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Research on the path of digital economy empowering the high-quality development of rural tourism industry

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Abstract. As a crucial engine driving the high-quality development of rural tourism industry, the digital economy's empowerment path urgently requires in-depth exploration. Based on the New Endogenous Development Theory, this study constructs a three-dimensional analytical framework of "Technology Embedding - Subject Response - System Reconstruction". Taking Gaodang Village in Guizhou Province as a typical case, it comprehensively adopts literature analysis and case study methods. The research findings show that: through data factor-driven, platform integration, and intelligent technology application, the digital economy reconstructs the industrial chain and innovation chain of rural tourism, effectively improving the efficiency of resource allocation; however, Gaodang Village faces practical dilemmas such as weak digital infrastructure, insufficient digital literacy of subjects, and inadequate industrial ecosystem collaboration. The optimization path needs to synergistically strengthen digital infrastructure construction, enhance the capabilities of subjects, promote ecological integration, and establish a multi-agent collaborative mechanism. This study provides a theoretical basis and practical reference for the digital transformation of rural tourism industry in ethnic areas. In the future, it is necessary to further explore the path of in-depth integration between digital technology and rural characteristic resources to achieve higher-quality and more sustainable development.

Keywords:digital economy, rural tourism, high-quality development

1. Introduction

The Digital Rural Development Action Plan (2022-2025) states that efforts should be made to promote the development of rural digital economy, provide technical support for the high-quality digital development of rural tourism, boost the growth of the digital economy, and guide the digital transformation of rural tourism industry, which is a practical measure to promote the high-quality development of rural tourism industry. China's "14th Five-Year Plan" clearly puts forward the strategic guidance of "in-depth integration of digital economy and real economy". As an important approach to realize rural revitalization, rural tourism is urgently facing the demand for digital transformation. To achieve this goal, it not only requires the design of external policies, but also needs to explore feasible paths for the high-quality development of rural tourism industry from the perspective of arousing the endogenous development momentum of the industry. As a model that can arouse the endogenous development momentum of the industry, the digital economy should empower the high-quality development process of rural tourism industry. Regarding the integrated development of digital economy empowerment and rural tourism industry in Guizhou, although the current development of digital economy empowerment has reshaped the overall pattern of traditional publicity and marketing of rural tourism industry and laid a solid foundation for the transformation and upgrading of rural tourism industry, due to the certain degree of mismatch between the digital economy and rural tourism industry in terms of market, space, and public services, the empowerment effect of the digital economy on the high-quality development of rural tourism industry is not obvious at present. Taking Gaodang Village in Anshun City, Guizhou Province as an example, as one of the well-preserved Buyi ethnic ancient villages in China, it has obtained titles such as "National 4A-Level Tourist Scenic Spot" and "China's Ethnic Minority Characteristic Village" by virtue of its stone slab architecture, ethnic culture, and geographical advantages adjacent to Huangguoshu Scenic Area. Through the "scenic area operation + villagers' self-governance" model, it has achieved the dual improvement of tourism income and villagers' employment. However, at present, the tourism industry in Gaodang Village still faces problems such as backward digital infrastructure, insufficient transformation of cultural resources, and conventional marketing methods. Tourist experience mainly focuses on offline sightseeing, lacking digital products such as virtual tourism and intelligent navigation. Moreover, the source of tourists mostly relies on traditional travel agencies, failing to make good use of

big data to accurately reach target groups. With the help of the New Endogenous Development Theory, this project seeks the process mechanism and implementation path of the digital economy empowering the high-quality development of rural tourism industry from the theoretical perspective of "internal and external symbiosis" and "top-down and bottom-up linkage". It studies the governance path of the digital economy promoting the high-quality development of rural tourism industry from the theoretical level, and then conducts on-the-spot investigations in Gaodang Village, Anshun City, Guizhou Province. It deeply analyzes the actual dilemmas faced by the current digital economy empowering the development of rural tourism industry; explores the path of the digital economy promoting the high-quality development of rural tourism industry from the practical level, and also provides decision-making references for the government's policy design in the digital transformation and high-quality development of rural tourism industry. It not only follows the national "Digital Rural" strategy, but also provides a practical sample for solving the bottleneck of the upgrading of cultural and tourism industries in ethnic areas, with distinct characteristics of the times and regional features.

1.1. Literature review

In recent years, the rapid development of the digital economy has brought new opportunities to rural tourism. Digital technology has not only changed the publicity and marketing methods of rural tourism, but also promoted the innovation of tourism products and service models, providing a strong driving force for rural revitalization. At the policy level, the Chinese government has successively issued a series of policies to support the integration of digital economy and rural tourism. For example, the Digital Rural Development Action Plan (2022-2025) clearly proposes to accelerate the digitalization process of rural tourism and improve rural digital infrastructure. Although policy promotion provides support for the digital development of rural tourism, there are still challenges such as weak infrastructure, low market matching, and insufficient application of digital technology in practical applications. Therefore, the academic community has conducted many studies on how the digital economy empowers rural tourism and achieved certain results.

(1) How the digital economy promotes the development of rural tourism. Existing studies generally believe that the digital economy can optimize the industrial structure, improve production efficiency, and promote the optimization of resource allocation. The digital economy provides an important opportunity for the economic development of western China, and it is suggested to strengthen the application of information technology to promote the high-quality development of the regional economy [1]. Some scholars have further analyzed the impact mechanism of the digital economy, believing that it promotes the transformation and upgrading of the economic model through industrial linkage and innovation effects [2]. The in-depth application of the digital economy can make rural tourism more intelligent and personalized, thereby enhancing the overall tourist experience [3]. Internationally, some scholars have proposed that the digital economy consists of three core parts: infrastructure, e-commerce processes, and e-commerce transactions [4], and e-commerce should be included in the scope of the digital economy [5]. These studies show that the digital economy is not only an important booster for the development of rural tourism, but also has a profound impact on the transformation and upgrading of the entire economic system.

