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Research on the "Last Mile" Problem and Countermeasures of Rural E-commerce Logistics Distribution

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Abstract: ***Rising rural incomes and expanding Internet infrastructure have driven rapid growth in rural e-commerce. However, weaknesses in infrastructure, high distribution costs, and a shortage of skilled personnel have turned the logistics "last mile" into a bottleneck that limits further development. This paper examines the last mile of rural e-commerce logistics. After systematically reviewing its current status and principal challenges and drawing on relevant theories, it proposes actionable measures for infrastructure investment, policy coordination, service-model innovation, and talent development. The study aims to inform solutions to last-mile delivery problems, improve the efficiency of rural logistics services, and offer decision-making guidance for enterprises and policymakers.***

Keywords: Rural e-commerce, Logistics distribution, Last mile, Countermeasures**.**

1. Introduction

With the in - depth implementation of the "Internet +" strategy and the comprehensive advancement of digital rural construction, rural e - commerce in China has shown a rapid development trend. Data from the National Bureau of Statistics shows that in 2023, the national rural online retail sales reached 2.5 trillion yuan, a year - on - year increase of 8.5%. Rural e - commerce has become an important engine for rural revitalization. Against the backdrop of the rural revitalization strategy, the coordinated construction of rural public transportation and logistics infrastructure is regarded as the key support for promoting the integrated development of urban and rural areas (Cao & Ning, 2019). However, the "last mile" of the logistics distribution system has become a key bottleneck restricting the high - quality development of rural e - commerce. The "last mile" of rural e - commerce logistics specifically refers to the terminal distribution process from the township distribution point to the final consumers. This process is not only directly related to consumers' shopping experience and satisfaction but also affects the sustainable development of rural e - commerce. According to a survey by the China Federation of Logistics and Purchasing, the proportion of the "last mile" distribution cost in rural areas to the total logistics cost is as high as 30% - 40%, far higher than the 15% - 20% in urban areas. Meanwhile, problems such as poor timeliness of distribution, high damage rate of goods, and non - standardized services in rural areas have become increasingly prominent.

This study focuses on the "last mile" problem of rural e-commerce logistics, which holds significant theoretical and practical implications. At the theoretical level, through a systematic analysis of the characteristics and patterns of the last-mile delivery of rural e-commerce logistics, this study contributes to enriching and improving the theoretical system of rural logistics. At the practical level, the research findings can provide decision-making references for the government to formulate rural logistics policies, for enterprises to optimize delivery models, and to enhance the service level of rural logistics. It also has important practical significance for promoting the integration of urban and rural logistics, driving the upgrading of rural consumption, and achieving the strategic goals of rural revitalization.

2. Major Problems in the "Last Mile" of Rural E-commerce Logistics

2.1 Weak Infrastructure and Insufficient Coverage of the Distribution Network

The overall level of logistics infrastructure in rural areas still lags significantly behind that in urban areas, which has become a fundamental obstacle restricting the efficiency of the "last - mile" delivery. According to the statistical data of the Ministry of Transport in 2023, although the total mileage of rural roads nationwide has exceeded 4.2 million kilometers, the road network density is only 32% of that in urban areas, and the proportion of roads at Class III and above is less than 40%. This situation results in low traffic efficiency and long transportation time for delivery vehicles. Especially in mountainous and hilly areas with complex terrains, the delivery accessibility is severely restricted.

The shortage of warehousing facilities further exacerbates the distribution difficulties. Currently, the average service radius of county-level logistics and warehousing centers exceeds 50 kilometers, the coverage rate of township-level distribution outlets is less than 60%, and there is a severe shortage of express delivery service points at the administrative village level. Most village-level outlets are temporarily set up in places such as grocery stores and village committees, lacking professional equipment for goods sorting, temporary storage, and preservation. This not only affects the safety of goods and the timeliness of distribution but also makes it difficult to handle the order pressure during peak periods such as holidays.

2.2 The Distribution Cost Remains High, Making It Difficult to Achieve Economies of Scale.

The "last mile" delivery of rural e-commerce logistics is

characterized by typical “high cost and low density”. The geographical dispersion of orders results in long delivery routes and low cargo loading rates, and the unit delivery cost is generally 60%-80% higher than that in cities. According to industry estimates, the last - mile delivery cost of a single express ticket in rural areas is about 4 - 6 Yuan, while the average unit price of e - commerce express has dropped below 3 Yuan, showing a prominent price inversion phenomenon.

