



Application of GIS System in Agricultural Logistics Information Management

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Abstract. In recent years, China's support for agriculture is increasing, and more and more agricultural products will go up. However, due to problems such as logistics infrastructure in rural areas, the timeliness and quality of agricultural products cannot meet the needs of consumers. Solving these problems is an important part of rural economic development. GIS (Geographic Information System) technology is mature, put it into agricultural logistics, can make agricultural products in the distribution process of the whole process management, to achieve targeted risk avoidance. This technology can also be used to calculate the optimal path of agricultural products transportation, which can solve the practical problems of high transportation cost and long time consumption. This paper mainly analyzes the application and significance of GIS system in rural logistics. The use of GIS system in agricultural logistics can save costs, ensure timeliness, improve the degree of informatization, and finally achieve the purpose of increasing economic benefits. Hope to provide an effective reference for the future research of agricultural logistics.

Keywords: geographic information system, agricultural logistics, information level management, logistics management

1 INTRODUCTION:

Xinhua News Agency, September 26, 2018. The Central Committee of the Communist Party of China and the State Council issued the Strategic Plan for Rural Revitalization (2018-2022), and issued a notice requesting all localities and departments to conscientiously implement it in light of the actual situation. On October 16, 2022, put forward in the report of the 20th National Congress: Promoting rural revitalization in an all-round way. Adhere to the priority development of agriculture and rural areas, adhere to the integration of urban and rural development, and smooth the flow of urban and rural elements. Solidly promote the revitalization of rural industries, talents, culture, ecology and organization. The rural revitalization strategy also shows that China's support for

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agriculture and the market demand for agriculture are increasing. However, due to some rural logistics infrastructure and other reasons, it has brought various difficulties to the development of agriculture. China has a large geographical span and many kinds of agriculture, but the production in different regions is special, and the current technical means can not make special agricultural products popular planting, so the current situation of agricultural logistics is that the cost consumption is large, the loss is large, and the timeliness cannot be guaranteed. This paper is mainly from the rural logistics demand research, and then the application of geographic information system in rural logistics, combined with the rural logistics system for logistics enterprises to effectively integrate resources, to achieve information management process.

2 LITERATURE REVIEW

The optimization of logistics information system is of great significance to the development of agricultural logistics, and also has a great impact on the development of rural economy. No matter what kind of logistics, it should be based on the principle of saving costs, meeting customer needs and improving economic benefits. The use of GIS technology can make logistics information intelligent management and effectively solve the problem of system requirements. Wu Fuqiang (2021) pointed out that GIS optimizes and innovates logistics information system, and designs logistics information system based on GIS technology, which proves the possibility of GIS application in logistics. Finally, it is suggested that it can be popularized and applied in practice^[1]. Hu Yujing and Huang Ying (2020) analyzed BDS/GIS collaborative operation, established logistics distribution scheduling system model, and planned logistics route according to traffic conditions to get the best distribution route^[2]. Chen Xuemei (2020) pointed out the existing problems of agricultural products logistics in China: imperfect logistics infrastructure, low degree of informationization, long time consumption, large loss and high cost, and proposed to integrate GIS technology into agricultural logistics to realize timely and accurate transmission of information, rationally plan transportation routes and improve the quality and efficiency of agricultural logistics^[3]. Lv Chengcheng (2021) introduced the specific functions of GIS technology and emphatically analyzed the specific application of GIS technology in agricultural logistics, which verified the feasibility and applicability of GIS technology in agricultural logistics^[4]. Li Xinle (2020) builds a rural logistics system supported by GIS technology, optimizes transportation routes, and realizes the whole process management in the process of product distribution, thus ensuring the sustainable development of logistics^[5]. Xu Yan Haonan, Xu Yang and Ho Lee (2021) introduced GIS technology, and explained the framework of GIS in logistics information system^[6]. Finally, an example was analyzed to prove that the application of GIS technology in logistics is meaningful.

3 THE DEMAND ANALYSIS OF AGRICULTURAL LOGISTICS

China is rich in kinds of agricultural products, the agricultural area is widely distributed, China is vast in territory and abundant in resources, and the regional and seasonal influence of agricultural products logistics makes the whole logistics process more complex and uncertain. China's agricultural logistics needs intelligence, standardization, rapidity and accuracy. With the support of national policies, more and more enterprises enter rural areas, and the development of rural logistics has become the first thing for these enterprises to solve. Whether agricultural products go up or industrial products go down, logistics is needed. When the products arrive at the rural outlets, the logistics delivery personnel will deliver the goods according to the specific receiving address. However, because the logistics infrastructure in rural areas is imperfect, they can not be delivered directly to the door like urban areas. If they are delivered to the door like urban areas, the cost of logistics enterprises will greatly increase, including labor costs, transportation costs, operating costs and so on. Because of the large service area of agricultural logistics, the large number of consumer groups, the dynamic nature of orders (uncertain time and place of orders), and the imperfect rural logistics infrastructure, it is necessary to adopt various modes of transportation in special road sections, which will use more distribution schemes. There are also problems such as the delivery and transportation of special agricultural products, such as fresh food and prefabricated food. The construction of cold chain logistics in China is imperfect, and the professionalism of agricultural employees is weak. Therefore, it is necessary to establish a logistics information platform or a logistics trading center, and use GIS technology to transparently manage cargo transportation and enhance informationization, which will not only save transportation operation costs, but also reduce quality loss in the process of cargo transportation.