(2) Current situation and challenges of rural tourism development. Domestic studies generally believe that the development of rural tourism depends on its rich natural resources and cultural heritage. For example, some scholars point out that Chinese rural areas have a long history and profound cultural accumulation, which provides a good resource foundation for the development of rural tourism [6]. However, rural tourism still faces many challenges in the development process, such as insufficient infrastructure construction, weak market competitiveness, and lack of professional management talents. It is necessary to make full use of existing cultural resources, promote cultural dissemination, and improve villagers' cultural literacy to promote the development of rural tourism [7]. Internationally, rural tourism is considered to not only promote rural economic growth, but also contribute to sustainable development. Studies have shown that rural tourism can increase farmers' income and promote rural economic prosperity [8, 9]. However, some scholars point out that relying solely on natural resources and cultural resources is not sufficient to support the long-term development of rural tourism industry, and government policy support and capital investment are also crucial [10].

(3) Paths and practical challenges of the digital economy empowering rural tourism. Domestic scholars mainly discuss the empowerment role of the digital economy in rural tourism from the perspectives of policy support and technology application. The key to the digital economy promoting the integrated innovation of rural tourism industry lies in accelerating infrastructure construction, promoting the digital transformation of cultural resources, and improving the rural digital cultural and tourism product system [11]. In addition, the rapid development of Internet technology has promoted the upgrading of rural tourism industry. For example, the rise of new models such as short video marketing and smart tourism has greatly improved the tourist experience [12]. However, studies have also found that the current digital economy empowering rural tourism still faces certain practical dilemmas, such as low participation of local governments and lagging construction of digital infrastructure in rural areas. Foreign studies also focus on the impact of digital technology on rural tourism. Some scholars emphasize that the digital development of rural tourism requires the joint efforts of the government, enterprises, and villagers [13].

Although existing studies have achieved certain results in the field of digital economy empowering rural tourism, there are still some limitations: (1) The focus is relatively single. Many studies focus on policy support and external environmental factors,

while the discussion on the internal dynamic mechanism of rural tourism is relatively insufficient. How to combine local characteristics and tap the innovative capabilities of rural areas themselves is a problem worthy of in-depth study. (2) There are limitations in the research area. Most current studies focus on economically developed areas in eastern China, while less attention is paid to the digital development of ethnic villages in western China. Due to the large differences in economic conditions and social environment between the western region and the eastern region, simply copying the successful experience of the eastern region may not be applicable. Therefore, there is still a large room for development in personalized research on ethnic villages in western China. (3) The research methods are relatively single. Existing studies mostly focus on theoretical discussions, lacking empirical research and case analysis, making the path of how the digital economy specifically promotes the development of rural tourism unclear. Therefore, it is necessary to combine specific cases and support research conclusions with data to enhance the application value of the research. To make up for these research gaps, this study takes Gaodang Village in Anshun City, Guizhou Province as a case to deeply explore how the digital economy promotes the high-quality development of rural tourism, and puts forward feasible optimization strategies on this basis. It is hoped that through this research, more targeted references can be provided for the digital development of rural tourism and scientific guidance can be provided for the rural revitalization strategy.

2. Analytical framework for the digital economy promoting the high-quality development of rural tourism industry in Guizhou

2.1. Digital technology embedding

It is quite certain that rural tourism can increase farmers' income and promote rural economic prosperity [8, 9]. The deepening of this process is inseparable from the strong support of digital technology. In the process of investigating how the digital economy promotes the high-quality development of rural tourism industry, the embedding of external digital technology is a key starting point. This process not only involves the construction of infrastructure such as hardware facilities like broadband networks and mobile communication base stations, but also includes the application and services at the software level, such as the application practice of technologies like big data analysis, cloud computing, Internet of Things (IoT), and Artificial Intelligence (AI). Improving digital infrastructure is the foundation for rural tourism to realize digital transformation [6]. Taking Guizhou Province as an example, relying on the implementation of the Guizhou Province "13th Five-Year" Informatization Development Plan, the province has made great efforts to improve the Internet access capacity in rural areas and ensure that every village can enjoy high-speed and stable network services. Such infrastructure construction has laid a solid foundation for the subsequent technology application. With the nationwide deployment of 5G technology, rural areas are about to usher in more efficient communication conditions, which will greatly drive the development and application of new tourism products such as intelligent tour guides and Virtual Reality (VR) experiences [14].

The application of big data analysis can deeply understand the behavioral preferences and demand changes of tourists, helping local governments and enterprises formulate more accurate marketing strategies. The implementation of sentiment analysis on user comments on social media can quickly capture the true opinions of tourists on specific scenic spots or activities, thereby adjusting the relevant services and products [3]. The Digital Rural Cultural and Tourism Development Report (2023) shows that with the help of cloud computing platforms, small tourism enterprises and individual businesses can obtain powerful computing capabilities and storage resources at a lower cost, which is of great significance for improving their operational efficiency.

2.2. Multi-subject response

In the stage of the digital economy promoting the high-quality development of rural tourism in Guizhou, attention should be paid to the role of multiple stakeholders such as the government, enterprises, and residents [13]. The integration of digital production factors has effectively promoted the response and collaboration of multiple subjects including party organizations, the government, market entities, social organizations, and the public by reconstructing industrial chain relationships, optimizing resource allocation, and stimulating synergy effects. Party organizations promote the overall coordination of policies and resources through top-level design. The Guizhou Provincial Party Committee has incorporated rural revitalization and tourism industrialization into the main strategies of "Four News" and "Four Modernizations", and highlighted the leadership of the Party through digital rural construction to enhance the effectiveness of rural governance [1]. The government integrates data flow and business flow through digital governance platforms. The Guizhou Provincial Department of Culture and Tourism and Mafengwo jointly launched the "AI Travel Guizhou" intelligent tool to achieve accurate matching between tourist needs and public services. At the same time, it integrated the resources of 684 A-level scenic spots through the "One Code Travel Guizhou" platform, with a total transaction volume exceeding 111 million yuan, demonstrating the improvement of government service efficiency driven by data [2]. Market entities activate the vitality of business formats through technological innovation. Tencent Interactive

Entertainment linked the game IP Wanshang Shanhai with Wuxi Scenic Area, increasing the online check-in volume by 13 times and building a closed loop of "traffic - consumption - industrial upgrading". Social organizations have become a bridge for technology empowerment. The Guizhou Provincial Federation of Social Sciences, together with university expert teams, formulated a digital transformation plan for the ancient building complex in Loufang Village, Shiqian County, promoting the integration of traditional villages into the online economic circle; units such as the China Tourism Association have trained more than 50,000 "leading talents" through training programs to address the shortage of rural digital skills. As the core beneficiaries and participants, the public directly participates in the value system through digital platforms. For example, Xiaohongshu's "Hometown Promoter" program has cultivated villagers into content creators; the AI tour guide "Xiaodan" in Danzhai County has boosted the sales of intangible cultural heritage products; during the "Village Super League" event in Rongjiang County, villagers used digital means such as live broadcasting to achieve both cultural dissemination and economic benefits. From a theoretical perspective, the collaborative response of multiple subjects reflects the dynamic adaptability of "technology - system - organization".

