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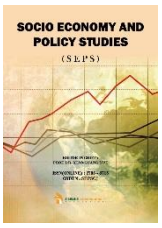

RESEARCH ARTICLE

THE DEVELOPMENT PATH OF YUNNAN BORDER PORTS UNDER THE BACKGROUND OF ACTIVE INTEGRATION OF "ONE BELT, ONE ROAD"

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ABSTRACT

As a significant province in southwestern China, Yunnan borders Myanmar, Laos, and Vietnam, boasting abundant geographical advantages and border resources. Yunnan's border ports play a crucial role in advancing the "Belt and Road" initiative, fostering economic cooperation, and promoting regional integration with neighboring countries. Therefore, studying the development challenges and solutions for Yunnan's border ports is of great significance. Through field research and interviews, it has been identified that Yunnan's border ports face several issues: a simplistic economic development model, incomplete infrastructure construction, lack of coordinated development among ports, unclear port layout and positioning, and difficulties in monitoring cross-border e-commerce information. To fully leverage Yunnan's strategic gateway role, several countermeasures are proposed, including promoting the diversification of the port economy, improving infrastructure construction, enhancing communication and exchange mechanisms with neighboring countries, clarifying the layout and positioning of each port, and implementing a "cross-border e-commerce + blockchain" regulatory model.

KEYWORDS

"The Belt and Road"; Ports of entry; Yunnan (Province)

1. PREAMBLE

Over the past decade, the Belt and Road Initiative (BRI) has achieved remarkable success, significantly contributing to global trade and economic cooperation. As a crucial node of the BRI, Yunnan Province has played an extremely important role in economic cooperation with Southeast Asian countries. The initiative has led to significant improvements in infrastructure in Yunnan and surrounding countries, with substantial progress in the construction of six economic corridors, railways, highways, and ports, thus providing robust support for trade, investment, and cultural exchange. Yunnan has actively participated in the BRI, establishing bilateral (and multilateral) cooperation mechanisms with Thailand, Laos, Vietnam, and Myanmar, resulting in steady growth in trade volume. In 2022, Yunnan's import and export values with these four countries increased by 21.7%, 38.5%, 29%, and 6%, respectively. The China-Laos Railway accounted for 14.02 billion yuan in imports and exports, with exports reaching 9.94 billion yuan and imports totaling 4.08 billion yuan. Despite these achievements, Yunnan's border ports, as key carriers of the BRI, still face issues in economic development models, customs clearance efficiency, regional economic development cooperation with neighboring countries, strategic port development planning, and information regulation.

To identify the obstacles hindering the development of Yunnan's border ports and determine pathways for high-quality development, this paper conducts a comprehensive analysis of the current state of Yunnan's border port development. Key bottlenecks are identified, and corresponding countermeasures are proposed. These insights are crucial for the future development of Yunnan's ports and the promotion of trade among BRI countries. Like some researchers has emphasize the importance of improving trade structures and diversifying trade partners for sustainable development (Lamsal and Dhakal, 2019).

Given China's status as the "world's factory" with its extensive involvement in international trade, the Belt and Road Initiative (BRI) aims to establish a new global financial order by enhancing trade and infrastructure connectivity, particularly within Asia. This initiative reflects China's strategy to export surplus capacity and foster regional cooperation, despite facing geopolitical challenges and competition from Western financial systems (Wong et al., 2017). Das summarizes that the BRI offers South Asia economic opportunities through improved connectivity and infrastructure (Das, 2017). However, it faces dilemmas related to regional security, geopolitical tensions, and the need for joint development among participating countries to maximize benefits. Johnston explains that China's BRI seeks to bolster its economic and strategic interests globally (Johnston, 2018).

The initiative focuses on infrastructure, trade, and financial integration but faces criticism regarding transparency, debt sustainability, and potential geopolitical implications. Enderwick notes that the BRI aims to stimulate economic growth and development through extensive infrastructure projects (Enderwick, 2018). While it highlights China's increasing influence in global trade, it also points out the challenges of geopolitical tensions and the sustainability of investments in participating countries. Researchers has uses gravity models to analyze the positive effects of the BRI on trade flows and global value chains from 2000 to 2018 (Lu, 2024). This analysis finds that certain corridors, such as China-Pakistan and China-Mongolia-Russia, are more beneficial, promoting deeper international trade connections.

