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Research on the Development Path of Rural E-commerce in Yunnan Border Ethnic Regions under the Rural Revitalization Strategy

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Abstract:
Against the backdrop of implementing the Rural Revitalization Strategy, Yunnan's border ethnic regions should actively integrate into the digital economy era, transforming their resource advantages into economic and social benefits. Developing rural e-commerce is one effective way to achieve this. This paper, through a review of the literature and combining field research and case analysis, identifies several challenges faced by the development of rural e-commerce in Yunnan border ethnic regions, including an incomplete logistics and delivery system, a severe shortage of e-commerce talent, low levels of agricultural product standardization and branding, and weak network infrastructure. Based on these findings, the paper proposes targeted countermeasures, such as improving the rural e-commerce logistics system, establishing a multi-level talent cultivation and introduction mechanism, promoting agricultural product standardization and branding, and increasing investment in digital infrastructure and technological empowerment.

Keywords:
Yunnan border ethnic regions; Rural e-commerce; Rural revitalization; Development path; Countermeasures and suggestions

1. Introduction

1.1 Research Background and Significance

Agricultural, rural, and farmer issues have always been fundamental to the national economy and people's livelihoods (Liu Shenghua & XIAO Li, 2025)[1]. President Xi Jinping of China has emphasized that "placing the resolution of 'agriculture, rural areas, and farmers' (referred to as the 'three-rural' or 'san nong') issues at the core of the Party's work is an important experience for our Party in governing and rejuvenating the country, and it must be adhered to in the long term without wavering." On January 2, 2018, the Central Committee of the Communist Party of China and the State Council of the People's Republic of China issued the "Opinions of the CPC Central Committee and the State Council on Implementing the Rural Revitalization Strategy," which made a comprehensive deployment for the implementation of the Rural Revitalization Strategy nationwide. The comprehensive advancement of the Rural Revitalization Strategy is closely tied to the overall modernization process with Chinese characteristics. It serves as the overarching framework for "three-rural" work

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in the new era of China and is the core policy framework for current rural development. It aims to address the imbalances and inadequacies in urban-rural development and rural development, ultimately achieving modernization of agriculture and rural areas and building a new pattern of "thriving industries, livable ecology, civilized rural customs, effective governance, and prosperous lives" (Ye Xingqing, 2018; Xie Yangyang & LI Hao, 2024)[2][3]. In the process of implementing the Rural Revitalization Strategy, e-commerce, with its unique business model, has broken through the limitations of time and space in traditional commercial activities. It can effectively expand sales channels for local agricultural products and increase farmers' income, becoming an important way to promote local rural economic development.

Located in the southwestern part of China, Yunnan Province comprises 26 prefectures (cities), of which 8 prefectures (cities) and 25 counties (county-level cities) border Myanmar, Laos, and Vietnam. The total length of the border is 4,060 kilometers. There are 110 border townships and 374 border administrative villages (communities) (including 3,824 natural villages) along the entire border, with a total population of 965,400 people, accounting for 2.07% of the province's total population of 46.73 million. The proportion of ethnic minorities in the region reaches 79.4%, and 16 cross-border ethnic groups are present. This area is a complex interweaving of ethnic, religious, and border issues. It is one of the most important battlegrounds for the Chinese government to consolidate and expand the achievements of poverty alleviation, comprehensively advance the Rural Revitalization Strategy, and forge a strong sense of community for the Chinese nation. It is also at the forefront of the southwest region's efforts to consolidate, invigorate, strengthen, and enrich the border areas (Zhao Zengkun, 2024; Ma Xinhuan, 2024)[4][5]. The development of rural e-commerce in Yunnan's border ethnic regions is both urgently necessary and highly challenging. On the one hand, rural e-commerce has been proven to boost local rural economic development.

On the other hand, the development of rural e-commerce relies on the necessary infrastructure. This contradictory yet unified relationship means that the development path of rural e-commerce in this region differs from that in other areas, with both significant potential for growth and numerous practical challenges. Therefore, researching the development path of rural e-commerce in Yunnan's border ethnic regions is not only of great theoretical value but also of profound practical significance for implementing the Rural Revitalization Strategy.

