International Business & Economics Studies
ISSN 2640-9852 (Print) ISSN 2640-9860 (Online)
Vol. 8, No. 2, 2026
www.scholink.org/ojs/index.php/ibes

Original Paper

Blockchain-Empowered Quality Improvement and Digital Brand Construction Path for Yizhou Silk

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Received: March 26, 2026 Accepted: April 22, 2026 Online Published: May 8, 2026

doi:10.22158/ibes.v8n2p196 URL: http://dx.doi.org/10.22158/ibes.v8n2p196

Abstract

As the "New Silk Capital of China," Yizhou boasts a complete sericulture and silk industry chain and holds the "Yizhou Silkworm Cocoon" national geographical indication certification. However, it has long been plagued by challenges such as insufficient quality control, low brand trust, and inadequate supply chain coordination. By leveraging blockchain technology, this study constructs a digital brand framework for Yizhou silk through three synergistic paths: quality, culture, and supply chain. The quality path relies on blockchain to achieve full-process credible traceability of Yizhou silk; the cultural path leverages blockchain to transform regional cultural resources, including the Liu Sanjie cultural brand, into certifiable digital assets for Yizhou silk; the supply chain path utilizes blockchain collaboration platforms and smart contracts to break down barriers to digital brand coordination. The research shows that blockchain technology can effectively address the industry's development challenges and provide a replicable "Yizhou Experience" for the digital brand construction of traditional characteristic industries.

Keywords

Blockchain, Yizhou Silk, Digital Brand, Liu Sanjie

1. Introduction

With the deep integration of the digital economy and industrial upgrading, the digital transformation of traditional characteristic industries has become a key path to achieving high-quality development. Yizhou, known as "China's New Silk Capital", has "Yizhou Mulberry Silkworm Cocoon" certified as a national geographical indication. It has formed a complete industrial chain from mulberry planting and silkworm breeding, silk reeling and weaving to dyeing and garment processing. In the era of digital intelligence, blockchain empowers the improvement of Yizhou silk quality and the construction of

digital brands, providing a replicable practical model for the digital transformation of Yizhou's traditional characteristic industries.

2. The Implications of Blockchain Empowerment and Brand Digitalization

2.1 Blockchain Empowerment

Blockchain is a decentralized, distributed ledger technology that uses technologies such as encryption algorithms, consensus mechanisms, and smart contracts to make data immutable, fully traceable, and publicly verifiable with the participation of multiple parties. Its core features include decentralized storage, data transparency, irreversibility of operations, and the ability to automatically execute contracts, providing a technical foundation for addressing information asymmetry and lack of trust in multi-agent collaboration.

Blockchain empowerment refers to the process of deeply embedding blockchain technology into industrial production, circulation, management, and brand operation, reconfiguring business processes, optimizing resource allocation, and establishing trusted mechanisms with its technical characteristics, thereby enhancing industrial efficiency, product quality, and brand value.

In this article, blockchain empowerment specifically refers to the systematic upgrading of the Yizhou silk industry through technological means in terms of quality control, supply chain collaboration, brand building, etc., to promote the digital transformation of the traditional silk industry.

2.2 Digitalization of Brands

Brand digitalization refers to the process of systematically rebranding and enhancing the value of a brand through digital technology. It encompasses three levels: First, the digital expression of brand elements, such as the transformation of brand identity, cultural connotations, product information, etc. into digital form; The second is the digital reach of brand communication, using the Internet, mobile terminals, social media and other channels to achieve precise marketing and user interaction; Third, the digital construction of brand value, through data-driven, user co-creation, trusted certification and other means to enhance the brand's market recognition, consumer trust and premium capacity.

Brand digitalization in this article specifically refers to the construction of a digital brand system for Yizhou silk with blockchain technology as the core support, featuring trusted traceability, cultural empowerment, and supply chain collaboration, to promote the transformation of the Yizhou silk brand from regional characteristics to high-end and international.