The underlying reason for the high cost is that the business volume has not yet achieved economies of scale. In rural areas, the population is scattered, and the average daily express delivery volume per square kilometer is generally less than 20 pieces, far lower than the level of 200 pieces per square kilometer in urban areas. The low business density makes it difficult to allocate fixed costs. The vehicle loading rate is often less than 40%, and the empty return rate exceeds 70%. Meanwhile, there are significant seasonal fluctuations. The peak period of agricultural products going upstream often misaligns with that of industrial products going downstream, further reducing the resource utilization rate.

2.3 Low Level of Informatization and Delayed Application of Smart Logistics

The informatization construction of rural e-commerce logistics is still in its primary stage, and the phenomenon of “information islands” is quite common. Most rural logistic service stations have not been connected to a unified logistics information platform. The processes such as order processing, route planning, and cargo tracking still rely on manual operations, with an informatization coverage rate of less than 30%. The application and promotion of intelligent logistics technologies in rural areas face special challenges. The deployment of smart parcel lockers in rural areas has progressed slowly due to high installation and maintenance costs and low usage frequencies. Advanced technologies such as route optimization algorithms and drone delivery are also difficult to be applied on a large scale because of factors like complex rural road conditions, unstable network signals, and insufficient skills of operators. According to a survey, only about 15% of rural logistics enterprises have adopted basic logistics management systems, and the proportion of those applying new - generation information technologies such as artificial intelligence and the Internet of Things is less than 5%.

2.4 Shortage of Professional Talents and the Service Quality Varies

The rural e-commerce logistics sector is confronted with a severe structural shortage of talent. On one hand, high-level logistics management talent generally reluctant to work in rural areas, the proportion of management staff in county-level logistics enterprises who have a college degree or above is less than 40%, and the professional operation ability is weak. On the other hand, the last-mile delivery personnel are mostly local part-timers or temporary workers, with high mobility and lack of professional skills, and they lack systematic service standard training.

This situation regarding the workforce makes it difficult to ensure service quality. Delivery personnel have insufficient understanding of the characteristics of goods, leading to relatively high loss rates in the delivery of special goods. Their service attitudes and communication skills vary significantly, and the customer complaint rate is approximately 50% higher than that in urban areas. Moreover, they lack the ability to use modern logistics equipment and systems, which restricts the improvement of operational efficiency. In addition, due to unclear career development paths and uncompetitive salary packages, the annual talent turnover rate remains above 30%, further exacerbating the talent shortage.

2.5 Lack of a Collaborative Mechanism and Low Level of Resource Integration

There is a lack of effective collaborative cooperation mechanisms among various participants in rural e - commerce logistics, and the phenomenon of “operating independently” is prominent. Competition among express delivery enterprises outweighs cooperation. The duplication of building delivery stations and parallelly opening transportation routes is widespread, resulting in low resource utilization efficiency. Information sharing among e - commerce platforms, logistics enterprises, and local merchants is poor, making it difficult to achieve overall coordination of orders, warehousing, and transportation capacity. Resource integration faces institutional and systematic obstacles. Systems such as postal services, transportation, and supply and marketing possess a large amount of existing resources in rural areas. However, due to different affiliations and varying interest demands, cross - system resource integration encounters numerous difficulties. Government support policies also lack overall coordination. Policies introduced by different departments sometimes overlap or conflict, making it difficult for enterprises to form stable expectations. According to research, the comprehensive utilization rate of logistics resources in rural areas is less than 40%, far lower than the 65% level in urban areas. The co - existence of idle resources and repeated investment is quite prominent.