1.2 Research Questions and Objectives

Although rural e-commerce can play a very positive role in the Rural Revitalization Strategy and effectively promote rapid rural economic development, the scientific and effective development of rural e-commerce in Yunnan's border ethnic regions faces many key issues that need to be resolved. First, the remote geographical location and lagging transportation development result in an incomplete logistics and delivery system, which is the primary constraint on the development of rural e-commerce in the region. In particular, the lack of various facilities required for cold chain logistics makes it difficult to ensure the effectiveness of storage and the timeliness of transportation for agricultural products, affecting their quality and, consequently, the consumer experience and economic benefits for farmers [6]. Second, due to slow socio-economic development, the region's attractiveness to external talent is limited. Combined with the low educational level and weak self-learning abilities of residents, there is a severe shortage of e-commerce practitioners, which increases the difficulty of implementing rural e-commerce projects. Third, the lack of awareness of agricultural

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product standardization and branding results in low external recognition of the quality and safety of local agricultural products, significantly weakening their market competitiveness and placing them at a disadvantage in intense market competition. In addition, the weak network infrastructure and insufficient mechanisms and service support for rural e-commerce constructed by the local government also restrict the development of rural e-commerce to varying degrees.

In response to the above issues, this paper aims to explore a development path for rural e-commerce tailored to the local characteristics of Yunnan's border ethnic regions. It analyzes the existing problems in rural e-commerce development in these areas and combines domestic and international development experiences. The goal is to provide feasible suggestions for implementing the Rural Revitalization Strategy in the region and to further enrich research on rural e-commerce and economic development in border ethnic regions within the context of the Rural Revitalization Strategy.

2. Theoretical Foundations and Literature Review

2.1 Theoretical Foundations

With the advent of the digital age, rural e-commerce has emerged as a key intersection between the digital economy and rural revitalization strategies, becoming a hot topic in academic research in recent years. E-commerce theory involves multiple disciplines, including economics, management, computer information technology, and international relations, making it a typical interdisciplinary field. In terms of business models, e-commerce theory focuses on how enterprises create commercial value through the use of Internet information technology. For rural e-commerce, this involves selecting e-commerce models tailored to the rural context, which is distinctly different from mature markets, considering the unique geographical, cultural, and social backgrounds of rural areas. Rural e-commerce can also be categorized into common e-commerce models such as "B2B," "B2C," "C2C," and "C2B" (He Yujing, 2018)[7]. The B2C model, a retail model that directly targets consumers, requires a solid foundation in e-commerce software and hardware, as well as a mature market platform. This model enables farmers to sell agricultural products directly to consumers, thereby reducing intermediary links and increasing economic benefits (CHANG Jin, 2024)[8][9]. The C2B model emphasizes meeting the demand of large organizations for agricultural products through customized "orders." This model can maximize the avoidance of market risks, optimize resource allocation, and reduce the energy that farmers need to devote to market engagement (Du Yansui, 2017)[10]. The C2C model requires farmers to possess good e-commerce skills to sell agricultural products independently through e-commerce platforms, thereby increasing their income. In addition, with increasing market demands for service quality in rural e-commerce, the "A2A" and "A2C" models involving agents have gradually gained popularity. Regardless of the type of rural e-commerce model, the choice should be based on the actual situation (Du Yansui, 2017)[10]. Moreover, since 2016, with the popularization of social apps, emerging e-commerce models such as social commerce and live-streaming sales have begun to penetrate the agricultural product sales market, bringing vitality to rural e-commerce. According to data from the Ministry of Commerce of China, in the first half of 2023, the number of live-streaming sessions on key monitored e-commerce platforms exceeded 110 million, with more than 70 million products and over 2.7 million active hosts (Chen Fabao et al., 2024)[11]. The rise of social commerce and live-streaming sales has brought new challenges to rural e-commerce in Yunnan's

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border ethnic regions. On the one hand, it can further expand the market coverage of products, enhance consumer recognition of local agricultural products, and improve the competitiveness of local specialty agricultural products. On the other hand, it has put forward higher requirements for rural e-commerce talent and implementation conditions (WU Yuan, 2023)[12].

