

Research on Mechanisms and Pathways for Upgrading the Geographical Indication Agricultural Product Industry Chain in Western Guangdong, China Based on the Digital Economy

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Abstract: Under the national strategy of deeply integrating digital technology with the entire agricultural chain, Western Guangdong, despite its rich resources of Geographical Indication (GI) agricultural products, faces practical challenges such as a low industrial chain level, insufficient brand premium, and a fragile supply chain. The innovation of this paper lies in: based on the industrial chain upgrade theory and from the perspective of stakeholders, it systematically analyzes a three-dimensional constraint framework affecting industrial upgrading, namely "Digital Infrastructure - Subject Digital Literacy - Industrial Chain Coordination". Accordingly, an integrated upgrade path of "strengthening digital infrastructure, enhancing farmers' digital literacy, and deepening industrial chain coordination" is proposed. This research provides a regionally adapted theoretical explanation and practical solution for resolving the structural problem of "high quality but not high price" for GI agricultural products in Western Guangdong and similar smallholder economic zones.

Keywords: Geographical Indication Agricultural Products, Industrial Chain Upgrading, Digital Economy, Western Guangdong, Smallholder Economy.

1. Introduction

The deep integration of digital technology and the agricultural industry chain is a crucial measure for implementing national strategic deployments such as the "Digital Village Development Action Plan (2022-2025)" and for enhancing the brand value of Geographical Indication (GI) agricultural products [1, 2]. Western Guangdong, an advantageous production area for tropical characteristic agricultural products in China, possesses rich GI resources including Xuwen Pineapple and Lianjiang Red Orange [3]. However, the industrial development in this region is trapped in a structural dilemma characterized by "high yield but low value," commonly manifesting as low processing rates (below 40%), low digital penetration, and weak brand premium capability [4, 5]. In practice, sharp conflicts exist between front-end marketing innovations like "live commerce" and the underdeveloped backend capabilities in processing, cold chain, and logistics, leading to the paradox of "increased production without increased income" [6]. Therefore, investigating how the digital economy can effectively drive the upgrading of the GI agricultural product industry chain in Western Guangdong holds urgent practical significance for addressing the core challenge of "high quality not commanding high prices" and for fostering new quality agricultural productivity [7].

Scholars have explored the integration of the digital economy and agriculture from various dimensions. Domestic research primarily focuses on three themes: first, elucidating the reconstructing effects of digital technology on the entire agricultural chain [8]; second, demonstrating the positive role of geographical indications in enhancing brand value and farmers' income [9]; and third, examining the inevitable trend towards whole-chain coordination and digital innovation in

the agricultural industry chain [10]. International research, often situated within large-scale agricultural contexts, highlights the significant effectiveness of technologies like big data and the Internet of Things in reducing costs, improving efficiency, and optimizing supply chains [11, 12]. However, notable limitations persist in existing studies. Foreign models based on scale and private brands struggle to align with China's complex governance structure of "GI public brand + smallholder farmers". Domestic studies frequently concentrate on grain crops or macro-level analyses, lacking in-depth examination of regional heterogeneity in areas like Western Guangdong and failing to systematically reveal the internal transmission mechanisms between the "digital economy" and "industrial chain upgrading".

Addressing these research gaps, this paper makes marginal contributions in two key aspects. Theoretically, adopting a stakeholder perspective, it systematically constructs a three-dimensional analytical framework—"digital infrastructure - subject digital literacy - industrial chain coordination"—to deepen the understanding of the constraints hindering industrial chain upgrading in Western Guangdong. Practically, moving beyond a "one-size-fits-all" approach and grounded in the reality of a smallholder-dominated economy in Western Guangdong, it proposes a set of integrated upgrading pathways with greater regional adaptability. This aims to provide a more targeted theoretical foundation and practical guidance for resolving the development dilemmas of the GI industry in similar smallholder economic zones in China.