2.6 Unperfected Policy Support System

Although the state has issued multiple policy documents to support the development of rural logistics, there are still many problems at the local implementation level. Firstly, the policies are fragmented. The support measures of different departments lack effective coordination, making it difficult to form a synergy. Secondly, the subsidy methods are single. Most subsidies are universal and evenly distributed, failing to provide differentiated support according to the characteristics of different regions and models. Thirdly, there is a lack of an evaluation mechanism for implementation effects, and policy adjustments lag behind actual development needs. The enthusiasm of market entities has not been fully stimulated. Rural logistics has a long investment return cycle and low rate of return, so social capital is not keen on entering. The existing support policies mostly focus on the construction of hardware facilities, and the support for soft aspects such as innovation of operation modes, improvement of service quality, and talent cultivation is insufficient. Meanwhile, the transparency and fairness of policy implementation also need to be improved. Some enterprises reported problems such as untimely subsidy distribution and complex approval

processes.

3. Countermeasure System for the "Last Mile" of Rural E-commerce Logistics Distribution

In response to the structural contradictions in the "last mile" of rural e-commerce logistics, it is necessary to construct a systematic solution featuring "government guidance, market leadership, multi - party collaboration, and technology - driven development". This chapter proposes the following countermeasure system from five dimensions: infrastructure, operation mode, policy environment, talent support, and technology application.

3.1 Improve the Three - level Logistics Infrastructure Network

1) Establish a hierarchical logistics node system

Scientific planning of the layout of rural passenger transport stations is the foundation for improving the coverage of the logistics network (He & Zhang, 2016). Promote the construction of a three - level network of "county - level logistics hubs - township distribution centers - village - level service outlets". At the county level, integrate existing resources from transportation, postal services, supply and marketing cooperatives, etc., and build logistics parks with comprehensive functions such as warehousing, sorting, distribution, and information processing. Each county should build at least one standardized county - level logistics center.

At the township level, renovate and upgrade existing distribution stations, and equip them with basic sorting equipment and information systems to achieve "one point with multiple functions and one network with multiple uses". At the village level, adopt the model of "multiple stations integrated into one and one point with multiple functions", integrate places such as village convenience stores, village committees, and set up standardized express delivery service points. Full coverage of express delivery services in administrative villages should be achieved by 2025.

2) Improve the traffic capacity of rural roads

Implement a special action to improve the quality and efficiency of rural roads, focusing on upgrading the road grades from towns to administrative villages to ensure that all roads meet the standards of Class IV roads or above. In the construction of "well - built, well - managed, well - maintained, and well - operated rural roads", plan the logistics and transportation needs simultaneously and rationally set up supporting facilities such as passing points and loading and unloading areas. For remote mountainous areas and sparsely populated regions, explore the use of special transportation modes such as cableways and drones to solve the problem of "being connected but not smoothly accessible". Establish a long - term mechanism for rural road maintenance, clarify the maintenance responsibilities of counties, townships, and villages at three levels to ensure the continuous smoothness of logistics channels.

3) Promote the standardization construction of logistics facilities

Formulate the "Standards for the Construction and Operation of Rural E - commerce Logistics Facilities" to unify the building specifications, equipment configurations, signs, and service standards of county - level, township - level, and village - level outlets. Promote the use of green logistics equipment such as standardized logistics turnover boxes and recyclable packaging to reduce cargo damage and packaging waste. In major agricultural product producing areas, support the construction of cold - chain facilities such as pre - cooling, refrigeration, and freezing to make up for the shortcomings in the "first mile" of agricultural product distribution to urban markets.

3.2 Innovate Diversified Terminal Delivery Operation Models

The integrated development of transportation and postal services has been proven to be an effective way to improve the efficiency of rural logistics (Tian et al., 2019). Promote the intensive "unified warehousing and joint distribution" model and deepen the resource - sharing "transportation - express integration" model.

1) Promote the intensive model of "unified warehousing and joint distribution"

At the county level, establish a logistics joint distribution alliance to integrate the warehousing and distribution resources of enterprises in the postal, express delivery, e-commerce, and commerce sectors. By constructing a county-level logistics joint distribution center, achieve unified warehousing, unified sorting, and unified distribution, reducing the number of logistics distribution vehicles within the county by over 30% and increasing the loading rate to over 70%. Explore the integrated development of "express delivery + e-commerce + commerce", and support express delivery enterprises to undertake local e-commerce orders and supermarket distribution services to improve resource utilization efficiency.