The theory of industrial integration in rural e-commerce emphasizes the interaction and collaboration between agriculture, commerce, and the service industry to create business growth points that are more aligned with local characteristics and realities. In addition to the commonalities of rural areas in other regions, Yunnan's border ethnic regions are significantly influenced by ethnic, religious, and cross-border cultures in the development of rural e-commerce. Through digital trade means, rural e-commerce promotes the transformation of traditional agriculture into modern, digital, and information-based agriculture, improving local agricultural production efficiency and the quality of products and services. Moreover, rural e-commerce relies on the support of related industries, including processing, trade, logistics, and tourism, and the entire industry chain exhibits strong extensibility (TANG Dan, 2023)[13].

The digital divide and empowerment theory focuses on the differences in the application of information technology among various regions and groups, as well as its impact on socio-economic development. Yunnan is located in the western part of China, with 25 border counties (cities) bordering Myanmar, Laos, and Vietnam along a 4,060-kilometer-long border. Overall, border areas are remote, with weak infrastructure and low levels of education among the local population. The digital divide is a common phenomenon. Although local governments are continuously making efforts to increase hardware investment, especially in network infrastructure, which has seen significant improvement, villagers still lack sufficient knowledge of digital information. There are also significant gaps in the government's construction of digital information service systems, e-commerce technical support, market demand information, and digital financial assistance[14].

2.2 Current Research Status at Home and Abroad

Through keyword searches and analyses on domestic and international literature databases such as CNKI, Wanfang Data, Scopus, and Web of Science, current research on rural e-commerce mainly focuses on multiple dimensions, including the impact of rural e-commerce on farmers' income increase, the labor market, industrial development, social effects, and their underlying mechanisms. In terms of promoting income growth for farmers, numerous studies have confirmed that rural e-commerce can effectively increase farmers' incomes and has a significant positive impact on improving household income. GUAN Xin (2025) argues that due to the different levels of education among farmers, some are unable to master e-commerce skills. However, these farmers can still reap digital dividends by collaborating with other e-commerce operators, and this indirect participation model can also significantly increase household income [15]. Lu Liyuan (2025) examines the issue from a macro perspective of urban-rural factor integration, pointing out that rural e-commerce can effectively promote the flow and integration of local labor, external capital, and land and technology factors between urban and rural areas, thereby increasing farmers' income[16]. WANG Qi (2025) and GUAN Xin (2025) believe that engaging in rural e-commerce not only increases household income but also optimizes the income structure, with a particularly noticeable effect on increasing wage income[15][17].

Meanwhile, Chen Huashuai (2024) et al. argue that rural e-commerce helps narrow income gaps within vil-

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lages and between urban and rural areas, thereby promoting inclusive income growth[18]. In terms of influencing and adjusting labor, rural e-commerce has had a certain impact on the employment structure and labor mobility trends in rural areas. XIA Yong (2025) finds, based on the quasi-natural experiment of the "Comprehensive Demonstration Policy for E-commerce in Rural Areas," that the introduction of e-commerce has significantly reduced the probability of rural laborers working outside their hometowns[19]. WANG Qi (2025) also supports this conclusion, arguing that rural e-commerce entrepreneurship has become a "reservoir" for local employment[17]. The above studies mainly focus on the impact of rural e-commerce on local economic development. With the in-depth implementation of China's Rural Revitalization Strategy, a large number of studies have begun to focus on how rural e-commerce can promote the structural reform of agricultural supply and optimize the rural industrial structure. However, whether through traditional economic development research or from the perspective of economic structure, existing studies have mainly focused on rural areas in the central and eastern regions and coastal areas of China, with relatively few studies on the southwestern region, especially Yunnan's border ethnic regions. Research on e-commerce development paths under regional characteristics and cultural backgrounds remains limited (TANG Dan, 2023)[13].