3. The Logical Origin of Blockchain Empowering the Digitalization of Silk Brands

3.1 The Digital Age Background of Yizhou Silk Brand Digitalization

Yizhou District, located in Hechi City, Guangxi, is known as the "New Capital of Silk in China". By the end of 2025, the area of mulberry plantations in Yizhou reached 396,000 mu, the output of cocoons was about 109,000 tons, and the income from sericulture was 5.6 billion yuan. The scale of sericulture has ranked first among all counties in China for 20 consecutive years. Yizhou has formed a complete

industrial chain from mulberry and silkworm breeding, silk reeling and weaving to dyeing and garment processing. “Yizhou Mulberry and Silkworm cocoons” have been certified as a national geographical indication, and raw silk products have become designated raw materials for international luxury brands such as LV and Hermes. The industrial foundation is solid and the resource endowment is outstanding.

Under the macro background of the deep integration of the digital economy and industrial upgrading, although Yizhou’s silk industry has scale advantages, it still faces multiple development predicaments: traditional production links rely on manual recording, data silos are prominent, traceability coverage is less than 30%, and quality control is difficult to achieve standardization and precision; Counterfeit and shoddy products are rampant on e-commerce platforms. In 2025, the brand authenticity rate of Yizhou silk is only 65%, the brand value is diluted, and the recognition in the high-end market is insufficient. Information asymmetry at each link of the industrial chain, inventory turnover rate lower than the industry average, and low supply chain synergy efficiency; At the same time, traditional centralized data systems are vulnerable to attacks, and there is a risk of leakage of enterprise core data and consumer privacy.

Blockchain technology, with its immutable, decentralized, and fully traceable features, offers innovative solutions for the digital transformation of traditional industries. Blockchain traceability applications have been successfully implemented in domestic silk production areas in Jiangsu and Zhejiang, Guangxi Hengzhou jasmine tea and other industries; Internationally, silk powerhouses such as Italy and France have also achieved deep integration of blockchain technology with supply chains and brand building. In this context, exploring the application of blockchain technology in Yizhou’s silk industry is of great practical significance for promoting the improvement of Yizhou’s silk quality and the construction of digital brands, and achieving high-quality and high-value-added development of the industry.

3.2 Experience of Blockchain Empowering the Digitalization of Silk Brands

3.2.1 Experience in the Application of Blockchain Traceability Technology in the Silk Industry

As a global silk industry power, Italy has achieved on-chain data of the entire silk industry chain based on the IBM Food Trust framework, precisely tracking SNP-1, strictly controlling the silk reeling temperature at 70±2 ° C, limiting the heavy metal content of dyes to ≤0.3ppm, and consumers can scan codes to obtain full-process information and carbon footprint data of products. The trust in the products has been significantly enhanced. France has used smart contracts to optimize the silk industry supply chain, achieving automatic supplier matching (response time ≤2 hours), precise recording of logistics temperature and humidity data (error rate ≤1.5%), and a 15% increase in supply chain collaboration efficiency, verifying the significant role of blockchain technology in supply chain optimization.

The Jiangsu-Zhejiang silk production area has promoted the deep integration of blockchain and Internet of Things technology. By using high-precision sensors to monitor data such as CO_2 concentration in silkworm houses (≤800ppm) and daily weight gain of silkworms in real time, energy consumption in

the silk reeling process has been reduced by 12%, providing a technical reference for digital production in the silk industry. Guangxi has launched a blockchain traceability pilot driven by policies, setting up a special fund of 140 million yuan to support the research and development of full-chain traceability for silkworms. The “Mulberry Garden - Consumption” pilot in Yizhou covers 30,000 mu of silkworm production bases, achieving full-process information traceability and laying the foundation for the large-scale application of blockchain technology in Yizhou’s silk industry.

3.2.2 Experience of Blockchain Empowerment for Silk brands

European and American silk brands have achieved data-driven product design based on big data analysis of blockchain platforms, captured consumption trends by mining user behavior data, and launched customized products to achieve a 30% year-on-year increase in sales. International premium brand Hermes encapsulates silk historical data and traditional craftsmanship as NFT digital assets and combines VR virtual workshops to create immersive brand experiences, achieving digital dissemination of brand culture, enhancing brand unique value and market competitiveness, and providing an innovative paradigm for digital empowerment of silk brands.

Domestic silk brands have upgraded their brands through IPization and cross-border integration. The Suzhou Silk Museum has collaborated with cosmetic brands on the re-creation of intangible cultural heritage patterns, achieving monthly sales of over 100,000 pieces. A silk brand on Douyin launched a live stream of “cloud silkworm rearing”, which combined blockchain traceability to increase the brand’s repurchase rate by 25 percent. Meanwhile, Guangxi Jinzhuang Brocade Company used blockchain evidence preservation technology to complete copyright protection for 132 Zhuang brocade patterns, effectively preventing cultural theft and providing practical experience for the protection of the cultural value of silk brands.