2.3. Reconstruction of industrial ecosystem

When external digital technology and various stakeholders are effectively activated, the entire rural tourism industrial ecosystem enters the reconstruction stage. The core task of this stage is to break traditional boundaries and build a new ecological system of industrial and innovation linkage [2].

2.3.1. Industrial chain reconstruction

The reconstruction of the rural tourism industrial chain by the digital economy essentially breaks through traditional industrial boundaries through technology integration and factor integration, and cultivates a new industrial ecosystem with greater resilience and synergy. The traditional rural tourism industrial chain generally presents a fragmented characteristics, with links such as resource development, product design, and service supply separated from each other, leading to low efficiency of supply-demand matching and chaotic resource allocation. Due to the in-depth embedding of digital technology, this linear structure has been changed. Relying on the cross-temporal and cross-spatial movement of data factors and the dynamic adjustment of intelligent algorithms, each node of the industrial chain has transitioned from isolated operation to networked collaboration.

At the resource development end, digital technology endows rural tourism resources with more efficient transformation capabilities. The practice of Gaodang Village shows that the application of IoT sensors and remote sensing technology can real-time monitor the carrying capacity of the ecological environment, dynamically control tourist flow to prevent over-development; 3D modeling and digital twin technology can transform cultural resources such as Buyi ancient architecture and traditional craftsmanship into interactive digital assets, laying a solid foundation for subsequent product development. This digitalization of resources not only solves the problem of information asymmetry in traditional development, but also forms a reusable cultural gene bank through data accumulation, laying the foundation for the continuous innovation of the industrial chain.

The transformation at the production end is reflected in the precision and personalization of product design. Relying on big data analysis of tourists' behavioral preferences, rural tourism products have transitioned from standardized supply to flexible customization. By mining the emotional tendencies of tourists on social media [12], Gaodang Village can design differentiated cultural experience projects for different customer groups - developing intangible cultural heritage manual interactive courses for parent-child families, creating AR treasure hunting games for young customer groups, and restoring slow-paced folk life scenes for middle-aged and elderly tourists. This data-driven content production model has greatly solved the problem of serious homogenization of traditional rural tourism products and significantly improved the value creation capability of the industrial chain. The reconstruction at the circulation end is manifested in the intelligent upgrading of the supply-demand matching mechanism. Traditional rural tourism attracts customers through intermediate channels such as travel agencies, with many information transmission links and high costs. Digital platforms integrate scattered services such as scenic spot ticketing, accommodation booking, and transportation connection to create a "one-stop" supply-demand docking system. Tourists can obtain personalized travel arrangements through intelligent recommendation systems, while suppliers can dynamically adjust inventory and pricing strategies based on real-time booking data. This two-way optimization mechanism not only reduces transaction costs, but also makes value distribution more reasonable by shortening the industrial chain, enabling villagers as resource holders to participate more directly in benefit sharing.

The in-depth significance of industrial chain reconstruction is to activate the potential of cross-border integration of rural tourism. Digital technology blurs the boundaries between tourism and industries such as agriculture, cultural and creative industries, and education, giving birth to composite business formats such as "tourism + e-commerce" and "culture + technology" [12]. Gaodang Village has made Buyi batik craftsmanship into digital collectibles and expanded the derivative market through online auction channels; at the same time, it has promoted the direct sales of agricultural products through study tours, creating a closed loop of "experience - consumption - reproduction". This expansion and reorganization of the industrial ecosystem has

upgraded rural tourism from a single sightseeing economy to a multi-value network, laying a more sustainable development path for rural revitalization.

2.3.2. Innovation chain reconstruction

The digital economy is reconstructing the rural tourism innovation chain at the system level through the in-depth integration of data factors, platform economy, and intelligent technology. This reconstruction process is not only reflected in the progress at the technology application level, but also in the significant changes in industrial organization models and value creation logic. According to the report of Qiannan Government, Qiannan Prefecture of Guizhou Province has integrated 591 channel providers and 269,000 tourism-related enterprises, constructing a digital platform pattern of "cloud-edge-end" collaboration, which has significantly reduced the proportion of unsalable agricultural products and fully demonstrated the allocation significance of data factors. The core of this innovation chain reconstruction focuses on original breakthroughs driven by technology integration. For example, Longmen Grottoes has built a digital twin platform through 1:1 3D modeling, allowing tourists to trigger the interpretation of historical scenes with AR glasses. Business format innovation continuously expands the edge of the value chain. Huangling Village in Jiangxi Province launched the "autumn sun-drying" IP through Douyin short videos. In 2023, the number of newly added rural-themed videos on Douyin exceeded 1 billion, with a total playback volume of 2.4 trillion times. Tourists then participate in offline experiences, forming a closed loop from digital communication to offline experience and then to e-commerce repurchase [5].

The digital economy is significantly changing the development model of rural tourism in Guizhou. Relying on the coordinated operation of the industrial chain and innovation chain, a benign circular development structure has been created. This change is not a simple technology aggregation, but a reshaping of the development path of rural tourism at the underlying logic level. The reconstruction of the industrial chain has ended the fragmented situation of various links in traditional rural tourism, and realized digital cooperation from resource development to product sales through technologies such as the Internet of Things and AI algorithms, laying a solid foundation for value creation.