The development experience of rural e-commerce abroad provides important insights for Yunnan's border ethnic regions. Kshetri believes that rural e-commerce is a business model based on specialized Internet technology applied to rural development (Kshetri, 2018)[20]. He also argues that in recent years, e-commerce participation in rural communities in developing countries has increased, but despite these advances, e-commerce in developing countries remains highly urban-oriented (Kshetri, 2018)[20]. Karine believes that e-commerce in the BRICS countries is growing rapidly and creating opportunities worldwide. However, due to regional imbalances within the BRICS countries, cooperation in the e-commerce sector is not smooth. She suggests increasing investment in infrastructure in rural and remote areas, ensuring e-commerce education, strengthening consumer protection, establishing a more comprehensive online dispute resolution mechanism, and enhancing cooperation with international organizations to improve the representation of the BRICS countries in international indices such as the OECD Digital Services Trade Restrictiveness Index (STRI) (Karine, 2021)[21]. Research in the field of logistics is also very extensive. It is widely recognized that adopting intelligent warehousing management systems and efficient cold-chain transportation networks can effectively ensure the quality of agricultural products. Lee et al. argue that building a smart logistics warehousing management system based on the Internet of Things can increase warehouse productivity, improve picking accuracy, and effectively resist changes in orders (Lee et al., 2017)[22]. In terms of e-commerce talent cultivation, scholars from South Korea and Japan believe that specialized e-commerce training institutions should be established to develop professional talents rather than relying solely on schools, as the e-commerce knowledge system in schools does not keep pace with the rapid changes in e-commerce development. In addition, foreign scholars are positive about the integration of e-commerce with tourism, culture, and other industries and have proposed innovative business models, such as "farm direct supply" and "rural experiential shopping." These theoretical and practical research findings provide useful references for Yunnan's border ethnic regions to explore diversified e-commerce development paths (Du**,** 2024)[23].

2.3 Innovations of This Paper

This paper focuses on the under-researched area of e-commerce development in special regions, particular-

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ly the unique geographical and cultural environments of Yunnan's border ethnic regions. Conducting targeted research reveals the specific impacts of these factors on e-commerce logistics, product selection, and marketing strategies, thereby providing a basis for formulating more targeted development strategies [9]. Secondly, this paper combines practical case studies to explore further mechanisms suitable for the development of rural e-commerce in Yunnan's border ethnic regions. It pays particular attention to the integration of the industrial chain, talent cultivation models, and logistics and distribution systems, striving to offer practical and feasible implementation plans for local governments and enterprises. Ultimately, this paper will further explore the issue of digital integration in the realm of rural e-commerce.

3. Analysis of the Development Status of Rural E-commerce in Yunnan Border Ethnic Regions

3.1 E-commerce Infrastructure and Logistics System

With the in-depth implementation of the Rural Revitalization Strategy, the government has increased investment in infrastructure, resulting in significant development in digital information and logistics warehousing. According to the website of the Yunnan Provincial Department of Transportation, by the end of 2023, the total mileage of highways in Yunnan Province had reached 329,000 kilometers, with expressway mileage reaching 10,466 kilometers, connecting 124 counties (cities, districts) throughout the province. In terms of railways, the total operational mileage of railways in the province had reached 5,222 kilometers, including 1,212 kilometers of high-speed rail. Additionally, according to the "2023 Yunnan Province Information and Communication Industry Statistical Bulletin," as of 2023, a total of 44,000 5G base stations had been built in the province. The main urban areas of the 16 prefectures (cities) and 129 county-level administrative regions had all achieved 5G network coverage, and the main areas of 1,453 township-level administrative regions had effective 5G network coverage. Improvements in infrastructure in the transportation and information sectors have provided strong support for the development of rural e-commerce in Yunnan. However, border ethnic regions still face issues such as insufficient rural road construction, especially in remote areas where road conditions are poor, with low-grade roads, high maintenance costs, and difficulties in maintenance, leading to high loss rates during the transportation of agricultural products. Although the broadband coverage rate in rural areas has reached 86.7% and mobile data coverage exceeds 90%, problems such as slow network speeds and unstable signals still exist. The construction of cold chain logistics facilities is slow, facing issues such as insufficient area, outdated equipment, or even a lack of facilities, which cannot effectively meet the requirements for the entire cold chain of fresh agricultural products in border ethnic regions. Moreover, the construction of the logistics and distribution network, especially the "last mile," is challenging, with low delivery efficiency. The standardization of agricultural production is challenging due to outdated technology and inconsistent quality, which are also significant issues (Yan Qiong, 2023; Guo Chao, 2023; Cai Ping, 2023)[6][27][28].

3.2 Online Sales Structure and Product Characteristics of Agricultural Products

The online sales structure of agricultural products in rural Yunnan presents a diversified feature. For example, characteristic agricultural products such as Pu'er tea, tribute rice, Yunnan Baiyao, fresh flowers, jade, Qu-

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jing Xuanwei ham, Luoping small yellow ginger, Fuyuan konjac, and Huize pomegranates account for a large proportion. Among them, the online sales ratio of bulk agricultural products is relatively low, primarily due to the low degree of standardization and the limited brand effect of agricultural products. In contrast, characteristic agricultural products have a better competitive advantage. For example, Pu'er tea, with its unique processing technology and cultural connotations, is widely accepted in both domestic and international markets and has even achieved a high brand premium.