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Twillert and Vega empirically analyze the debt implications of the BRI on the China-Central Asia-West Asia Economic Corridor (Twillert and Vega, 2023). Their findings indicate that external debt service positively affects GNI per capita, with infrastructure development also showing positive impacts. These results highlight both opportunities and concerns regarding debt sustainability. Currently, international research mainly focuses on the relationship between port development and economic impact. For instance, Qifei Ma summarized the impact of port integration on urban economic growth using Chinese ports as a case study (Ma, 2021). The study indicated that port integration significantly promotes economic growth in port cities, especially in small and medium-sized cities in the Yangtze River Delta, while the impact is relatively smaller in the Bohai Bay area and larger cities.

These findings provide guidance for port integration, transportation, and logistics sectors globally. A researcher used input-output analysis to treat the Chinese port industry as an exogenous factor, assessing its economic impact (Wang, 2019). The study concluded that these models effectively quantify the direct and indirect contributions of the Chinese port industry and analyze its evolution in terms of industry linkage effects, output induction effects, sector supply shortage effects, and employment induction effects. In other study, the author examined the economic impact of South African ports through input-output analysis, treating the port sector as an exogenous factor and studying its direct and indirect economic impacts (Chang, 2014).

The findings showed that the port sector had lower demand for other industries in production activities but was highly utilized by other industries. Additionally, the study analyzed the cost increase in the port sector using Leontief's price model. David Jaffee highlighted the growing importance of port economies due to globalization and the increasing geographical distance between production and consumption points (Jaffee, 2015). Using Jacksonville, Florida as a case study, the paper considered the role of the growth machine model in urban development, acknowledging the limitations of applying it to "strategic coupling" development strategies amid intense port competition based on urban economies and global supply chains.

Chinese scholars have also conducted research on China's border ports. For example, a research analyzed the economic development status of Guangxi ports, suggesting that port economic construction in Guangxi can be promoted through four strategies: infrastructure-led development, industry-led development, differentiated complementary development, and multi-regional linkage development (Yu, 2015). In recent study, authors used qualitative and quantitative methods to analyze the constraints on economic development of ports in eastern Northeast China and proposed corresponding countermeasures (Zhiying and Tianfu, 2010). Jie analyzed issues in Yunnan's port access, customs clearance facilities, clearance processes and systems, cooperation mechanisms with neighboring countries, and professional talent, providing corresponding countermeasures (Jie, 2019).

Heng evaluated the "Three Countries, Ten Stations" border inspection cooperation in Yunnan and constructed a border inspection police cooperation framework involving immigration departments from China, Laos, and Thailand (Heng, 2020). Although certain studies have been conducted on border port development, most research focuses on the port economies of other provinces and the customs clearance efficiency of Yunnan ports, with relatively few studies on the development paths of Yunnan ports. Therefore, based on field research at several Yunnan ports, this paper analyzes the role of Yunnan ports in the new round of opening up and BRI construction, providing guidance for further leveraging their functions.

2. Analysis of the Current Situation of the Development of Yunnan's Border Ports

Yunnan, with its unique geographical location bordering Myanmar, Laos, and Vietnam, and its proximity to South Asia and Southeast Asia, has historically been a vital gateway for China's foreign trade. Over 2,000 years ago, Yunnan served as a land route connecting China to South Asia, Southeast Asia, and the Middle East. In modern times, the development of Yunnan's ports has accelerated rapidly. Since the 18th National Congress of the Communist Party of China, significant progress has been made in the opening and construction of Yunnan's ports. Tianpeng Port was upgraded to a national-level port, and the State Council approved the establishment of two new road ports (Mengkang and Dulong), two new air ports (Lijiang and Mangshi), one new railway port (Mohan), and one new water port (Guanlei Port). Currently, the number of ports in Yunnan has increased to 27, ranking fourth nationwide (excluding former second-class ports), behind only Guangdong, Heilongjiang, and Jiangsu. The opening level of Yunnan's ports has continuously expanded, making it one of the five provinces in China to simultaneously possess air, railway, road, and water ports. These ports play a crucial role in supporting Yunnan's high-quality leapfrog development in the new era.