3. Practical progress of digital economy empowering the high-quality development of rural tourism industry

3.1. Basic development process of digitalization in Gaodang Village's tourism industry

Period of Dormant Resource Endowment (Before 2013): Gaodang Village, an ancient village with profound historical heritage in Zhenning Buyi and Miao Autonomous County, Anshun City, Guizhou Province, boasts a Buyi culture inherited for nearly a thousand years. However, due to its location in a mountainous area surrounded by mountains, geographical barriers are significant and transportation is extremely inconvenient. The winding and narrow mountain roads make it difficult for the outside world to access this mysterious land, leaving Gaodang Village in a state of "being unknown to the world" for a long time. The village's economic structure is extremely single, with traditional agriculture as the main economic pillar. The per capita arable land is less than one mu (a Chinese unit of area, approximately 0.0667 hectares), and the lack of land resources restricts the large-scale development of agriculture. The main crop grown is corn, with traditional planting methods, lacking scientific planting techniques and modern agricultural equipment, resulting in extremely low added value of agricultural products. The meager agricultural income is insufficient to meet the villagers' living needs, leading to a large number of young and middle-aged laborers migrating to cities for work, and the phenomenon of "hollow villages" becoming increasingly serious.

Policy-Driven Initial Period (2013-2017): In 2013, Gaodang Village ushered in an important development opportunity - it was included in the second batch of China's Traditional Village List and became a key pilot for poverty alleviation through tourism. The local government seized this opportunity, centering on the development theme of "protection and development of ethnic culture, improvement of the ecological environment, and integration of happy living, working, and traveling", and made every effort to build Gaodang into a millennium-old Buyi ancient village tourist attraction integrating cultural inheritance, folk experience, ecological sightseeing, and leisure entertainment. It aimed to promote cultural inheritance and development through tourism, enhance the quality of tourism through culture, and drive the increase of people's income and prosperity. The initial development of Gaodang Village was launched. The government invested funds to carry out preliminary repairs on ancient buildings, restore stone slab roads, clean up river garbage, and improve the village appearance, laying the foundation for tourism development. At the same time, it explored Buyi cultural resources and transformed them into tourism selling points: organizing Buyi song and dance performances to showcase traditional Buyi costumes, dances, and music; setting up handicraft exhibition areas to display traditional Buyi techniques such as batik and embroidery. However, the development model in this stage was relatively extensive, lacking scientific and reasonable planning and professional operation management. Infrastructure construction was backward: the roads were narrow and unable to meet the traffic needs of vehicles; the number of public toilets was insufficient with poor sanitation conditions; the accommodation facilities were simple, mostly simple homestays renovated

by villagers' own houses with incomplete supporting facilities. These factors led to extremely limited tourist reception capacity and meager tourism income, failing to form a scale effect. Gaodang Village's tourism industry was only in the initial exploration stage.

Market-Oriented Transformation Period (2018-2020): In 2018, to promote a qualitative leap in Gaodang Village's tourism industry, Zhenning Autonomous County conducted a thorough market investigation and introduced Guizhou China Youth Travel Service (CYTS). Guizhou CYTS took the lead in forming an alliance with more than 10 well-known local travel agencies including Baishiying Tourism Investment, and established Guizhou Puxiang Gaodang Cultural Tourism Co., Ltd., which was entrusted with the operation of the scenic area. According to the scenic area entrusted operation agreement, 10 rights and obligations of Zhenning Autonomous County in terms of property rights, supporting investment, and government services were clarified, making every effort to promote the improvement of the scenic area's infrastructure and laying a good foundation for the stable and rapid development of the scenic area. Meanwhile, 12 rights and obligations of the entrusted company in terms of scenic area operation rights, development and operation, and driving development were specified. A professional team dispatched by the shareholder travel agencies was responsible for the overall operation of Gaodang Scenic Area, giving full play to professional advantages and the channel advantages of the shareholder travel agencies to introduce tourist sources, and striving to build the scenic area into a model in Anshun, a well-known scenic spot in Guizhou, and a domestic famous ethnic ancient village tourist attraction. This realized the professional management of the scenic area. The enterprise invested a large amount of funds to improve infrastructure such as the tourism reception center, ecological parking lot, and tourist rest area. The tourism reception center was equipped with professional service personnel to provide tourists with one-stop services such as consultation, ticket purchase, and tour guidance; the ecological parking lot was reasonably planned and laid out to accommodate a large number of vehicles. At the same time, it deeply explored Buyi culture and developed a series of cultural experience projects, such as Buyi batik making experience courses and traditional food production teaching activities, enriching the content of tourism products. In 2018, 2019, and 2020, the scenic area achieved operating incomes of 8.6 million yuan, 10.8 million yuan, and 10.4 million yuan respectively, maintaining a sound development trend in its operation. Gaodang Village successfully transformed from a poor village to a tourism demonstration village. However, the outbreak of the COVID-19 epidemic dealt a heavy blow to the tourism industry: the number of tourists in Gaodang Village Scenic Area plummeted, and tourism income dropped sharply to 3.8 million yuan, only half of that in 2019. This exposed problems such as insufficient industrial risk resistance capacity and over-reliance on offline tourist sources, and the development of the tourism industry fell into a standstill.

Period of Quality Improvement, Efficiency Enhancement and Coexisting Challenges (2021-Present): With the gradual recovery of the tourism industry in the post-epidemic era, Gaodang Village seized the opportunity of the 8th Anshun Tourism Industry Development Conference and actively explored the path of transformation and upgrading of the tourism industry. Twenty-five enterprises with Zhenning ethnic cultural characteristics in "carving, weaving, embroidery, dyeing, painting, and products" joined forces to develop together, jointly creating the "Yincheng Qushi" cultural tourism brand, which drove the employment of 577 local people. It launched the night economy: creating a light show with ethnic characteristics, combining the ancient stone slab buildings with modern lighting art to create a unique atmosphere; opening a night market gathering Buyi characteristic snacks and handicrafts, extending the tourist stay time and increasing tourism consumption. It also introduced new business formats such as tent hotels to meet the accommodation needs of different tourists. During the "13th Five-Year Plan" period (2016-2020), Zhenning Autonomous County achieved a total tourism income of nearly 33.6 billion yuan and received nearly 35.33 million tourists; in the first quarter of this year (the year when the data was released), it received nearly 1.51 million tourists and achieved a tourism income of nearly 1.34 billion yuan [6]. By 2025, the annual number of tourists received by the scenic area has maintained steady growth. However, in the process of development, some problems have gradually emerged: surrounding similar ethnic villages have successively developed the tourism industry, resulting in serious homogenization of products and services, making it difficult for Gaodang Village to stand out; in the process of commercial development, some ancient buildings have been damaged, and the inheritance of traditional culture is facing a crisis. How to find a balance between cultural protection and commercial development has become an urgent problem to be solved. In addition, the quality of tourism services needs to be further improved, and the shortage of tourism talents also restricts the sustainable development of Gaodang Village's tourism industry.