Another example is the fresh corn in Dehong Prefecture. In 2023, the planting area of fresh corn in Dehong Prefecture reached 230,800 acres, with a total output of 260,000 tons and a value of 1.0062 billion yuan. The main yellow and white corn varieties account for more than 80% of China's winter market share. The Dehong Prefecture government actively developed a sales platform to provide farmers with sales channels and fully utilized e-commerce to sell fresh corn, thereby forming a new marketing system that combines both online and offline efforts (Dehong Prefecture People's Government Network, 2023)[29]. In addition, Yunnan's border prefectures and cities have gradually gained the affection of consumers across the country on e-commerce platforms due to their characteristic fruits, such as the green and organic characteristics of mangoes, jackfruits, and other fruits from Myanmar.

3.3 Types of E-commerce Participants and Collaborative Mechanisms

Similar to the nationwide development of rural e-commerce, the business entities engaged in rural e-commerce in Yunnan's border ethnic regions include local farmers, village collective organizations, cooperatives, e-commerce enterprises, and government departments. There are significant differences in the number, scale, and operational models of these entities due to local development conditions. Farmers are the basic units of rural e-commerce operations, often facing issues such as small scale, insufficient technical capabilities, and weak risk resistance, making it difficult to achieve economies of scale. Village collective organizations, established through collective land ownership and recognized by national laws, legally represent the collective ownership of their members. These include township-level rural collective economic organizations, village-level rural collective economic organizations, and group-level rural collective economic organizations. Cooperatives integrate the resources of scattered farmers to achieve unified operations in production, processing, and packaging, enabling a certain level of scaled operation. E-commerce enterprises come in various forms, including e-commerce platforms such as "Pinduoduo," "Taobao," and "JD.com," as well as local e-commerce enterprises, such as Dehong Xinhé Agricultural Technology Development Co., Ltd. (engaged in e-commerce live streaming), Dehong Chunan E-commerce Co., Ltd. (selling tribute rice), and Mangshi Fuduo Le Food Co., Ltd. (selling nuts). These e-commerce enterprises are responsible for building sales platforms and connecting domestic and international markets, acting as the link between farmers, collective economic organizations, and consumers. Throughout the operation of rural e-commerce, relevant government functional departments play a crucial role, as they both maintain market policies and optimize operational policies. They are responsible not only to farmers, economic households, and enterprises but also to consumers. Under the protection of market laws and relevant policies, a collaborative mechanism has been formed among the various participants. However, there are still some common or specific issues, such as the government's safeguard mechanism, the profit distribution mechanism at the collective economic level, and the responsibility and rights mechanism between e-commerce platforms, consumers, and farmers. These issues need to be further

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improved to ultimately build an efficient collaborative mechanism and promote in-depth cooperation among the various entities.

3.4 Regional Case Studies

Case One: Project Empowerment + E-commerce Breakthrough, Boosting Mangshi's Australian Macadamia Nuts to Become a Prosperous "Golden Fruit"

Mangshi is located in the western part of Yunnan Province and the southeastern part of Dehong Prefecture. This area has a unique geographical location, bordering Myanmar. Mangshi has a tropical monsoon climate with ample sunshine and distinct dry and wet seasons, making it particularly suitable for growing Australian macadamia nuts. The local government has identified the macadamia nut industry as an important sector for adjusting and optimizing the agricultural industrial structure. By the end of December 2024, the planting area of Australian macadamia nuts in Mangshi had expanded to 215,000 acres, yielding 25,000 tons. The industry has become a widely covered, highly beneficial, and prominently advantageous highland characteristic industry in Mangshi, with significant ecological, economic, and social benefits. In 2024, the local government implemented the Australian Macadamia Nut Initial Processing Mechanical Integration Project. After the project's implementation, the initial processing capacity of macadamia nuts was significantly enhanced. Mangshi Fuduo Le Food Co., Ltd., a company specializing in the initial processing and sales of nuts, has achieved an annual processing capacity of over 1,000 tons of fresh nuts and 300 tons of dried nuts thanks to this project. With the government's facilitation, the company has sold Mangshi nuts domestically through major e-commerce platforms under the "Fuduo Le" trademark and has exported them internationally. E-commerce sales account for more than half of the company's total sales, with the best-selling regions concentrated in northern China and first-tier cities such as Beijing, Shanghai, Guangzhou, and Shenzhen. The company has also launched live-streaming sales, opening stores on major live-streaming platforms, including Douyin, Kuaishou, and WeChat (Sina Finance, 2025)[29].