2) Deepen the resource sharing model of "integration of express delivery and transportation"

Expand the pilot scope of rural passenger vehicles for mail and express delivery services, and modify the carriage structure of rural passenger buses to add storage areas for express goods. Formulate the "Service Specification for the Integrated Development of Rural Passenger Transport, Freight, and Postal Services" to clarify mechanisms for safety management, responsibility allocation, and revenue distribution. On routes with low passenger flow, pilot the operation of "freight lines" that run at fixed times, to fixed destinations, and along fixed routes to solve the logistics accessibility problem in remote villages. By 2025, strive to achieve the coverage of the "integration of transportation and express delivery" model in 80% of towns across the country.

3) Optimize the "community group buying + self-pickup point" model

Support e-commerce platforms to cooperate with local retailers to establish a community group-buying distribution

system of "central warehouse - grid warehouse - self-pickup point". Set up standardized self-pickup points in administrative villages and larger natural villages, and equip them with smart express cabinets or shelves to enable 24/7 self-service parcel collection. Encourage operators of self-pickup points to expand value-added services such as purchasing on behalf, consignment sales, payment and recharge, and agricultural product collection to enhance the profitability and sustainability of the points. Research and formulate logistics service standards for community group-buying to standardize commodity storage conditions, delivery timeliness, and service processes.

3.3 Strengthen Policy Support and Institutional and Mechanism Safeguards

1) Increase fiscal and financial support

Establish special funds for the development of rural e - commerce logistics, and adopt methods such as "awarding instead of subsidizing" and "subsidizing after construction" to support the construction of the three - level logistics system. For express delivery service outlets in villages, an operating subsidy of 0.3 - 0.5 yuan per order shall be given according to the business volume. Encourage financial institutions to develop special financial products such as "logistics facility loans" and "vehicle purchase loans", and offer preferential interest rates and loan interest subsidies to rural logistics enterprises. Include smart express cabinets, cold - chain equipment, etc. in the scope of agricultural machinery purchase subsidies.

2) Improve land use guarantee policies

Incorporate rural logistics facility land use into the territorial spatial planning and annual land use plan, and give priority to meeting the land use needs of county-level logistics parks and township distribution centers. Encourage the construction of logistics facilities using existing properties and land such as idle school buildings, factories, and warehouses, and implement a policy of maintaining the land use type and property right type unchanged within five years. On the premise of complying with planning and safety requirements, allow village-level express delivery service points to use collective construction land and simplify the approval procedures.

3) Establish a collaborative regulatory mechanism

Establish a coordination mechanism for rural logistics involving multiple departments such as commerce, transport, postal services, and agriculture and rural affairs to coordinate policy - making and resource allocation. Establish a monitoring system for the service quality of rural logistics, regularly release service quality reports, and improve the consumer complaint handling mechanism. Formulate safety production standards for rural logistics and strengthen the supervision of key categories such as hazardous chemicals and cold - chain foods.

3.4 Accelerate the Digital Transformation and Intelligent Upgrading of Logistics

1) Establish a rural logistics information platform

Develop a national unified rural logistics information platform that integrates functions such as order management, vehicle scheduling, cargo tracking, and payment settlement. Promote the connection of the platform with e-commerce systems, traffic management systems, and agricultural product traceability systems to achieve data interconnection. Popularize the use of handheld terminal devices at township and village-level outlets to enable real-time collection and uploading of express delivery information.

2) Promote the application of intelligent logistics technologies

In areas where conditions are ripe, pilot applications of intelligent equipment such as unmanned delivery vehicles and drones will be carried out to solve the delivery problems in remote areas. The use of intelligent express lockers will be promoted, and contactless delivery methods such as "collecting parcels by scanning QR codes and facial recognition" will be supported. Path optimization algorithms will be applied to dynamically plan the optimal delivery routes based on data such as order distribution, road conditions, and vehicle positions, thus reducing the driving mileage and delivery time. An agricultural product cold-chain monitoring system will be established to achieve real-time monitoring and early warning of parameters such as temperature and humidity.

3) Enhance the application ability of data analysis

Utilize big data technology to analyze the characteristics of rural consumption and the laws of logistics demand, and provide decision - making support for network layout, capacity allocation, and inventory management. Establish a rural logistics operation monitoring system to grasp real - time information such as logistics flow volume, flow direction, and flow speed, and give early warnings for potential congestion and shortage problems. Identify high - value customer groups and potential product categories through data analysis, and provide personalized logistics services and precise marketing support.