2. Analysis of the challenges and three-dimensional constraints in the geographical indication agricultural product industry chain of western Guangdong

2.1. Current situation and manifestations of predicaments

The industrial structure is irrational, and products have low added value. Geographical indication agricultural products in western Guangdong exhibit the characteristic of “high yield but low value.” Taking Xuwen pineapples as an example, government data reveals that pineapple cultivation covers 350,000 mu (approximately 23,333 hectares) with an average annual output of about 700,000 tons, accounting for one-third of China's total pineapple production. However, the primary market season for pineapples nationwide is concentrated between February and May. This leads to a sudden surge in supply within a short period, causing demand to fall short of supply temporarily. According to economic principles, this results in a decline in commodity prices, which is unfavorable for increasing farmers' income and further compresses profit margins across the industrial chain. Despite the large output, pineapples are still primarily sold as primary agricultural products. Currently, processing capacity in western Guangdong's pineapple enterprises remains below half of production volume, with primary processing (canned pineapple) dominating. The proportion of deep processing—such as juice, freeze-dried products, and functional extracts—remains low. This limits value-added potential within the industrial chain, confining the cluster primarily to mid-to-low-end production and processing segments. Forming a clustered, high-end industrial chain within the short term is challenging. Similar scenarios unfold for Gaozhou's lychee and mango products, which hold national-leading production volumes yet maintain processing rates below 15%. These products suffer from short value chains, abundant substitutes, low brand recognition, and extreme vulnerability to market supply-demand fluctuations. Farmers' limited participation in and control over value-added services leaves them heavily dependent on market conditions. When intense competition arises, fruit growers lose bargaining power, severely impacting their earnings.

Brand equity premium remains low. Experts note that brands generate additional revenue for enterprises, as consumers are willing to pay a premium for branded goods over generic alternatives. Weak brand influence constitutes a bottleneck hindering the full realization of value for geographical indication (GI) agricultural products in Western Guangdong, resulting in limited market recognition. Despite national GI certifications for products like Xuwen pineapple, Gaozhou lychee, and Qandou mango, online surveys reveal that 90% of consumers remain unaware of or unfamiliar with these origins. Their brand reach falls far short of renowned national GIs like Wuchang rice or Yangcheng Lake hairy crabs. This lack of recognition and reputation severely hampers the branding and promotion of Western Guangdong's agricultural products, hindering the effective realization of their value. Without emotional recognition or deep impressions of Western Guangdong agricultural products, consumer misperceptions prevent the unique qualities and regional cultural significance of these goods from effectively reaching end markets. Customers struggle to form stable

quality recognition or emotional connections, further weakening brand premium pricing power and repeat purchase intent. This failure to cultivate loyal users hinders the industry's continuous upgrading.

The breadth and depth of sales channels remain insufficient. Despite achieving exports under proactive government guidance, Western Guangdong's specialty agricultural products still account for a low proportion of overseas sales, indicating substantial untapped market potential abroad. Currently, marketing channels for Western Guangdong's agricultural products heavily rely on traditional domestic wholesale hubs and regional retail outlets. This limits market coverage radius and results in fragmented sales expansion, making it difficult to adapt to the intense market competition of the digital economy era. In the digital economy era, e-commerce platforms have become primary sales battlegrounds. New marketing approaches like e-commerce-assisted agriculture and livestreaming for agricultural support present both opportunities and challenges. Many farmers remain unfamiliar with using e-commerce platforms for product sales and distribution, failing to seize development opportunities. Xuwen pineapples have achieved some success through online sales channels like JD.com and Douyin livestreaming. However, constraints in agricultural preservation technology and logistics systems result in high sales costs and spoilage rates for fresh produce. Additionally, some merchants pass off inferior goods as premium products, leading consumers to purchase spoiled or substandard items. The high cost of consumer rights protection directly dampens online purchasing enthusiasm, thereby hindering the optimization and upgrading of distribution channels.

2.2. Deep-seated constraints: a three-dimensional analytical framework

The development of digital infrastructure in Western Guangdong exhibits significant shortcomings, with insufficient carrying capacity. Compared to the Pearl River Delta region, Western Guangdong lags behind in economic development, with inadequate investment in digital technologies and a relatively late start in applying big data platforms. The vast rural areas of Western Guangdong suffer from unstable network connectivity, hindering the adoption and promotion of digital technologies. This poses a significant challenge for agricultural products that rely on stable internet connections for sales. Although the government is actively promoting digital village development, the effectiveness of these investments is not immediately apparent, and infrastructure improvements require time to mature. Concurrently, the cost of digital technology adoption remains high for farmers, and convenience is lacking. In Western Guangdong's vast rural areas, the outflow of young and able-bodied workers has left behind a “left-behind population” with limited digital literacy. Currently, agricultural product transactions in Western Guangdong lack a unified digital trading platform. Low compatibility between existing platforms and numerous regulations hinder usage and communication among farmers and businesses, reducing adoption enthusiasm. Although the government is committed to developing traceable agricultural products, lax management of geographical indication (GI) authorizations allows “fake GI” products to infiltrate digital traceability systems. This negatively impacts the promotion of digital technology adoption.