Through rural e-commerce sales, Mangshi's Australian macadamia nuts have become the "darling" of rural digital economic development and an important driver for local rural revitalization. They have not only become a characteristic agricultural product for Mangshi but also an important engine driving industrial and rural prosperity.

Case Two: Ruili Fresh Corn Boards the E-commerce "Express Train"

Ruili City is one of the earliest and most open regions on the southwestern border of China. Bordering northern Myanmar, Ruili has a South Asian tropical humid monsoon climate characterized by abundant rainfall throughout the year, a long sunshine duration, long summers, and short winters, making it highly suitable for growing highland and hot-zone crops. Fresh corn is different from ordinary corn; it is a type of tender corn with special flavor and quality. The corn kernels are plump, bright, high in sugar and starch content, and rich in various trace elements and amino acids.

By the end of 2024, the planting area of fresh corn in Ruili had reached 70,000 acres. Winter is the golden period for planting fresh corn. Benefiting from superior natural conditions and effective manual planting techniques, Ruili fresh corn has gained independent and sustainable advantages in the national market, becoming a significant cash crop for local farmers to increase their income and achieve financial prosperity. With the

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entry of e-commerce companies, the sales of Ruili fresh corn have gradually formed a trend of "offline" centralized purchasing and "online" live-streaming retail. The entire industry chain has developed into a full-chain model of "planting - processing - e-commerce." After being processed through vacuum packaging and low GI processing to increase added value, fresh corn from local farmers is sold well on platforms such as Taobao and Pinduoduo.

4. Major Challenges in the Development of Rural E-commerce in Yunnan Border Ethnic Regions

4.1 Incomplete Logistics System

The logistics and delivery system is a crucial foundation for the development of e-commerce. However, due to the remote geographical locations, complex terrain, and lagging public transportation infrastructure in border ethnic regions, coupled with the lack of hardware infrastructure required for modern logistics, local logistics costs are high, which weakens the competitiveness of e-commerce platforms in selling agricultural products. Cold chain logistics is an essential method for maintaining the quality of agricultural products and enhancing their competitiveness. The lack of cold chain logistics facilities in border areas means that high-value fresh agricultural products often cannot be transported or sold due to the absence of proper storage conditions. Even if they are sold and transported, the risk of quality degradation or spoilage is high. It not only causes economic losses for farmers but also reduces consumer satisfaction with agricultural products. In extreme cases, spoilage leading to food poisoning could have severe consequences. Additionally, the dispersed delivery points and freight stations are also a constraint on the development of rural e-commerce. Factors such as the limited number of delivery points and freight stations, slow response times, and unreasonable delivery route planning can directly affect the sales performance of agricultural products (YAN Qiong, 2023; GUO Chao, 2023)[6][26].

4.2 Severe Shortage of E-commerce Talent

Professional talent is crucial for the growth and development of rural e-commerce. However, Yunnan border ethnic regions face significant gaps in educational resources compared to more developed areas. Although the government has invested substantial financial and material resources in recent years, leading to improved educational infrastructure, the software aspects—especially the availability of excellent teachers, high-quality curriculum resources, and top-tier educational institutions—remain a major weakness in cultivating various types of talent in the region. E-commerce is an emerging industry with high technical requirements, a broad knowledge base, and rapid updates. E-commerce professionals need not only to understand the basic theories of e-commerce but also to master skills such as online store decoration and beautification. They must be able to apply market economy principles to grasp market demand dynamics and even be familiar with various consumer protection laws. It is particularly challenging for local farmers. On the one hand, government-led educational reforms cannot be achieved overnight, and the misalignment between professional knowledge structures and job requirements is currently the biggest issue faced by schools.