3.5 Strengthen the Cultivation of Professional Talents and the Construction of Talent Teams

1) Implement a talent cultivation plan for rural logistics

Incorporate rural e-commerce logistics talents into national and local talent development plans, and support vocational colleges to offer relevant majors such as logistics management and e-commerce. Promote the "school-enterprise cooperation and order-based training" model, where enterprises participate in curriculum design and practical training teaching, and students directly join the cooperative enterprises for employment after graduation. Rely on county-level vocational education centers to conduct on-the-job training for logistics practitioners.

2) Improve the talent incentive and guarantee mechanism

Provide policy incentives such as settlement subsidies, housing support, and preferential treatment for children's

education to logistics professionals who work in rural areas. Establish a salary system that suits rural characteristics and offer special allowances to delivery personnel working in remote areas. Organize rural logistics vocational skills competitions and recognize and reward outstanding talents. Establish career development paths for logistics practitioners and support them in improving their educational background and skills through continuing education.

3) Cultivate a local logistics service team

Encourage rural migrants returning to their hometowns, military veterans, college graduates and other groups to participate in rural logistics entrepreneurship, and provide services such as entrepreneurship training, loan support, and market connection. Support local residents to serve as operators of village - level express service points and enhance their service capabilities through professional training. Establish credit files for logistics practitioners, link service quality and customer evaluations with income to stimulate internal motivation. Cultivate a group of rural logistics leaders who understand technology, are good at business operations and management.

3.6 Promote Multi-party Collaboration and Ecological Co-construction

1) Establish an industrial collaborative development mechanism

Promote the in - depth integration of industries such as e - commerce, logistics, agriculture, and commerce to form a virtuous cycle of "driving logistics with business flow and promoting business flow with logistics". Support logistics enterprises to provide value - added services such as packaging, branding, and marketing for the upward movement of agricultural products to increase the added value of agricultural products. Encourage commercial enterprises to use the logistics network to expand the rural market, carry out centralized procurement and unified distribution, and reduce the retail prices of rural commodities.

2) Establish a mechanism for resource sharing and win - win cooperation

Promote the sharing of resources such as warehousing facilities, transport vehicles, and delivery personnel among logistics enterprises, and achieve collective development through alliances, cooperation, and franchising. Encourage different e - commerce platforms to share village - level service outlets to avoid redundant construction and vicious competition. Support logistics enterprises to deepen cooperation with state - owned platforms such as passenger transport enterprises, supply and marketing cooperatives, and the postal service, giving full play to their respective network advantages to achieve mutual benefit and win - win results.

3) Improve the community participation governance mechanism

Integrate logistics services into the village-level public service system and encourage village committees and villagers' groups to participate in tasks such as site selection for logistics outlets and service supervision. Establish a villager evaluation mechanism, regularly collect opinions and suggestions on logistics services, and continuously improve service quality. Support the establishment of rural logistics cooperatives, where villagers jointly contribute capital, jointly manage, and share benefits, thereby enhancing the sense of acquisition and participation of the community.

4. Conclusions

The solution to the "last - mile" problem in rural e - commerce logistics is a profound transformation involving multiple dimensions such as infrastructure, business models, technology applications, policy systems, and social participation. This is not only a technical issue of improving logistics efficiency but also a systematic project for urban - rural integrated development, digital rural construction, and rural consumption upgrading. With the in - depth implementation of the rural revitalization strategy and the rapid iteration of digital technologies, rural e - commerce logistics is facing a historical development opportunity.

In the future, we can further draw on international experience in public transport integration (Solecka, 2011), improve the policy coordination mechanism according to local realities (Sohail et al., 2006), and deepen the integrated development practice of transportation and postal services so as to systematically break through the development bottleneck of the "last - mile" in urban and rural logistics (Sun et al., 2020). With the in - depth implementation of the rural revitalization strategy and the rapid iteration of digital technologies, a rural e - commerce logistics system featuring "high efficiency and convenience, controllable costs, high - quality services, and green and intelligent operation" will surely be gradually established.

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