4. Analysis of the Advantages and Bottlenecks of Digitalization of Yizhou Silk Brands in the Digital Age

4.1 Unique Advantages of Digitalization of Yizhou Silk Brands in the Digital Age

4.1.1 Yizhou Silk Industry Scale and Industrial Chain Advantages

For 20 consecutive years, Yizhou has ranked first among all counties in China in terms of sericulture scale. By 2025, the area of mulberry plantations will be 396,000 mu, and the income from sericulture will be 5.6 billion yuan, forming a complete industrial chain from mulberry planting and sericulture, silk reeling and weaving to dyeing and garment processing. The large-scale silk enterprises in Yizhou are generally equipped with automated production equipment. The automated silk reeling production line can produce 2,800 meters of raw silk per minute, with the fineness deviation rate controlled within 0.95D and the rate of high-quality products reaching 95%. The Silk Road Holding Group has introduced refining, dyeing and printing technology to fill the gap in Guangxi, achieving “weaving - dyeing - sales” integration, reducing comprehensive energy consumption by 15%, and continuously improving the level of industrial intelligence and scale.

4.1.2. The Foundation and Policy Support of Yizhou Silk Brand

Yizhou raw silk has become the designated raw material for international luxury brands such as LV and Hermes, and its products are exported to high-end markets such as Italy and Japan. “Yizhou Mulberry Cocoon” has been certified as a national geographical indication, and local enterprises in Yizhou have participated in the formulation of six industry standards. Relying on the Liu Sanjie cultural brand, a strong regional cultural recognition has been formed, and brands such as “Qiyuan” and “Southern Silk Nest” have been recognized as famous trademarks in Guangxi. At the policy level, the governments of Hechi City and Yizhou District have successively introduced a number of Yizhou silk support policies, directly investing 14.5 million yuan to support the “Technological Transformation for Strong Mulberry and Smart Silkworm Rearing” project. Guangxi’s “Eastward Mulberry Westward Shift” and “Digital Guangxi” policies have been continuously advanced, providing strong policy and financial support for the digital upgrade of Yizhou’s silk industry.

4.1.3 Industry-University-Research cooperation and blockchain technology foundation in Yizhou Silk

Hechi University, in collaboration with several other universities, established the “Guangxi Key Laboratory of Sericulture Ecology and Intelligent Technology Application”, and trained a total of 12,000 technicians. Guangxi Linshengtang Silkworm Tools Company has developed nearly 70 patents for automated silkworm rearing equipment and increased production efficiency by 20 times. Meanwhile, Yizhou has built an intelligent infrastructure for the entire process of sericulture. The smart sericulture platform, through 5G+AI, keeps the mortality rate of silkworms within 1% and provides data collection and superior quality technical support for the blockchain traceability system.

4.2 The Real Bottleneck of Digitalization for Yizhou’s Silk Brand in the Digital Age

4.2.1 Poor Silk Quality Directly Undermines the Foundation of Digital Brands

The traditional production process of Yizhou silk relies on manual recording, and there is a risk of information distortion and loss in the process of data collection and circulation. As of the end of 2025, the author’s research shows that the traceability coverage rate of Yizhou silk enterprises is less than 30%, and the phenomenon of data silos throughout the entire industrial chain is prominent, making it difficult to achieve standardized and precise control of Yizhou silk quality. There is a problem of insufficient credibility of data in the third-party quality inspection process, making it difficult for consumers to effectively verify the authenticity of quality inspection reports, which affects the credibility of Yizhou silk quality and significantly restricts the development of Yizhou silk branding, especially digital branding.

4.2.2 The Absence of Elements of Silk Culture Restricts the Construction of Digital Brands

Although regional cultural elements such as Liu Sanjie’s ballads and Zhuang brocade patterns have unique cultural value, they have not yet been deeply integrated with the construction of Yizhou’s silk brand. The lack of effective integration of distinctive cultural resources such as Liu Sanjie and Zhuang brocade in the brand narrative of Yizhou Silk has led to a relatively low cultural awareness of Yizhou silk among young consumers. By the end of 2025, the brand premium capacity of Yizhou Silk was

relatively weak, with an average brand premium rate of 15% for Yizhou silk, while the average brand premium rate of similar domestic silk products such as Hangzhou silk exceeded 25% during the same period. In addition, despite having the national geographical indication certification of "Yizhou Mulberry Silkworm Cocoon", Yizhou silk still lacks a highly recognizable core brand influence in the international and domestic high-end markets.