3.2. Policy progress promoting the digital transformation of Gaodang Village's tourism industry

In 2022, Guizhou Millennium Buyi Tourism Development Co., Ltd. took over Gaodang Scenic Area and launched a plan to revitalize idle and inefficient tourism projects. Through policy guidance and capital injection, the scenic area was included in the key cultural and tourism projects of Zhenning Autonomous County, and the direction of digital upgrading was initially planned. In 2023, Guangzhou GZL Yuejing Co., Ltd. settled in the area and proposed a digital upgrading plan of "cultural heritage + interactive content + scenario experience", developed a smart tourism platform to realize functions such as online booking and intelligent tour guidance, and introduced big data analysis to optimize the tourist experience. After the launch of the smart platform, the number of tourists increased initially in 2023.

In 2024, with the support of Guangdong-Guizhou cooperation, Gaodang Village invested 3.95 million yuan of Guangdong-Guizhou cooperation funds to build a Buyi culture-themed restaurant. This not only brought a unique food experience to tourists, but also successfully revitalized idle venues, giving new vitality to old buildings [3]. At the same time, Gaodang Village vigorously promoted the intelligent upgrading of infrastructure, constructing 5G base stations and smart parking lots. Through the Internet of Things technology, Gaodang Village can monitor the flow of people and environmental information in real time, providing a safer and more convenient visiting environment for tourists, and the tourist satisfaction rate has increased to over 90%. The Millennium Buyi Jingshan Stone Residence Hotel has introduced an intelligent management system, which has significantly improved its service level. During the peak tourism season, the hotel's occupancy rate reaches 100%, and service efficiency has increased by 40%, providing tourists with efficient and comfortable accommodation experience. In terms of cultural experience projects, Gaodang Village has also achieved remarkable results: 7 new intangible cultural heritage study tour routes have been added, covering rich content such as Buyi language teaching and batik making, allowing tourists to have an in-depth understanding of Buyi culture and driving the extension of tourist stay time to 3 days. In addition, Gaodang Village launched a Buyi wedding scene drama before the Spring Festival in 2025, bringing folk culture to the stage. It is expected that the tourist participation rate will increase significantly, adding a new highlight to the tourism development of Gaodang Village. The government and Internet enterprises have jointly built a rural tourism big data platform, integrating tourist behavior data to optimize route planning and resource allocation. In 2024, the scenic area received 185,000 tourists (a year-on-year increase of 250%) and achieved a revenue of 3.2 million yuan (a year-on-year increase of 92.8%). It has cooperated with platforms such as Anlvtong to link with Huangguoshu Scenic Area to achieve a daily average of 50,000 tourist arrivals during the peak season. By means of data analysis, it has optimized low-carbon travel routes, with carbon emissions decreasing by 15% year-on-year in 2024, and was awarded the provincial-level green tourism demonstration site. The coverage rate of digital training for villagers has reached 80%, and 52 villagers have achieved an average annual income of 18,000 yuan through employment in the scenic area.

In 2025, in accordance with the Digital Rural Development Action Plan (2022-2025), a unified data center will be built to integrate the whole-chain services of "catering, accommodation, transportation, travel, shopping, and entertainment", with the goal of increasing the tourist repurchase rate by 30% in 2025. It will develop digital museums and VR experience projects, with the expected annual online visits exceeding 500,000; explore the metaverse scenario to enhance the interactive experience between virtual and real. It will continue to promote the integrated model of "cultural tourism + catering", optimize supply chain management using big data to reduce resource waste; jointly cultivate interdisciplinary talents in digital tourism with universities, and add courses to improve the skills of practitioners. In the future, Gaodang Village will further explore the in-depth application of AI and the Internet of Things (such as intelligent customer service and unmanned tour guidance) to consolidate its position as a national benchmark for the digital transformation of rural tourism. The state and local governments have issued supporting policies, such as the Digital Rural Development Action Plan (2022-2025), to promote the digitalization of rural tourism.

3.3. Current situation of digital economy empowering the high-quality development of Gaodang Village's tourism industry

(1) Promoting the industrial upgrading of Gaodang Village's tourism industry: The digital economy has become the core engine driving the quality and efficiency improvement of rural cultural and tourism industries. In terms of infrastructure construction, relying on digital technology to upgrade rural public facilities, it promotes the expansion of network coverage and the intelligent transformation of tourism service systems. Through data resource analysis, government departments can strengthen the effectiveness of market dynamic supervision, thereby extending the value chain of the tourism industry - not only opening up new channels for agricultural and sideline products e-commerce, but also cultivating new-type professional farmers in the digital era, and ultimately building an ecological system of in-depth integration of intelligent technology and rural development. In terms of cultural value communication, the new media matrix has significantly enhanced the communication effectiveness of local culture: the innovative application of short video platforms and social media, through the creation of immersive cultural and entertainment content, has not only expanded the cultural radiation radius, but also built a digital interface for tourists to interact and participate. This communication innovation has effectively realized the multi-dimensional experience integration of cultural cognition, artistic appreciation, and leisure entertainment, and reshaped the modern tourism service paradigm: the smart tourism system based on mobile Internet, cloud computing and other technologies has given birth to new service forms such as cloud tour guidance, time-sharing reservation, and global universal code, promoting tourists to transform from information receivers to content co-creators. Through data profiling technology, it can accurately match the personalized needs of tourists, realize the flexible configuration of links such as itinerary planning, accommodation selection, and theme customization, and form a service closed loop linking online and offline. This has completely changed the shallow sightseeing model and cultivated a deep experience-based tourism market.

(2) Promoting the innovative development of Gaodang Village's cultural industry and enhancing market competitiveness: The digital economy has opened up a new path for the activation and utilization of local cultural resources. Through digital carriers such as VR panoramic tours, live interaction, and 4K images, it has carried out innovative transformation of the historical context, folk customs, and geographical features of traditional villages. Breaking the constraints of time and space, it has formed a differentiated and multi-level supply system of cultural and tourism products, effectively meeting the diversified consumption demands of segmented markets and improving the tourist experience.

