Making

Digital technology serves as the primary driving force in reshaping the form of the cross-border trade value chain for green agricultural products. Key technological elements include establishing an intelligent agricultural production environment monitoring system based on the Internet of Things, enabling the real-time sensing and regulation of ecological parameters such as soil, water, and atmosphere; applying blockchain technology to create a tamper-proof, fully transparent traceability and credit system, thereby reducing transaction costs and certification risks through digital trust; and utilizing big data and artificial intelligence models to conduct predictive analysis of global consumption trends, logistics routes, and climate risks, supporting precise decision-making and agile responses for enterprises within the chain. The integrated application of these technologies is evolving from a toolset into the new infrastructure of the value chain.

3.2.2 Improving the Support System for Standards Integration and Human Capital Enhancement

At the level of the standards system, the key to the enhancement pathway lies in promoting the mutual recognition, integration, and innovation of standards. On one hand, it involves actively participating in the revision of international standards to foster harmonization among the market access requirements of different regions. On the other hand, it necessitates advancing the development of "green standards of origin" based on region-specific ecological endowments and cultural heritage, thereby transforming local uniqueness into a competitive market advantage. At the level of human capital, it is essential to construct a lifelong learning system that spans all segments of the value chain. Through a collaborative model involving industry, academia, and research, this system should cultivate versatile professionals proficient in modern agricultural technology, familiar with cross-border supply chain management, and equipped with the ability to strategize green branding, thereby providing the intellectual capital necessary for the upgrading of the value chain.

3.2.3 Innovating Synergistic Mechanisms for Financial Support and Multi-level Governance

The design of synergistic mechanisms serves as a bridge connecting key elements to value creation. In terms of financial synergy, it is essential to develop green financial instruments that go beyond traditional collateral-based models. Examples include supply chain financing linked to sustainable performance, and green credit products based on future revenue streams or carbon sink assets. These instruments should guide capital to be precisely invested in the greening segments of the value chain. Regarding governance synergy, the encouragement of a polycentric, networked governance model is crucial. Through establishing industry alliances, digital platforms, and other vehicles, this model promotes strategic information sharing, joint research and development, and collaborative market expansion among enterprises within the chain. This fosters collective action capability to address systemic challenges.

3.3 Optimization Directions for the Cross-Border Trade Value Chain of Green Agricultural Products in Emerging Markets

3.3.1 Ecological and Smart Transformation at the Upstream Production End

The core of upstream optimization is to transform production bases from singular output units into composite systems where ecological value and product value coexist. Ecological transformation involves promoting farming models based on agroecology, increasing agricultural biodiversity, reducing reliance on external chemical inputs, and exploring pathways for the market-based realization of the value of ecosystem services such as soil carbon sequestration and water conservation. Smart transformation focuses on utilizing satellite remote sensing, drones, and sensor networks to achieve precise monitoring and management of crop growth, soil moisture, and pest and disease occurrence. By employing data-driven decision-making to optimize the input efficiency of resources like water, fertilizers, and pesticides, this approach aims to maximize positive environmental benefits while ensuring yield[6].

3.3.2 Greening and Digital Integration at the Midstream Circulation End

The focus of optimizing the midstream segment lies in constructing an efficient, transparent, and low-carbon cross-border circulation corridor. Greening integration requires conducting comprehensive environmental impact audits of processing and logistics activities. This involves promoting low-carbon

processing technologies such as energy-efficient dehydration and low-temperature sterilization, adopting eco-friendly packaging materials that are biodegradable and recyclable, and designing optimized routing based on multimodal transport to reduce the overall carbon footprint. Digital integration is dedicated to creating a "digital twin" that spans port, warehousing, and transportation systems. By implementing unified data exchange standards, it achieves seamless connectivity for procedures such as customs declaration, inspection, and bonded logistics, thereby significantly enhancing the efficiency and visibility of cross-border circulation.

3.3.3 Branding and Community-Based Expansion at the Downstream Market End

The goal of downstream optimization is to break through the predicament of "having products but lacking brands," achieving a leap from merely selling goods to conveying value. Branding expansion emphasizes the systematic development of value narrative capabilities. It involves deeply excavating the origin stories, ecological value, and cultural connotations behind green agricultural products, and establishing clear identity recognition and quality trust in the minds of global consumers through a unified visual system and certification marks. Community-based expansion fully leverages social media and cross-border e-commerce platforms to build interest communities centered around healthy and eco-friendly lifestyles. Through content marketing, experience sharing, and interactive communication, it fosters emotional connections with target consumers that go beyond mere transactions, transforming one-time buyers into loyal brand advocates, thereby solidifying and expanding the market foundation.

Conclusion

Through a systematic analysis of the cross-border trade value chain for green agricultural products in emerging markets, this study demonstrates that constructing its enhancement pathways constitutes a comprehensive undertaking involving theoretical reconstruction, assessment of the current state, and strategic innovation. The research clarifies that this value chain possesses core characteristics of composite value, stringent standards, and the internalization of externalities, and its operation is profoundly guided by the concepts of sustainable development and shaped by global value chain governance models. The examination of the current situation in emerging markets reveals underlying issues such as structural imbalances and insufficient momentum for upgrading, despite rapid expansion. In response to these challenges, the enhancement pathway framework constructed in this paper emphasizes core objective principles centered on value co-creation, structural resilience, and lifecycle management. It highlights the driving role of key elements such as technological enablement, standards integration, human capital, and financial innovation, and outlines specific directions for systematic optimization along the upstream, midstream, and downstream segments.

Future research and practice can further focus on frontier areas such as the disruptive impact of digital technologies on value chain governance models, the innovative design of regional green standard mutual recognition mechanisms, and agriculture value realization mechanisms based on nature-based solutions. This will continuously propel the cross-border trade value chain for green agricultural products in emerging markets to evolve towards a stage characterized by greater resilience, enhanced inclusivity, and higher value.

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