Table 1: Summary of Ports in Yunnan Province

No.	County/City	Port Name	Counterpart Port	Location	Level
Ports to Myanmar					
1	Ruili City	Ruili	Muse	Muse City	First
2	Ruili City	Wanding	Kyu Koke	Kyu Koke City	First
3	Gengma County	Mengding	Qingshuihe	Kokang Qingshuihe City	First
4	Tengchong City	Houping	Kan Paitee	Kachin State Kan Paitee	First
5	Menghai County	Daluo	Mongla	Shan State Mongla	First
6	Zhenkang County	Nansan	Yanglong Zhai	Kokang Laojie	Second
7	Cangyuan County	Yonghe	Shaopa	Wa State Mengmao County	Second
8	Yingjiang County	Yingjiang	Lazan	Kachin State Lazan City	Second
9	Menglian County	Menglian	Pangkham	Wa State Pangkham	Second
10	Lushui City	Pianma	Datianba	Kachin State Myitkyina	Second
Ports to Vietnam					
12	Hekou County	Hekou Road	Lao Cai Road	Lao Cai City, Lao Cai Province	First
13	Hekou County	Hekou Railway	Lao Cai Railway	Lao Cai City, Lao Cai Province	First
14	Malipo County	Tianbao	Qingshui	Weichuan County, Ha Giang Province	First
15	Jinping County	Jinshuihe	Malutang	Phong Tho County, Lai Chau Province	First
16	Maguan County	Dulong	Jingmen	Jingmen County, Ha Giang Province	First
17	Funing County	Tianpeng	Shangpeng	Miaowan County, Ha Giang Province	Second
Ports to Laos					
18	Kunming City	Mohan Road	Boten Road	Namtha City, Namtha Province	First
19	Kunming City	Mohan Railway	Boten Railway	Namtha City, Namtha Province	First
20	Jiangcheng County	Mengkang	Lantui	Yot Ou County, Phongsaly Province	First

Table 1 (Cont.): Summary of Ports in Yunnan Province					
Airports					
21	Kunming City	Kunming Airport	—	—	—
22	Lijiang City	Lijiang Airport	—	—	—
23	Jinghong City	Xishuangbanna Airport	—	—	—
24	Mangshi City	Mangshi Airport	—	—	—
Water Ports					
25	Pu'er City	Simao Port	—	—	—
26	Jinghong City	Jinghong Port	—	—	—
27	Jinghong City	Guanlei Port	—	—	—

Source: Compiled by the author based on official and survey data.

As Yunnan's largest and busiest key demonstration port, the Hekou-Lao Cai Port has made significant strides since its trial operation began in December 2018. Both sides have implemented measures to streamline customs procedures, innovate regulatory models, and reduce administrative barriers, effectively advancing the construction of a green channel. By the end of December 2022, the international trade volume of imports and exports via the Hekou Port China-Vietnam railway increased by 29%. The Hekou Customs supervised and cleared international rail freight with a total value of 1.263 billion RMB. The import and export of agricultural and sideline products reached 6.305 billion RMB, a year-on-year increase of 92.9%, accounting for 46.5% of the port's total trade volume.

As a landmark project of the Belt and Road Initiative and the Pan-Asian railway, the opening of the China-Laos railway has brought new development opportunities to Yunnan's ports. Since its inauguration in December 2021 until May 16th of this year, the China-Laos railway has transported over 20 million tons of goods, with cross-border freight exceeding 4 million tons, valued at 17.7 billion RMB. The range of goods transported has expanded from the initial 10 categories to over 2,000. Goods shipped from China to Laos primarily include machinery, household appliances, vegetables, flowers, and mechanical parts, covering multiple Belt and Road Initiative partner countries. Conversely, goods transported from Laos to China mainly consist of metal ores, cassava, and Job's tears, reaching 25 provinces (autonomous regions and municipalities) in China, thus providing strong support for the stability and smooth flow of industrial and supply chains along the route.

Furthermore, the completion and operation of the designated supervision site for imported fruits at the Mohan railway port in Yunnan has enabled the China-Laos railway to fully handle inbound fruit transportation. The "Lancang-Mekong Express" international freight train allows Southeast Asian fruits to reach Kunming, promoting the steady increase in freight volume on the China-Laos railway. From January to April this year alone, the railway transported 6.69 million tons of goods, an increase of 4.08 million tons compared to the same period last year, reflecting a growth rate of 156%.

These figures and developments indicate that Yunnan's ports have made substantial achievements in enhancing economic cooperation with Southeast Asian countries. However, challenges such as inadequate infrastructure, increased difficulties in cross-border cooperation, and border security risks still need to be addressed to further promote port development and tackle emerging challenges.