(3) Expanding the boundaries of Gaodang Village's tourism industry: In 2023, Gaodang Village established 7 regular study tour routes inside and outside the province, 4 regular routes within the province, and added 2 inbound tour routes. By developing digital products such as online tour guidance and virtual reality experience, tourists can learn about the historical and cultural knowledge of Gaodang Village anytime and anywhere [3]; using big data to analyze the interest preferences of tourists, it provides personalized tourism route recommendations and services for tourists. These digital means have effectively enriched the connotation of tourism products, turning tourism into a in-depth experience that combines education with entertainment, greatly improving the quality of tourism experience and promoting the vigorous development of Gaodang Village's tourism industry in a more intelligent and personalized direction.

4. Practical dilemmas of digital economy empowering the high-quality development of rural tourism industry

4.1. Insufficient embedding of external digital technology

The construction of rural digital economy infrastructure is relatively weak. Infrastructure is the material foundation for rural areas to develop the digital economy, and its relative weakness is an important reason for the slow development of the rural digital economy [15]. In recent years, Guizhou Province has made remarkable progress in the digitalization of rural tourism by building smart tourism platforms such as "Cloud Travel Guizhou" and "One Code Travel Guizhou". By 2025, the province has 150,600 5G base stations (including logical stations), with 39.1 5G base stations per 10,000 people. The 5G access rate of administrative villages has reached 99.9% (excluding the FAST quiet zone), forming a 5G network pattern with in-depth coverage in key areas, continuous coverage in counties and above, and basic coverage in rural areas, laying a preliminary foundation for the development of digital villages [4]. However, the problem of unbalanced regional development has seriously restricted the overall construction effect. Research data shows that the current development level of digital villages in the province presents an obvious gradient difference: the Guiyang Metropolitan Area, Southeast Guizhou, and Northern Guizhou are in a relatively leading position, while the marginal areas of the province are generally in the low-to-medium development stage. This spatial differentiation is mainly caused by two restrictive factors: First, the natural geographical conditions pose objective obstacles to infrastructure construction. Guizhou's unique karst landform results in mountainous and hilly areas accounting for more than 92% of the total area. The complex terrain significantly increases the cost of laying network facilities in remote mountainous areas. Especially in deep rocky mountainous areas where ethnic minorities live in concentrated communities, the backlog of traditional infrastructure construction and the emerging demand for digital infrastructure have formed a superimposed effect, resulting in a mobile communication network coverage rate lower than the provincial average and a prominent "digital divide". Second, the basic support system of the digital economy has structural shortcomings. Surveys show that some key rural tourism villages in the province have not yet established standardized data collection systems, the coverage rate of agricultural product traceability platforms is low, and the density of smart logistics nodes in the eastern region is lower than that in other parts of the province. Such fundamental defects restrict the application scenarios of digital technology and make it difficult to effectively exert the expected effects of optimizing resource allocation and reducing transaction costs.

4.2. Insufficient response of stakeholders to digital technology

First, in the integration of the digital economy and rural tourism, the government has insufficient capabilities in policy planning and implementation, exposing governance shortcomings [16]. The successful development of rural tourism should also include government policy support, capital investment, and cooperation between public and private sectors [10]. For example, although provincial-level plans point out the direction of cultural and tourism integration, they lack "implementation details" for digital transformation, leading to difficulties in grass-roots implementation. The fragmentation of government departments causes difficulties in connecting digital infrastructure with cultural and tourism projects; the "centralized management and tight local control" of approval authority restricts the initiative of county and township governments, and key projects such as Gaodang Village have missed opportunities due to slow cross-departmental procedures. Government digital projects often only complete basic data entry due to the limited capabilities of implementers, failing to tap into in-depth value. The crux lies in the "emphasis on hardware over software" - funds are concentrated on equipment procurement, while neglecting training and maintenance, resulting in intelligent equipment becoming "decorations" [17]. Rigid governance thinking exacerbates contradictions: the

traditional management model conflicts with the open and shared nature of the digital economy, and the fragmented data systems of various departments disconnect the tourism chain. Villagers are insufficiently involved in policy formulation, leading to digital transformation plans that are divorced from actual needs and a gap between results and blueprints. Second, enterprises play a key role in the digital transformation of rural tourism; however, the current enthusiasm for participation among market entities is generally low, and the root cause lies in systemic dilemmas [18]. The imbalance between investment and return is the main factor: rural projects have long payback periods (5-8 years) and high risks, so small and medium-sized enterprises tend to choose short-term urban projects. Policy ambiguity further inhibits investment - uncertainties in land nature and data ownership make enterprises more inclined to choose government projects with controllable risks. More alarmingly, some enterprises simply apply the smart scenic area solutions used in cities to rural areas, resulting in digital products that are disconnected from the cultural characteristics of villages. This not only fails to meet tourists' demand for authentic experiences but also loses the core value of technological empowerment [20]. Third, the weakening of villagers' subjectivity is a core contradiction. The "digital gap" in cultural inheritance is the most prominent issue [7], manifested in elderly artisans being trapped by the digital divide and young people lacking in-depth understanding of local culture, leading to the superficialization of intangible cultural heritage inheritance. Capital-driven digital transformation weakens the cultural core - for example, traditional rituals are simplified into performances. The lack of discourse power in governance marginalizes villagers in technical decision-making [19]; even more, the phenomenon of "data colonialism" has emerged, with some villagers staying away from scenic areas to avoid data collection, forming a vicious cycle of self-denial [20]. Finally, the majority of tourists in Gaodang Village are middle-aged and elderly, with low acceptance of digital technology; although activities such as ethnic costume experiences have been launched, there is a lack of products that attract young tourists, such as short video challenges and virtual check-ins, failing to keep up with trends like "special forces-style tourism".

4.3. Imperfect construction of the industrial digital ecosystem

4.3.1. Industrial chain

There is insufficient resource integration. Gaodang Village still relies on traditional management models and has not used digital means to systematically integrate various tourism resources or build a comprehensive smart tourism platform. This results in scattered data across transportation, accommodation, and cultural experiences, with no unified data sharing mechanism. As a result, it is impossible to provide tourists with convenient, efficient one-stop services, nor is it conducive for managers to conduct overall planning and management of tourism resources.