On the other hand, vocational skills training also lags behind the demands of the e-commerce industry.

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Moreover, most county-level training institutions lack professional teachers and need to seek trainers from higher-level regions or schools. In addition to the local talent shortage, attracting external talent is also very difficult. The harsh living conditions, low level of modernization, limited career development opportunities, and differences in lifestyle and culture in border ethnic regions make it unattractive for external talent to work there (He Yujing, 2018)[7].

4.3 Low Standardization and Branding of Agricultural Products

Standardization and branding of agricultural products are important aspects of enhancing their competitiveness. In Yunnan border ethnic regions, the level of standardization and branding of agricultural products is generally low. First, there is a lack of awareness regarding standardization and branding. Due to limited education, many farmers are unaware of the concepts of standardization and branding. Some agricultural products, which have not undergone strict quality inspection and grading, lack market competitiveness. Second, local enterprises are small in scale and often lack strategic vision, focusing on short-term gains while neglecting long-term benefits. They lack systematic brand planning and promotion strategies (YAN Qiong, 2023; Du Zhaolin, 2024)[6][23]. Third, local governments provide insufficient guidance. Although standardization and branding are primarily the responsibility of farmers and enterprises, the government could strengthen its guidance, especially in the construction of "geographical indication products," and actively coordinate various stakeholders to form a united effort, making brand building much easier (Du Zhaolin, 2024)[23].

4.4 Digital Divide Cannot Be Eliminated in the Short Term

The causes of the digital divide (Digital Divide) can be broadly divided into two aspects—first, the lag in infrastructure construction. The network information infrastructure in border ethnic regions is weak, with insufficient network coverage in some mountainous and remote areas. Weak or missing signals are common, and even where broadband is available, issues such as unstable network quality, narrow bandwidth, and slow internet speeds are prevalent. It is particularly evident in live-streaming sales. Second, local farmers are unable to address or resolve digital issues. They face difficulties in accessing network data, especially market demand databases and online financial data. They also struggle with limited methods and weak capabilities in handling online customer service.

5. Development Paths and Policy Recommendations

5.1 Improving the Rural E-commerce Logistics System

1. Optimizing Logistics Layout to Reduce Costs:

By rationally planning logistics nodes and integrating local spatial and geographical characteristics, a tiered logistics system comprising logistics centers, distribution centers, and delivery stations can be established to achieve intensive utilization of logistics resources. Typically, regional logistics centers should be located at transportation hubs or in areas with concentrated agricultural production. It not only reduces transportation distances but also enhances sorting efficiency and delivery timeliness (CAI Ping, 2023)[27].

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2. Integrating Resources through Joint Delivery Models:

The government should lead and support logistics companies in adopting joint delivery models. This approach not only avoids the waste of logistics resources and promotes green logistics but also facilitates the standardization of logistics operations.

3. Increasing Investment in Cold Chain Logistics:

Fresh agricultural products, which are crucial yet challenging to handle in rural e-commerce, often have high value. Ensuring the quality and transportation of products such as fresh corn in Dehong, matsutake mushrooms in Diqing, and okra in Baoshan is key to the future development of rural e-commerce in Yunnan's border ethnic regions. Therefore, it is essential to plan and construct regional cold chain logistics bases, increase investment in equipment and facilities, and introduce advanced cold chain technologies and management expertise to enhance the overall operational capacity of the cold chain logistics system (YAN Qiong, 2023)[6].

5.2 Establishing a Multi-level Talent Cultivation and Introduction Mechanism

To address the shortage of e-commerce talent in rural areas, a combination of internal cultivation and external introduction is necessary. On the one hand, local schools, including universities and vocational colleges, should take primary responsibility for cultivating e-commerce talent. Their curricula and courses should align with industry job requirements, emphasizing practical teaching and integrating productive practice to ensure that students are well-equipped for employment upon graduation. Additionally, vocational skills training should be strengthened at the county and township levels with well-organized and categorized training programs that are accessible and effective. The training content should be scientifically designed, easy to understand, and cover e-commerce platform operations, online marketing, and data analysis, among other topics, using real-world cases to enhance trainees' practical abilities (LI Jing, 2023; GUO Chao, 2023) [14][25].