3. Factors Hindering Yunnan Border Ports Under the Background of the "Belt and Road Initiative"

3.1 Unclear Port Layout and Insufficient Port Coordination

From the perspective of Yunnan Province's "14th Five-Year Plan" for port development and comprehensive transportation system, the understanding of Yunnan Province's important role in promoting new development patterns at ports is inadequate, and its positioning is unclear. There is insufficient forward-looking research on the role of Kunming as a logistics hub after the completion and opening of the China-Myanmar, China-Laos, and China-Vietnam railways. The port development layout only considers Kunming's aviation ports, without detailed planning for the development of Kunming's land ports, and there has been no implementation plan for the construction of Kunming International Land Port so far. Furthermore, the port positioning is unreasonable and unscientific, mixing Yunnan Province's ports and important border passages into five categories: international hub ports, national important ports, ordinary ports, incubation-type ports, and stable-border important passages. There is a lack of clear guidance on the development positioning, direction, and focus of each type of port and passage, leading to issues of homogenized competition.

Table 2: Revised Positioning of Yunnan Province's "14th Five-Year Plan" for Port Layout	
Port Positioning	**Port Names**
International Hub Ports	Kunming Aviation Port, Ruili Port, Ruili Railway Port, Wanding Port, Tengchong Houqiao Port, Mengding Qingshui River Port, Hekou Port, Hekou Railway Port, Mohan Port, Mohan Railway Port
National Important Ports	Tianbao Port, Jinshui River Port, Guanlei Port, Daluo Port, Mengkang Port, Dulong Port, Tianpeng Port
Ordinary Ports	Jinghong Port, Mengman, Longfu, Zhangfeng, Nansan, etc. (original Class II ports / passages), Xishuangbanna Airport, Lijiang Airport, Mangshi Airport, Dali Airport, Shangri-La Airport, Tengchong Airport Aviation Ports
Incubation-Type Ports	Pianma, Menglian, Yonghe, Yingjiang, etc. (original Class II ports), Nongdao, Pinghe, Mandong (Menglong), Donggan, Qiaotou, Mucheng, etc. Key Passages
Stable-Border Important Passages	Other unplanned passages, based on traffic flow and development conditions, refer to relevant national standards for phased and step-by-step applications to expand opening as freight channels for adjacent ports

3.2 Insufficient Transportation Support and Lagging Infrastructure Construction at Ports

As Yunnan Province's openness to the outside world continues to expand, the number of open ports has increased significantly, reaching a total of 25, including 18 Class I ports (4 airports, 2 seaports, 1 railway, 11 highways) and 7 Class II ports (all highways). Although Yunnan Province has established a comprehensive, multi-level, and three-dimensional pattern of port openness, the increasing number of ports also brings forth some prominent issues:

Firstly, there is inadequate transportation support at ports. Internally, among Yunnan's 18 highway ports, 12 such as Mengding Qingshui River, Daluo, Tianbao, and Mengkang are not yet connected to high-speed roads. Bilateral port interconnectivity projects, such as the Ba Sa-Bacha Red River International Highway Bridge, China's Jinshui River-Vietnam's Malutang Multifunctional Cross-border Bridge, China's Tianbao-Vietnam's Qingshui Cross-border Traffic Engineering, Menglian Port Cross-border Freight Bridge, and the relocation of boundary markers at Tianpeng Port (456), as well as road surface hardening, have not been completed and put into operation. Externally, influenced by various factors such as neighboring countries' politics, economy, and culture, progress in constructing external port channels has been slow, and the problem of "reaching the border but not beyond" still exists. For instance, although Ruili and Wanding ports have direct access to domestic highways, conditions for passage to Myanmar at the 105th mile from Ruili and

Wanding to Wanding are still relatively poor.

Secondly, port (basic) infrastructure functionality is incomplete, with pronounced issues of lagging inspection facilities. For example, the Mo Han Highway Port handled over 4.7 million tons of import and export freight in 2019, far exceeding its designed capacity of 600,000 tons. Furthermore, the standardization and regularization of port construction are not high; currently, only Mo Han Railway, Hekou Highway, Tianpeng, and Mengkang ports comply with the "National Port Inspection Infrastructure Construction Standard" (Construction Standard 185-2017), with most highway port freight channels having only 1 entry and 1 exit lane.

Thirdly, funding for port supervision facilities is insufficient, leading to delays in the construction of designated supervision sites. For instance, the construction and operational positioning of the China-Laos Railway as entirely public welfare means that the Hai Guang designated site at the Mo Han Railway Port cannot collect fees once completed. This situation creates a contradiction between public welfare and profitability, as companies undertaking the project cannot recover the approximately 200 million yuan in initial construction investment and annual operating costs amounting to tens of millions of yuan without corresponding subsidies from local finances. Thus, there is currently no entity willing to undertake construction and operation under these conditions.