The business format is singular. Gaodang Village's tourism products are mainly sightseeing-oriented, with a relatively simple form. In the era of rapid digital technology development, it has not fully utilized technologies such as VR/AR to create interactive scenarios or realize "digital + intangible cultural heritage" experiences. The lack of immersive experience projects makes it difficult to meet tourists' increasingly diverse needs, limiting the duration of tourist stays and consumption potential. Compared with successful IP cases such as Guizhou's "Village Super League", Gaodang Village is insufficient in excavating and promoting cultural symbols. Its development model is similar to that of most other ethnic characteristic rural tourism projects, and it has not developed or promoted its unique cultural symbols into IPs. This makes it difficult to attract young customer groups who pursue personalization and trendiness, restricting the diversified development of business formats.

The linkage between supporting industries is poor. The integration of agriculture, handicrafts, and tourism in Gaodang Village is relatively low. In particular, characteristic agricultural products still rely on offline sales, with no e-commerce support or digital marketing channels such as live-streaming e-commerce. The promotion methods are single and rigid, limiting the sales scope of characteristic agricultural products and making it impossible to fully leverage the development of tourism to increase income and form a sound pattern of industrial coordinated development.

4.3.2. Innovation chain

The application of digital technology is backward. The promotion of digital technology suffers from a "triple disconnect": in terms of communication methods, administrative villages still rely on paper media, with insufficient utilization of new media platforms; in terms of content design, promotional materials do not incorporate local industrial elements; in terms of organizational support, the rate of grass-roots cadres meeting digital literacy standards is relatively low. These systemic obstacles result in a penetration rate of digital technology in agricultural production that is lower than that in cities.

There is a shortage of innovative talents. The "brain drain" and ineffective talent introduction mechanisms have led to an urban-rural development gap that fosters a "talent siphon effect". Young and middle-aged laborers continue to migrate from rural to urban areas, forming a "digital capability gap" among the remaining population - more than 60% of the remaining residents have gaps in digital skills. At the same time, the current training system for interdisciplinary talents is absent. The digital transformation of agriculture and rural areas urgently requires "digital + agriculture" dual-competence talents, but the existing training mechanism shows a mismatch between supply and demand: the proportion of digital technology courses in agricultural

colleges and universities is less than 12%, and the annual coverage rate of digital skills training at the county level is only 19.3%. This structural contradiction results in 73% of new agricultural business entities facing difficulties in digital transformation, and the conversion rate of smart agricultural technology has long been lower than 35%, making it difficult to support the local digital transformation and development.

5. Research on optimization paths for the digital economy to empower the high-quality development of rural tourism industry

5.1. Improving the level of digital technology embedding

The rural tourism industry faces numerous problems in terms of digital technology embedding, which severely restrict its high-quality development [21]. The prominent issue of "data silos" means that there is a lack of effective information sharing and communication mechanisms between tourism-related departments, enterprises, and individuals. Scenic area management departments struggle to obtain key information such as tourist consumption data and feedback in a timely manner; tourism enterprises, due to a lack of understanding of the scenic area's overall operation and market demand, cannot make timely and scientific decisions. Furthermore, the ticketing systems of scenic areas, homestay booking platforms, and catering consumption data are not interconnected, making it impossible to analyze tourist behavior preferences through big data. This results in missed opportunities to optimize product design and service processes, as well as to improve tourist experiences and increase revenue.

There is a lack of a smart tourism service system. The ancient village lacks modern facilities such as AR real-scene navigation and intelligent voice guidance [22]. Tourists mainly rely on paper maps and paid manual guides (costing 100 yuan per session), with a limited number of guides available. This leads to insufficient depth of cultural experience - tourists cannot use AR technology to intuitively understand the historical background and cultural connotations of ancient buildings, making it difficult to truly appreciate the charm of Buyi culture. At the same time, the scenic area has not established a real-time tourist flow monitoring system, leading to overcrowding and potential safety hazards during peak tourism periods. Early warning information for extreme weather relies on traditional radio broadcasts, which are inefficient and have incomplete coverage, making it difficult for tourists to receive warnings in a timely manner and posing safety risks.

Digital marketing capabilities are insufficient. The scenic area has invested little in digital marketing. Although it has released static images and texts on WeChat official accounts since 2022, and launched regular operations on Douyin and Xiaohongshu in 2023 and 2024 respectively, its popularity is far lower than that of Zhaoxing Dong Village during the same period. For example, the "Dong Village Costume Transformation" event in Liping County in 2022 received 140 million views, while Gaodang Village has not built a tourist database, resulting in vague user profiles and an inability to accurately target customer groups [23]. At the same time, it has failed to identify the demand for "intangible cultural heritage study tours" among middle and high-end tourists in first-tier cities such as Shanghai and Guangzhou, and can only receive student study tours from nearby Anshun City, missing opportunities to develop customized products. Additionally, it lacks effective operation on short video platforms, making it impossible to attract young tourists and losing a large number of potential customers.

To address these issues, the following optimization strategies should be adopted: Accelerate the popularization of 5G networks and build a unified big data platform to achieve data interconnection and help the scenic area make accurate decisions; promote AR/VR intelligent navigation systems and establish real-time tourist flow monitoring and efficient early warning systems to enhance tourist experiences and safety; increase investment in digital marketing, build a tourist database to accurately analyze demand, and use platforms such as short videos for diversified marketing to attract more tourists.

5.2. Enhancing the response capabilities of multiple subjects

In all fields of rural development, digital technology should enable multiple subjects to participate in rural governance [24]. Most tourism service personnel in the scenic area, including tour guides, homestay operators, and catering practitioners, have a low level of digital technology proficiency. When facing inquiries and booking requests from tourists through online platforms, they cannot respond promptly and accurately, which affects tourists' perception of the scenic area's services. Some tour guides are unable to use electronic navigation equipment and can only provide simple verbal explanations, failing to meet tourists' diverse needs. During peak booking periods, homestay operators are unfamiliar with online booking systems, leading to delayed order processing, which causes dissatisfaction among tourists and reduces the scenic area’s reputation and competitiveness.

To address this, it is necessary to enhance the response capabilities of multiple subjects. On the one hand, provide digital skills training for tourism service personnel, conduct regular training courses on digital technology applications to improve their ability to operate online platforms and use electronic navigation equipment, thereby shortening service response times. On the other hand, introduce incentive mechanisms to encourage service personnel to improve their digital literacy, and reward those who perform well to enhance the overall service level of the scenic area.