Farmers' digital literacy needs improvement. Farmers are

the main actors in upgrading the GI agricultural industry, yet their digital literacy is generally low, lacking the ability to apply digital technologies in agricultural production, marketing, and management. This significantly limits the adoption of digital technologies in rural areas. Additionally, due to the high cost of implementing digital technologies, farmers and enterprises show insufficient willingness to invest in technology, coupled with long investment return cycles. Digital technology operates in a high-end domain, and farmers lack mastery of these knowledge and skills, failing to grasp their value and role in enhancing the competitiveness of agricultural products. For any new technology to gain widespread adoption in rural areas, it must be built upon broad recognition. Only then can digital technologies be actively promoted and implemented. Government investment in knowledge dissemination is substantial, making it challenging to quickly familiarize farmers with entirely new concepts and knowledge. Farmers' limited disposable income dampens their enthusiasm for investing in new technologies, and they show insufficient initiative in learning and applying new skills. Only when the benefits far outweigh the costs will they have the means to leverage digital technologies to empower agriculture.

Insufficient coordination within the industrial chain. The agricultural product supply chain, from production to sales, involves numerous stakeholders. Driven by profit motives, each party pursues maximum gains, making it difficult for stakeholders to align on maintaining the chain's healthy operation. However, upgrading the geographical indication agricultural products industry in Western Guangdong requires seamless coordination across all chain segments. Currently, there is a lack of effective linkage and cooperation mechanisms between production, processing, and sales, resulting in inadequate chain coordination. Increased sales prices for farmers inevitably dampen corporate procurement enthusiasm, while lowering prices undermines planting incentives. This multi-party dilemma makes achieving a win-win outcome challenging. The overall smooth operation of the industrial chain remains unmaintained, and the value-added potential of agricultural products remains unrealized. Particularly under the influence of the digital economy, deficiencies in industrial chain coordination will be further magnified, leading to product stagnation and difficulties in value enhancement.

Through the above analysis, it naturally follows that to overcome these challenges, a systematic upgrade path must be proposed that addresses the constraints across these three dimensions.

3. Building an integrated pathway for digital economy-driven industrial chain upgrading

This section aims to propose solutions. Countermeasures must strictly correspond to the “three-dimensional constraint framework” outlined in Part I, forming a closed-loop logic of “problem-solution” that embodies the path's “integrated nature” and “targeted approach.”

Strengthen infrastructure development. First, the government should increase financial investment. Network infrastructure equipment is relatively expensive and requires government funding to expand network coverage. Encourage telecommunications companies to support rural areas by building communication base stations. Increase subsidies for

digital equipment procurement while establishing a team of digital rural infrastructure maintenance personnel to promptly resolve technical issues and ensure equipment stability and availability. Second, standardize e-commerce trading platforms. The proliferation of digital trading platforms increases transaction costs and hinders agricultural product distribution. Therefore, enterprises and governments should collaborate to establish a unified, standardized trading platform where farmers and businesses can promptly access supply and demand information, reducing the cost of using the internet. Leveraging influential e-commerce platforms can also boost product sales. Currently, platforms like JD.com and Pinduoduo are actively supporting agriculture and promoting online sales of agricultural products, achieving notable results. Finally, strengthen the management of digital technology applications. Advancements in digital technology enable traceability for geographically indicated agricultural products, enhancing product transparency. However, this also allows unscrupulous actors to exploit technical loopholes for illegal use. This damages the reputation of agricultural products and jeopardizes consumer health. Western Guangdong should introduce a dual-certification label combining “Geographically Indicated Agricultural Product Traceability + Official Flagship Store” to combat counterfeiting. For this double-edged sword of digital technology, it is imperative to strengthen oversight, crack down on violators, and promptly disclose penalty information.