3.3 Poor Coordination on Both Sides of Ports, Communication Efficiency Needs Improvement

Yunnan Province faces difficulties in coordinating with foreign ports. Due to the complex geopolitical and environmental factors with neighboring Myanmar, Laos, and Vietnam, communication and coordination pose significant challenges. Issues such as multiple entry-exit management thresholds, cumbersome procedures, lengthy approval times, frequent regulatory policy adjustments, and inconvenient goods and personnel exchanges still persist at ports of neighboring countries. For example, Houqiao and Qingshui River ports need to be upgraded to international ports. While China has fulfilled domestic procedures, Myanmar has been slow to respond. Myanmar does not permit the passage of Chinese, third-country nationals through Ruili, Wanding, Daluo, and other ports with passports. Myanmar's side imposes various abnormal charges, which have recently increased rather than decreased. Currently, goods destined for the 105-mile trade zone in Myanmar face forced fees from the Kachin Independence Army (KIA), Ta'ang National Liberation Army (TNLA), and Shan State Army (SSA). The total fees per vehicle carrying Chinese exports range from 2,400 to 6,720 RMB, and for imports, they range from 7,920 to 39,120 RMB, increasing operating costs for enterprises continually.

3.4 Lagging Port Operations Management, Inadequate Support for Emerging Trade Services

Many ports in Yunnan Province primarily focus on serving traditional trades such as raw materials, food, and machinery. However, cross-border e-commerce, as an emerging trade model, has rapidly developed in recent years. It involves small-scale, high-frequency goods circulation, demanding highly efficient logistics and customs clearance services to support rapid order processing and delivery. Yet, many traditional port facilities and processes have not fully adapted to the needs of cross-border e-commerce, especially in pricing and inspection and quarantine aspects.

In terms of pricing for cross-border e-commerce, traditional physical attribute-based pricing methods do not fully meet the diverse and irregular packaging of goods involved in e-commerce transactions. Therefore, cross-border e-commerce requires a more flexible pricing model, such as pricing based on the actual value or sale price of goods. In the inspection and quarantine process, the diverse types and rapid iteration of goods in cross-border e-commerce demand not only accelerated inspection and quarantine but also require more precise risk assessment capabilities to meet the efficiency demands of e-commerce.

Currently, Yunnan's online supervision models for cross-border e-commerce include bonded stocking (1210), direct mail and direct purchase (9610), direct export from enterprise to enterprise (9710), and export to overseas warehouses (9810), among other customs supervision models. Under these models, customs risk control primarily relies on manual operations, consuming significant manpower and time. Inaccuracies in logistics information not only hinder trade facilitation but also lead to logistics delays, affecting customs efficiency. Particularly in the field of cross-border e-commerce, the varying degrees of informatization along the entire chain of overseas warehouse trade hinder effective information exchange among various entities. As a result, data transmission from shipping units to agency units to logistics companies depends on the accuracy of information at each stage. Any errors in intermediate stages require re-entering previous data. Moreover, high information sharing costs between government and corporate sectors, inadequate information connectivity, and the inability of overseas warehouse information to effectively interface with customs regulatory departments increase regulatory difficulties. This makes it challenging for customs departments to obtain accurate and complete business data on the overseas warehouse trade chain from enterprises.

3.5 Monotonous Port Economic Model, Insufficient Development of Hinterland Markets

Despite steady progress in trade development at Yunnan's ports in recent years, there remains a considerable gap compared to other provinces. In 2022, Guangxi's total import and export volume reached 874.2 billion RMB, more than four times that of Yunnan. The cargo volume through ports totaled 157.5193 million tons, more than five times that of Yunnan (see Figure 4). In terms of cross-border e-commerce, Yunnan's export volume in 2022 was 7.537 billion RMB, only 18.52%, 31.36%, and 41.97% of Chongqing, Sichuan, and Guangxi respectively (see Figure 5).

The primary reasons for Yunnan's low ranking in national import and export volumes are its relatively limited resources and underdeveloped information infrastructure, particularly in emerging industries such as cross-border e-commerce, market procurement trade, overseas warehouses, and integrated foreign trade services. These limitations hinder the development of diversified economic models. As suggested by some researcher, future economic diversification in sectors like tourism, agriculture, and entertainment is crucial, emphasizing the need for innovative sustainability frameworks to drive future growth (Onyeka and Onyeka, 2023).