5.3. Reconstructing the digital ecosystem of rural tourism industry

5.3.1. Industrial chain

The development of tourism resources in Gaodang Village faces significant bottlenecks at the industrial chain level. The mountainous geographical environment and the layout of stone-wooden houses result in narrow, winding stone slab alleys. Although a special tourism route has been built and the village is located between 5A-level scenic spots such as Huangguoshu and Longgong, the regional linkage effect has not been fully realized. Inconvenient transportation increases tourists' time and economic costs; the limited frequency of public transportation further affects the experience of independent travelers. The loose connection between upstream and downstream links of the industrial chain makes it difficult to effectively integrate into the regional tourism economic network, restricting the efficiency of tourist source introduction and resource sharing.

5.3.2. Innovation chain

In rural governance, digital technology, as a new production factor, uses digital platforms to integrate various data resources, conduct comprehensive tracking and monitoring of rural information, adjust rural governance in a timely and effective manner, and promote the orderly development of rural areas [25]. However, the tourism development of Gaodang Village lacks the empowerment of digital technology. Existing tourism projects, such as ethnic costume photography and climbing ancient fortresses, have not integrated technologies such as virtual reality (VR) and augmented reality (AR), resulting in a lack of interactive and experiential digital tourism products. Brand building and marketing methods are outdated - relying only on static images and texts on WeChat official accounts and basic operations on Douyin and Xiaohongshu, without leveraging the traffic advantages of short video platforms to accurately reach young customer groups. The absence of digital creative elements makes it difficult to meet current tourists' demand for novel experiences, restricting the innovative upgrading of the tourism industry and the enhancement of market competitiveness.

Reconstructing the digital ecosystem of rural tourism industry requires focusing on the integration of the two chains (industrial chain and innovation chain): For industrial chain integration, strengthen strategic collaboration with surrounding scenic spots, design cross-regional tourism routes featuring "ancient village culture + natural landscape", and realize ticket interconnection through a joint operation platform. Simultaneously, optimize the transportation system and introduce an intelligent scheduling system to match tourist flow with vehicle schedules in real time, breaking through the barriers to scenic area linkage and improving the overall efficiency of regional tourism. For innovation chain empowerment, launch a "Buyi Tech Trend" themed challenge on platforms such as Douyin and Bilibili, invest in Douyin's promotion tools ("Doujia") and invite local influencers to endorse the campaign, using big data algorithms to push content to potential tourist groups with relevant interests. Promote the collaborative evolution of the three chains (industrial chain, innovation chain, and value chain) and the digital transformation of the tourism industry.

6. Conclusion and prospects

6.1. Conclusion

Taking Gaodang Village in Anshun City, Guizhou Province as the research object, this study constructs a "Technology Embedding - Subject Response - System Reconstruction" analytical framework based on the collaborative governance theory, and explores the logical mechanism and practical path of the digital economy empowering the high-quality development of rural tourism industry. The research finds that through data factor-driven development, platform integration, and intelligent technology application, the digital economy reconstructs the industrial chain and innovation chain of rural tourism, which can increase tourism income, improve service quality, and provide technical support for cultural protection and industrial integration. Taking Gaodang Village as an example, the digital economy has demonstrated significant empowerment value in improving smart tourism infrastructure, building a three-dimensional marketing network, and optimizing product design and service processes.

Currently, the digital transformation of Gaodang Village's tourism industry faces multiple challenges. Insufficient digital technology embedding is manifested in prominent "data silos", lack of smart service facilities, and low digital marketing efficiency, making it difficult to accurately reach target customer groups; weak response capabilities of multiple subjects are reflected in insufficient digital literacy of tourism service personnel, lack of government policy coordination mechanisms, and insufficient social capital investment; the absence of an industrial digital ecosystem is reflected in loose connection between upstream and downstream links of the industrial chain and lack of digital creative elements in the innovation chain, which restricts the attraction of young customer groups and industrial upgrading.

Promoting the digital economy to empower the high-quality development of rural tourism industry requires coordinated optimization from three aspects: First, improve the level of digital technology embedding by accelerating 5G network coverage

and big data platform construction, promoting intelligent navigation and early warning systems, and strengthening short video marketing and accurate customer positioning. Second, enhance the digital literacy of multiple subjects through hierarchical training and incentive mechanisms to improve the digital skills of practitioners and strengthen the collaborative participation of the government, enterprises, and villagers. Third, reconstruct the digital ecosystem of rural tourism by integrating regional tourism industrial chains, activating cultural resources through digital technology, and cultivating innovative business formats through short video platforms and cross-sector integration, forming a development model of collaborative evolution.

6.2. Prospects

This study conducts a systematic analysis of the digital transformation of Gaodang Village; however, it lacks a comparative analysis of rural tourism digitalization models in other western regions (such as Sichuan, Yunnan, and Tibet), which may limit the generalizability of its conclusions. Additionally, the research has insufficient depth in technology application - discussions on specific application scenarios of digital technology in rural tourism are relatively macro, and fail to deeply analyze details of technology implementation (such as data security and privacy protection) and difficulties in integrating technology with local culture. Due to limitations in research duration, there is a lack of evaluation of long-term effects; without long-term tracking data on the sustainability of the digital economy empowering rural tourism, it is difficult to verify the long-term mechanism of "technology - industry - society" coordinated development.

In the future, research directions need to be expanded from multiple dimensions to improve the theoretical and practical framework of the digital economy empowering the high-quality development of rural tourism industry. First, conduct cross-regional comparative studies: select different ethnic areas in the west (such as Yi and Tibetan villages) for comparison, analyze the adaptability between geographical environment, cultural types, and digitalization paths, and refine differentiated development models. Second, conduct refined research on technology application: focus on the specific application of technologies such as VR/AR in intangible cultural heritage protection and experience, and explore the balance between technology standardization and local characteristics, such as building a comprehensive system for cultural experience and protection. Finally, study the coordination mechanism between central and local policies: explore the path of cross-departmental resource integration under the "Digital Rural" strategy, such as establishing a data sharing platform and joint decision-making mechanism among departments of culture and tourism, agriculture, and science and technology. At the same time, learn from international cases such as Japan's "Rural Digital Revitalization" and the EU's "Smart Villages", and combine the characteristics of China's rural governance to propose strategies for integrating technology introduction and institutional innovation. This will further deepen the theoretical system of the integration of the digital economy and rural tourism, and provide more targeted solutions for the high-quality development of ethnic areas.

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Notes

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