On the other hand, strategies for attracting talent should be enhanced. E-commerce enterprises should be the primary body for talent introduction, while the government should introduce supporting policies to enhance the attractiveness of local talent. These could include specialized e-commerce talent subsidies, dedicated talent apartments, entrepreneurial funding, and tax incentives. Furthermore, talent exchange platforms should be strengthened to promote short-term exchanges between e-commerce professionals from developed regions and border ethnic regions (LI Jing, 2023)[14].

5.3 Promoting Standardization and Branding of Agricultural Products

Standardization and branding of agricultural products are key to high-quality agricultural development and a crucial prerequisite for the rapid growth of rural e-commerce. First, a comprehensive standard system for agricultural product processing, production, and packaging should be established to enhance the quality of local agricultural products and boost their market competitiveness. Specific measures include developing and revising agricultural standards, encompassing production techniques, grading, packaging, and safety and hygiene standards; strengthening the quality inspection and certification of agricultural products to enforce market entry systems strictly; and advancing informatization through coding and traceability systems to en-

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hance circulation efficiency. These measures ensure that agricultural products meet national requirements and satisfy the market's demand for high quality. Second, efforts should be made to create high-quality brands and implement brand promotion strategies. Local enterprises should be encouraged to apply for "brand" certification, and market regulatory departments should consciously cultivate high-end brands with market competitiveness. They should actively promote "brand" construction in collaboration with cultural tourism, propaganda, commerce, and other relevant departments and establish brand promotion mechanisms to utilize various resources for comprehensive brand development.

5.4 Strengthening Digital Infrastructure Investment and Technological Empowerment

Investing in digital infrastructure is essential for enhancing the technological empowerment of rural e-commerce. It is necessary to integrate resources from the government, enterprises, and society to promote technological empowerment. First, digital infrastructure should be strengthened by expanding network coverage and improving network quality in border ethnic regions, especially in mountainous and remote areas, to ensure that farmers have access to high-quality network services. Second, digital technology should be leveraged to optimize the logistics system and address the "last mile" delivery challenge by enhancing the logistics network. Third, a "one-stop" service platform should be created using digital technology to integrate resources from the government, enterprises, and society. This platform would provide farmers with market information, technical support, and sales and marketing services, reducing information asymmetry and improving the operational efficiency of rural e-commerce. Fourth, the application of emerging technologies should be promoted to enhance the operational efficiency and precision marketing capabilities of rural e-commerce. Big data can be utilized to analyze consumer behavior, gain a deeper understanding of market demand, and develop targeted marketing strategies. The use of artificial intelligence for customer service and intelligent inventory management can reduce labor costs and improve work efficiency (LI Jing, 2023)[14].

6. Future Development Trends

With the in-depth implementation of the Rural Revitalization Strategy, the development of rural e-commerce in Yunnan's border ethnic regions is expected to accelerate significantly. First, artificial intelligence (AI) and blockchain technologies will further permeate the field of rural e-commerce, injecting new vitality into the development of e-commerce in border areas. Through advanced natural language processing technologies and machine learning algorithms, consumers will receive more efficient pre-sales, mid-sales, and after-sales consulting services. AI-driven big data mining of consumer behavior preferences will increase the conversion rates of potential customers and enhance customer satisfaction. By forecasting market demand, optimizing inventory, and automatically setting more rational logistics routes, supply chain efficiency will be improved, agricultural product losses will be reduced, and the quality of fresh agricultural products will be enhanced. Second, the introduction of blockchain technology will enhance the traceability and security of transactions for agricultural products. Consumers will be able to trace the entire life cycle of products, thereby increasing their trust in product quality (LI Jing, 2023)[14]. Third, rural e-commerce will be deeply integrated with agriculture, tourism, and culture. The integration of "rural e-commerce + tourism" can promote high-quality agricultural products in combination with the unique natural landscapes and ethnic cultures of border ethnic regions, mutually reinforcing each other and driving the development of local tourism (Cui Zhanyi, 2023)

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[30]. For example, live-streaming sales can showcase local cultural festivals, handicraft-making processes, and other cultural activities. It not only enhances consumers' cultural experience but also stimulates their desire to consume further. The integration of "e-commerce + culture" will incorporate traditional handicrafts, music, dance, and other cultural elements into the e-commerce sales process, promoting the development of market-competitive products, such as ethnic clothing, handicrafts, and cultural derivatives.

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