Furthermore, Yunnan's existing ports mainly focus on traditional development models such as transit clearance services, product processing services, and port trade services. The industrial structure is monotonous, with product processing mainly at the crude processing stage of import and export products. There is also insufficient development in industries such as import and export trade processing, deep processing of mineral and energy resources, bonded logistics processing, international production capacity cooperation, international commodity trading, and international trade financial services.

Table 3: Comparison of Yunnan and Guangxi Ports in 2022

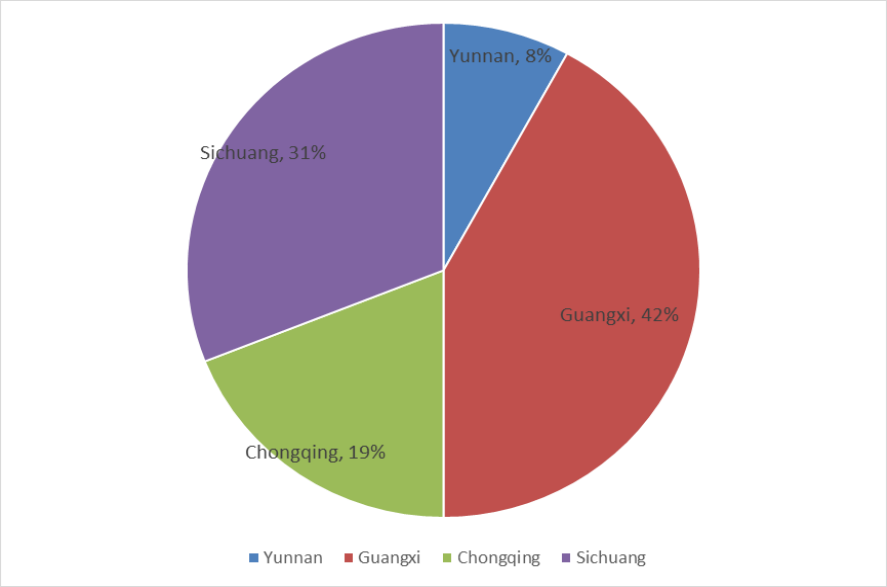
Province	Air Ports	Water Ports	Road Ports	Railway Ports	Total
Yunnan	4	3	18	2	27
Guangxi	3	6	8	1	18

Table 4: Comparison of Yunnan and Guangxi Port Data in 2022

Province	Import and Export Volume (billion RMB)	Cargo Volume (million tons)	Personnel (100,000 people)	Traffic Vehicles (10,000 units)
Yunnan	211.1	2952.41	14.429	9.255
Guangxi	874.2	15751.93	10.15	5.79
Gap (Yunnan vs Guangxi)	-663.1	-12799.52	4.279	3.465

Source: Compiled by the author based on official data and research data

Table 5: Comparison of Yunnan's Cross-border E-commerce Import and Export Volume with Surrounding Provinces and Cities in 2024



Source: Ministry of Commerce of China

4. Strategies and Recommendations for High-Quality Development of Yunnan Border Ports

4.1 Optimize Port Layout Planning to Leverage Synergistic Effects

Currently, the port development layout primarily considers Kunming's air port, with no comprehensive planning for the development of Kunming's land ports. To date, no construction plan for Kunming International Inland Port has been released. Additionally, the construction standards for infrastructure should be clarified to avoid severe homogenization and competition among ports. Therefore, the port layout should be structured around a "1+3+4+N" model, with Kunming as the core international hub (air/railway, proposed), leading key hubs at Mohan (road/railway), Hekou (road/railway), and Ruili (road/railway, proposed), supported by logistic node ports at Qingshuihe, Houqiao, Tianbao, and Guanlei Port, and other general ports and border crossings developing in coordination.

Leveraging Kunming as the hub, the leading roles of Mohan, Hekou, and Ruili ports should be enhanced to promote coordinated development among land ports, air ports, and water ports. This approach will integrate the four major port clusters and support the construction of a new international land-sea trade corridor toward the Indian Ocean.

- **Mohan (road/railway) Port**: Develop into a world-class land port, supported by Mengkang, Guanlei Port, and Mengman Channel (proposed new port), forming a port cluster radiating to Laos, Thailand, Malaysia, and Singapore.
- **Hekou Port**: Establish as a benchmark for national land ports to Vietnam, supported by Tianbao, Jinshuihe, Tianpeng, and Dulong ports, creating a port cluster radiating to Vietnam and surrounding countries.
- **Ruili and Wanding Ports**: Develop as strategic points of the China-Myanmar Economic Corridor, supported by Houqiao, Qingshuihe, Daluo, Nansan, Zhangfeng, Piema, Menglian, Yonghe, and Yingjiang ports, forming a port cluster radiating around the Indian Ocean region.
- **Kunming Air Port**: Coordinate with air ports in Xishuangbanna, Lijiang, Dehong, etc., to intensify connections with South Asia, Southeast Asia, and the Middle East, forming an international air port cluster focused on the Indian Ocean region and South and Southeast Asia.