4.2.3 Supply Chain Information Barriers Affect the Collaborative Efficiency of Digital Brands

There have long been problems such as insufficient information sharing, inconsistent data standards and lagging logistics information among the links of the Yizhou silk industry chain. There is a lack of a transparent mechanism for the purchase price of cocoons upstream, and it is difficult for farmers and silk reeling factories to form stable expectations. The matching of supply and demand between midstream production and downstream sales relies on empirical judgment and lacks real-time supply chain data support. Logistics node information is not updated in a timely manner, making it impossible for upstream and downstream enterprises to accurately predict delivery times and inventory changes. By the end of 2025, the average inventory turnover days of silk enterprises in Yizhou reached 45 days, significantly higher than the industry benchmark level of 30 days. The average annual loss of inventory build-up in Yizhou silk due to information silos in the supply chain exceeds 5 million yuan. The low efficiency of supply chain collaboration seriously affects the supply chain's efficient collaboration capabilities and user trust foundation necessary for building digital brands.

5. Blockchain Empowers the Quality Improvement of Yizhou Silk and the Construction of Digital Brand Paths

Based on long-term field research and taking advantage of local cultural resources such as Liu Sanjie culture and Zhuang brocade skills in Yizhou, to make up for the shortcomings of Yizhou silk in terms of quality and supply chain, the following presents specific methods for improving the quality of Yizhou silk in the digital and intelligent era from the perspective of blockchain technology empowerment, and further explores countermeasures for building a digital brand path based on high-quality silk.

5.1 Quality Path for Building Digital Brand of Yizhou Silk Empowered by Blockchain

5.1.1 Establish Standardized and Digitalized Traceability Throughout the Entire Breeding Process

Formulate and implement standardized breeding norms for silkworms in Yizhou, deploy Internet of Things monitoring devices for mulberry farmers to collect real-time data such as temperature and humidity in silkworm houses, CO_2 concentration, and daily weight gain of silkworms, and achieve automatic on-chain evidence based on blockchain technology to ensure that the data cannot be tampered with and is fully traceable. Simultaneously record information on mulberry seedling cultivation, pesticide use, mulberry leaf picking and other links, and integrate data from all links through the decentralized nature of blockchain to form a standardized and intelligent management system covering the entire breeding process. Build rigid constraints through blockchain traceability

mechanisms to force mulberry farmers to apply green farming techniques, continuously improve the quality of raw materials for cocoons, and lay a solid industrial chain quality foundation for the digital brand of Yizhou silk.

5.1.2 Strengthen Digital Monitoring and Full-process High-quality Production in the Processing stage

In the processing stages such as silk reeling, silk weaving and dyeing, promote the deep integration of production equipment with the blockchain system, collect information such as production process parameters, equipment operation status and quality inspection data in real time and complete the on-chain storage on the blockchain to achieve full traceability and verification of processing data. Real-time monitoring of the production process is achieved through dynamic intelligent quality inspection systems, immediate interception of substandard products and blockchain traceability tracking are carried out, and problem links are precisely located and optimized. At the same time, blockchain technology is used to build standardized management nodes, promote standardized management in processing links, unify production processes and quality standards, and further improve the quality of finished silk.

5.1.3 Real-time Intelligent Tracking and Quality Assurance throughout the Sales and Logistics Process

In the logistics process, GPS and temperature and humidity sensors are integrated to track the transportation routes and storage environments of silk products in real time, ensuring automatic synchronization of logistics data on the chain, achieving full traceability of the logistics process, and ensuring stable quality of products during transportation. When anomalies occur in the logistics environment, the blockchain smart contract automatically triggers the early warning mechanism to support timely intervention measures. In the sales process, a unique traceability QR code is assigned to each product. Consumers can scan the code to query the full traceability information and quality inspection report of the product through the blockchain, forming a “one product, one code” authenticity verification mechanism, effectively enhancing consumers’ trust in product quality.