Actively enhance farmers' awareness and strengthen professional training. First, shift traditional mindsets to emphasize the value of technology. In the digital economy era, agricultural product marketing extends beyond regional boundaries to a global scale. Competitors include both domestic and overseas agricultural products, intensifying market competition. Therefore, farmers must actively embrace digital technology, leveraging the internet for sales and promotion. Second, provide digital literacy training to elevate cultural competence. The adoption of new technologies poses challenges for farmers with limited educational backgrounds. Governments can organize expert-led skill training programs. These trainings should combine online and offline formats to avoid disrupting farmers' daily lives and production. Focus should be placed on e-commerce operations, live-streaming sales, and other relevant areas to help farmers master digital skills, enhance their capabilities, and boost production efficiency. Simultaneously, encourage digital agriculture experts and university students to engage in rural areas to assist farmers, addressing the shortage of digital talent in rural communities. Third, establish exemplary cases and reward proficient users. Reward farmers who actively respond to government initiatives by utilizing digital technologies to sell agricultural products, encouraging broader participation. For farmers resistant to digital adoption, strengthen guidance through case studies to address psychological concerns. Highlight exceptionally successful farmers as models to amplify the influence of digital technologies.

Enhance coordination across all links of the industrial chain to boost production efficiency. First, support deep processing to extend the value-added chain. The agricultural industrial chain involves multiple stages from production to sales, each offering opportunities for increased output and income. Primary agricultural products have relatively weak market bargaining power and require enhanced market influence, necessitating their entry into processing. Governments and

local authorities should actively attract enterprises to process multiple agricultural products and develop more market-driven commodities. While Western Guangdong has introduced some large-scale agricultural processing enterprises, current processing volumes and depth remain limited, leaving significant room for value enhancement. Second, coordinate economic interests among all parties to consolidate the industrial chain. The level of benefit for each participant directly influences their willingness to engage in the supply chain. Therefore, synergizing the interests of all parties is crucial. Strengthening information sharing and communication between links promotes cooperation and coordinated development among upstream and downstream enterprises. Industry associations and government organizations can be leveraged to regulate behavior and ensure smooth supply chain operations. Necessary penalties can be imposed on actions detrimental to supply chain development. Third, increase technological investment and support. The development of industrial chains involves numerous high-tech sectors, such as logistics and cold chain technology. The application of these advanced technologies requires robust government support and investment. Actively introducing third-party logistics enterprises can help address weaknesses in the industrial chain. Jointly undertaking activities like technological R&D, market expansion, and brand promotion will achieve the optimization and upgrading of the industrial chain.

4. Conclusions

This research systematically diagnoses the core challenges facing the GI agricultural product industry chain in Western Guangdong within the digital economy era by constructing a three-dimensional analytical framework of "digital infrastructure - subject digital literacy - industrial chain coordination." It proposes an integrated upgrade path centered on consolidating the digital foundation, empowering core stakeholders, and promoting collaborative governance. The research encompasses a complete process from reviewing the current situation and citing data (such as low processing rates and high e-commerce return rates) to analyzing deep-seated mechanisms and formulating targeted countermeasures. The workload is concentrated on the in-depth deconstruction of region-specific problems and the design of systematic solutions, ultimately demonstrating that only a shift from isolated digitalization to systemic reshaping can effectively resolve the structural problem of "high quality not commanding high prices" in Western Guangdong.

In summary, the pathways proposed in this paper offer both policy relevance and practical feasibility, providing a direct theoretical basis and action guide for industrial upgrading in Western Guangdong. However, this study has certain limitations. Primarily, the conclusions are largely based on qualitative analysis of macro-regional data and typical cases. Although the constructed theoretical framework is systematic, it has not yet been subjected to rigorous statistical testing using large-sample empirical data; thus, its universality and the precision of relationships between variables require further verification. Secondly, when discussing digital upgrade pathways, the study lacks an in-depth exploration of the micro-level mechanisms concerning the specific models, cost-benefit analysis, and potential risks associated with the deep integration of cutting-edge technologies like AI and blockchain into the industry chain. Future research should focus on conducting cross-regional comparative case studies

and large-scale empirical tests to verify and enhance the explanatory power of this framework. Simultaneously, efforts should be made to actively explore specific models for the integration of frontier technologies with the industry chain and evaluate their efficacy, aiming to develop a more universal development paradigm for the GI agricultural industry in smallholder economic zones.

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