By structuring the port layout in this manner, Yunnan can enhance its core hub at Kunming, leverage the leading roles of key ports, and promote the integrated development of land, air, and water ports. This will support the construction of a new international land-sea trade corridor and provide robust support for high-quality port development in Yunnan.

4.2 Optimize Port Economic Development and Expand Hinterland Markets

Yunnan's port economy is overly simplistic and lacks competitiveness. To address the backward and unbalanced development of Yunnan's ports, diversifying the port economy is essential. Internally, this involves developing the hinterland markets of the Chengdu-Chongqing Economic Zone and the Yangtze River Economic Belt. Externally, it involves collaborating with neighboring countries to explore markets in Malaysia, Thailand, and other regions, thereby increasing business volume. For example, Mohan Port has successfully implemented a regulatory model combining "cross-border e-commerce and railway transportation," where cross-border e-commerce goods from Kunming undergo local inspection and verification before being directly loaded onto trains for export. This significantly reduces logistics costs and improves transportation efficiency. By promoting and implementing this regulatory model at Mohan (Kunming) Port, other ports in Yunnan can adopt similar practices, collectively advancing port development.

Furthermore, establishing the "market procurement and railway transportation" model is crucial. Directly transporting market-purchased goods via rail can attract more foreign trade entities, resources, and service elements, revitalizing the market. Yunnan should also diversify its industrial structure, which currently focuses on agriculture and tourism, by attracting top-tier companies to develop industries like manufacturing through tax, financial, and land incentives. Future port economic development should extend to supply chain finance, bulk commodity trading, and trade technology cooperation to reduce dependency on specific industries and improve economic resilience.

4.3 Enhance Port Transportation and Infrastructure

Efficient transportation and robust infrastructure are vital for improving port operations and economic performance. Given the current state of Yunnan's ports, it's necessary to improve internal and external transportation conditions, upgrade infrastructure, and actively promote the construction and guidance of port supervision sites, ensuring quality and timely completion of infrastructure projects to support the economic development of border regions.

Improving Internal Transportation Conditions. Accelerate the construction of highways such as Ruili-Menglian, Mengxing-Jiangcheng-Luchun, Menglian-Menghai, and Hekou-Maguan. Expedite the completion of highways connecting 9 ports: Qingshuihe, Mengkang, Jinshuihe, Daluo, Tianbao, Nansan, Menglian, Tianpeng, and Guanlei Port. Promote the early completion and operation of the Baoshan-Ruili Railway. Enhance bilateral port connectivity by advancing projects like the Basa-Basa Red River Bridge, the China Jinshuihe-Vietnam Ma Luk Tong multi-functional cross-border bridge, the China Tianbao-Vietnam Qingshui cross-border transport project, and the Menglian Port cross-border freight bridge. Additionally, push for the relocation and pavement improvement of the 456th boundary marker at Tianpeng Port.

Promoting External Channel Construction. Advance the establishment of an international land-sea trade corridor towards the Indian Ocean as a national strategic priority, creating the most convenient sea route to the Indian Ocean region. Expedite the construction of the Hekou-Lao Cai-Hanoi-Haiphong standard-gauge railway and actively promote projects

like the China-Laos-Thailand standard-gauge railway, Muse-Mandalay Railway, and Mandalay-Kyaukpyu Railway. Speed up the construction of Laos Route 13 at the Mohan section and the Zhangfeng-Bhamo Road and complete the repair work of the Houqiao-Myitkyina secondary road. Facilitate the upgrade of the Wanding-105 Mile and Ruili-105 Mile roads.

Strengthening Port Infrastructure. Implement smart upgrades to streamline cargo clearance processes, such as building cross-border transport management platforms that offer services like vehicle queue reservation, queue information, parking guidance, and more. Companies can use these platforms for reservation and declaration, reducing waiting times by ensuring orderly entry into cargo yards.

Accelerating Fund Coordination and Involving Enterprises. Given the public welfare nature of port supervision sites, consider government financial allocations for construction, with relevant enterprises managing operations. Tax exemptions, land use rights for logistics hubs, and other policy subsidies could offset the operational costs for enterprises, balancing public welfare and profitability. Resolving clearance issues will expedite the flow of goods and funds, bolster Yunnan's logistics sector, stimulate the economy, and eventually provide tax revenue to support government finances.