5.2 A Cultural Path for Building a Digital Brand of Yizhou Silk Empowered by Blockchain

5.2.1 Digital Co-creation and Symbiosis of Regional Cultural Brands and Silk Brands

Dig deep into regional cultural elements such as the Yizhou Liu Sanjie Song and Zhuang brocade patterns, digitize the cultural genes through blockchain technology to generate traceable and interactive dynamic traceability pages, achieve co-creation and symbiosis of the Liu Sanjie cultural brand and the Yizhou silk brand, and contribute to the construction of the digital Yizhou silk brand empowered by blockchain. [6]Create digital cultural content such as 3D animation of Liu Sanjie, embed the product traceability system through blockchain traceability nodes, and consumers can scan codes to experience silk culture in an immersive way, forming a symbiotic experience between the brand and consumers, and achieving a dual experience of “traceability + culture”. At the same time, the “Sericulture Ecological Corridor” cultural and tourism route is designed based on blockchain. Tourists can get a blockchain certified NFT commemorative card by making an appointment through the blockchain APP, integrating culture and tourism with the silk industry. Relying on Liu Sanjie and the regional cultural

golden business card, the cultural connotation and popularity of the blockchain-enabled digital brand of Yizhou silk are enhanced in the long term.

5.2.2 Mutual Promotion and Interaction between Geographical Indications and Digitalization of Silk Brands

Based on the blockchain-based “one item one code” traceability system, achieve full traceability of Yizhou silk, solve the problem of counterfeit and shoddy products, increase the brand authenticity rate, form a mutual promotion of geographical indication protection and brand reputation, and build a solid foundation for blockchain to empower the digital brand of Yizhou silk. By taking advantage of the immutable and publicly verifiable nature of blockchain, we will enhance the value of the geographical indication “Yizhou Mulberry Silkworm Cocoon”, facilitate mutual promotion and recognition between geographical indications and silk brands, and achieve linkage between geographical indication certification and brand upgrading. Through blockchain-enabled quality and cultural enhancement, boost product premium, facilitate the creation of 3-5 benchmark brands, drive brand transformation towards the high end, and highlight the core value of the digital brand of Yizhou silk empowered by both geographical indication and blockchain.

5.2.3 Digital Integration and Synergy of Green Cultural Brands and Silk Brands

Build a green mass innovation design platform for Yizhou silk based on blockchain. Consumers scan codes to enter the digital intelligent design platform to participate in the creative design of green silk. Excellent environmental protection design schemes are put into production after being confirmed and certified by blockchain. Consumers can receive a share through blockchain smart contracts to deepen the interaction between brands and consumers and promote the deep integration of green cultural brands and Yizhou silk brands. Empower the digital brand building of Yizhou silk with blockchain technology. Establish a blockchain-based carbon credit mechanism, where users can earn blockchain-based traceable carbon credits for environmental protection, and these credits can be exchanged for rights or products to form a “green consumption” closed loop, build synergy between green concepts and brand value, and effectively enhance the social responsibility and consumer recognition of the digital brand of Yizhou silk empowered by blockchain.

5.3 Supply Chain Pathways for Building a Digital Brand of Yizhou Silk Empowered by Blockchain

5.3.1 Build a Supply Chain Collaboration Platform to Promote Digital Brand Building

Develop a blockchain supply chain collaboration platform for Yizhou silk, integrate data from all links of the supply chain (farmers, silk reeling factories, silk weaving factories, distributors, logistics enterprises), and enable real-time sharing of information related to inventory, production, logistics, sales, etc. with the digital brand building of Yizhou silk. Through this blockchain platform, enterprises can grasp the dynamics of the entire supply chain process in real time, accurately predict market demand, reduce inventory overstock caused by information asymmetry, promote the improvement of inventory turnover rate and the reduction of logistics costs, and promote the construction of the digital

brand of Yizhou silk through the efficient collaboration of the supply chain, giving full play to the core role of blockchain empowerment.