4.4 Enhance Coordination with Counterpart Ports and Improve Clearance Efficiency

Improving the Business Environment. Draft the Yunnan Province Port Services Regulations to standardize local government actions on port opening, construction, and management, ensuring inspection agencies fulfill their duties and market operators thrive. Implement a dynamic management system for port fee listings to enhance transparency. Conduct comprehensive performance evaluations of ports and share results with relevant departments and local governments, using the findings as a basis for building model ports and allocating provincial port construction funds.

Deepening International Port Cooperation. Strengthen bilateral port cooperation mechanisms with Laos, Vietnam, and Myanmar, focusing on reciprocal port openings, synchronized infrastructure development, innovative clearance systems, collaborative work systems, and coordinated emergency response. Promote information exchange, mutual recognition of regulations, and joint enforcement among port management authorities. Implement the Greater Mekong Subregion (GMS) agreements on facilitating cross-border transport of goods and people, and negotiate transit trade and cross-border transport agreements with Myanmar at the national level. Revise and sign the China-Myanmar Border Management and Cooperation Agreement.

Enhancing Diplomatic Efforts and Port Environment. Optimize the port environment through national-level platforms like horticultural expositions and import-export fairs, fostering close cooperation with neighboring countries. Dispatch delegations to surrounding countries to engage with high-level officials, participate in regional cooperation meetings, attend trade exhibitions, sign cooperation agreements, and establish sister-city relationships. These activities play a critical role in maintaining good relations and cooperation with neighboring countries, contributing significantly to the formulation and implementation of foreign policy towards neighboring countries(Jia et al.2018).

4.5 Introduction of Digital Intelligence Technology to Serve Emerging Logistics and Human Flow

Addressing the inadequacy of support for emerging trade services in Yunnan necessitates the introduction of digital intelligence technology to serve the new logistics and human flow. The application of this technology not only targets traditional cargo transportation and customer service but also significantly promotes new business models such as e-commerce, live-streaming sales, and free travel. By implementing advanced data analytics and intelligent management systems, Yunnan ports can provide more efficient cargo handling and distribution services for e-commerce platforms while supporting the immediate logistics needs of live-streaming sales activities.

The integration of digital intelligence technology also aids in promoting the free travel business. Intelligent systems can optimize the entry and exit processes for tourists, enhancing their travel experience while ensuring safety and compliance. For example, analyzing big data on traveler behavior can enable preemptive adjustments in personnel deployment and service facilities during peak periods, reducing congestion and wait times. The adoption of digital intelligence technology allows Yunnan ports to monitor cargo and human flow dynamics in real-time. Automated data collection and analysis facilitate timely responses to market changes and customer needs, enhancing operational efficiency and competitiveness. This transformation positions Yunnan ports as crucial trade and tourism nodes connecting China with Southeast Asia and beyond. Through such technological innovations, Yunnan ports will continue to play a central role in promoting regional economic development and international cooperation.

Moreover, integrating "cross-border e-commerce + blockchain" technology further strengthens the regulatory capabilities of Yunnan ports. Initially, overseas warehouse companies connect their business systems to the blockchain platform via interfaces, uploading relevant cargo information. Logistics companies then access and process logistics information on the blockchain, updating it in real time. Regulatory sites upload arrival or tally information onto the blockchain. Finally, export regulatory authorities retrieve cargo, logistics, and tally information through interfaces for logical validation and automatic auditing, generating information for control inspections, release, and customs clearance.

The "cross-border e-commerce + blockchain" model can track the supply chain information of goods, ensuring their authenticity and legality. By utilizing big data and algorithms, customs can identify potential illegal transactions and security risks and take timely actions. Additionally, establishing a data-sharing platform enables customs to share information with other regulatory agencies, e-commerce platforms, and logistics service providers, enhancing regulatory cooperation and data analysis (Bo, 2023). This achieves real-time monitoring, traceable operations, and tamper-proof data.

5. Conclusion

In the context of the "Belt and Road" initiative, Yunnan Province, with its unique geographical location and abundant border resources, has become a vital bridge connecting China with Southeast Asia and South Asia. Through investigating border port-related data, this study analyzed the issues affecting cross-border trade and port development in Yunnan and proposed strategies and recommendations for economic development. These insights are crucial for the next steps in enhancing infrastructure construction and foreign trade in border port areas.

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