5.3.2 Embed Smart Contracts in the Supply Chain to Facilitate Digital Brand Building

By embedding blockchain smart contracts in the supply chain collaboration platform, leveraging the immutable and automatically executable characteristics of blockchain, core functions supporting the digital brand building of Yizhou Silk can be realized, such as automatic order execution, automatic payment settlement, and automatic early warning of logistics anomalies. For example, when a silk dealer issues a purchase order, the blockchain smart contract automatically matches the supplier based on the inventory data of the production enterprise's supply chain, generates a production plan and tracks progress, automatically records the logistics data on the chain after the product is dispatched, and automatically completes the payment settlement after acceptance. Through the automation of the entire supply chain process, the efficiency of collaboration is enhanced. Empower Yizhou Silk with blockchain technology to build its digital brand efficiently.

5.3.3 Establish a Supply Chain Benefit-sharing Mechanism to Ensure Digital Brand Building

Design a blockchain-based supply chain benefit distribution model that feeds back the brand premium portion of blockchain-traceable products proportionally to each participating link in the supply chain, establish a "quality improvement fund" to provide subsidies to mulberry farmers and processing enterprises that adopt green farming and standardized production, and the subsidies are automatically executed through blockchain smart contracts and are fully traceable. Through a clear supply chain benefit distribution mechanism, increase the enthusiasm of mulberry farmers and small and medium-sized enterprises to participate in the industrial digital upgrade, build a coordinated development pattern of "government + enterprise + farmers", empower with blockchain to ensure the sustainability of the construction of the digital brand of Yizhou silk, and consolidate the supporting role of the supply chain for the construction of the digital brand of Yizhou silk.

6. Conclusions and Implications

6.1 Research Conclusions

This paper takes the Yizhou silk industry as the research object and explores the logic and path of how blockchain empowers its quality improvement and digital brand building. Based on theoretical analysis and field research, the following conclusions are drawn:

(1) Blockchain technology can effectively solve the problems of difficult quality control, low brand trust and weak supply chain collaboration in Yizhou silk. Its decentralized, immutable and fully traceable characteristics are highly consistent with the demands of quality traceability, brand certification and supply chain transparency in the silk industry, providing a feasible technical path for the digital transformation of the Yizhou silk industry.

(2) The digital brand building of Yizhou silk requires three-dimensional synergy of quality, culture and supply chain: The quality path is centered on blockchain traceability to achieve full-process data on the

chain; The cultural path enhances brand recognition through blockchain empowerment of digital transformation of regional culture, etc. The supply chain path relies on blockchain to break down information barriers and enhance synergy efficiency. The three paths work together to form a systematic framework for building the digital brand of Yizhou Silk.

(3) The essence of blockchain empowerment is the deep integration of technology and industrial logic, which not only embeds industrial processes but also reshapes data governance and trust relationships, promoting the transformation of industries towards quality, branding, and high added value, and providing a replicable practical model for the digital transformation of traditional characteristic industries.

6.2 Implications of the Study

(1) Implications for the Digitalization of Yizhou Silk Brands. Strengthen the integration of blockchain and Internet of Things, expand traceability coverage to achieve quality standardization; Dig deep into Liu Sanjie and Zhuang brocade culture, and use blockchain to achieve digital dissemination of culture and enhance brand premium; Relying on blockchain to improve supply chain collaboration and benefit-sharing mechanisms and break down information barriers; Leverage policy support, enhance industry-university-research cooperation, and strengthen technological and talent support.

(2) Implications for the digitalization of Traditional Characteristic industries in Yizhou. Based on its own endowments, precisely select suitable digital technologies and avoid blindly following the trend; Focus on the digital transformation of regional culture and build differentiated brands; Build a collaborative ecosystem and benefit-sharing mechanism to ensure the sustainability of the transformation.

(3) Implications for Digital development policies. Improve the digital support policies for traditional characteristic industries, increase investment in blockchain research and development and implementation, and establish a data standard and regulatory system; Promote digital and intelligent empowerment support policies to drive the upgrading of traditional industries, facilitate rural revitalization, boost Yizhou silk from scale advantage to value advantage, and provide replicable "Yizhou experience".

Acknowledgments

This study was supported by the Guangxi College Students' Innovation Training Program "Blockchain-Empowered Quality Improvement of Yizhou Silk and the Digital Branding Pathway of 'New Yizhou Silk Capital'" (S202510605116), and the Guangxi Social Science General Program "Research on the Mechanisms and Pathways of Digital Intelligence Empowering the Cultivation of Green Productive Forces in ethnic minority areas of Guangxi" (25GLF125).

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