The problem of rural logistics is the foundation of agricultural development. To solve the problem of rural logistics is to scientifically determine the transportation route, vehicle distribution and driving route of transportation vehicles through the destination of goods. The application of GIS (Geographic Information System) technology in agricultural logistics is to combine the technology with the management of rural logistics industry, which is the objective demand of rural logistics development. This technology is to store, analyze and process geographic data, and connect various geographic data at different levels to form a realistic model. It has powerful spatial data management, geographic analysis and transportation analysis capabilities, effectively reducing logistics transportation costs, reducing logistics transportation time and improving logistics service quality. To sum up, the application of GIS technology in agricultural logistics is meaningful.

4 THE APPLICATION OF GIS IN AGRICULTURAL LOGISTICS

4.1 Acquisition and Processing of System Data

The system data mainly includes two aspects: geographical spatial database and rural goods distribution information database. In GIS system, the most important thing is electronic map. Geospatial database includes spatial data and attribute data. Spatial data represents geometric attributes of geographical entities of objects, while attribute data represents non-geometric attributes of objects. The main sources of spatial data are electronic map, remote sensing data and GSP data. Rural goods distribution information database is mainly composed of rural road network data, basic geographic information and other traffic network electronic maps. Including the name, type, traffic direction and attribute of rural roads. The whole countryside is regarded as a complete network, and the logistics stations such as rural post stations are regarded as network outlets. The rural road network database uses GIS and GPS data combined with logistics management information system to manage the logistics transportation of agricultural products. Both of them establish a mathematical model of an entity geographical coordinates, and finally choose an optimal transportation path scheme according to the mathematical model.

4.2 The Application of GIS System in Agricultural Logistics

In agricultural logistics, the use of GIS technology can increase the information management ability of logistics enterprises, reduce logistics transportation costs, including reducing labor and operating costs, and make the optimal distribution scheme before distribution.

Vehicle Route Planning. GIS technology can calculate rural roads through geographical coordinates and other data, and optimize the allocation of existing vehicles. For example, the special geographical environment in rural areas can also achieve multiple modes of transportation, which can solve the higher transportation cost caused by the same starting point and end point of rural logistics or the same starting point and multiple stop-by ends. This technology increases the transportation efficiency, saves the cost of logistics enterprises, realizes the more optimal allocation of resources, and strengthens the supervision of logistics enterprises on express delivery and staff.

Network Layout. The GIS technology carries on the analysis to the rural logistics network, analyzes the existing rural logistics network cargo demand, the bearing capacity and the logistics enterprise transportation cost, then selects the suitable optimum new network according to the data, finally solves the existing network carrying capacity insufficiency and so on, thus may reduce the rural logistics enterprise cost, enhances the existing network utilization rate.

Implement Navigation. GIS technology can be used to navigate the transported goods. Through GIS navigation data, we can master the real-time situation in the transportation process, including transit time and road traffic problems. If we master these situations in advance, we can analyze them in real time according to the data and choose a more suitable and optimal real-time transportation scheme. It can also make consumers master the dynamic logistics of goods.

Traffic Accident Analysis. GIS technology can be used in the process of transportation of goods transport accidents to restore analysis, restore the accident scene, can be faster to restore the cause of the accident, faster analysis of responsible persons, faster settlement of accident disputes.

The Division of Service Scope Is Clearer. Using GIS technology can be a region of the same geographical environment of the service range of outlets for a clear division, so as to strengthen the management of logistics enterprises, achieve scope division, responsibility to people, improve the logistics service level of logistics enterprises.

5 SIGNIFICANCE OF GIS APPLICATION IN AGRICULTURAL LOGISTICS

5.1 Reduce the Cost of Rural Logistics Enterprises

Because of the imperfect logistics facilities in rural areas, the lack of express delivery, scattered distribution addresses, uncertain orders and other problems, the traditional logistics transportation cannot be adapted, which undoubtedly increases the operation and transportation costs of rural logistics enterprises. With the input of GIS technology, the actual geographical coordinates and other practical problems are digitized, and the transportation scheme is analyzed, which saves the labor cost caused by unnecessary problems.

5.2 Promote the Development of Agricultural Economy

Rural logistics is not only the last mile problem, but also the establishment of a two-way circulation system to achieve a good economic market system for agricultural products to go up and industrial products to go down. The use of GIS technology not only changes the problem of high cost in the last mile, but also transports characteristic agricultural products to the whole country or the whole world to promote the economic development of agriculture.

5.3 Optimize the Agricultural Logistics System

GIS technology will be the actual geographical location of data processing, can improve the transportation network, before the transport of goods can be real-time navigation

and monitoring of the transport path, understand the actual situation of the transport path, improve transport efficiency. Using the particularity of goods or distribution address, we can analyze data and choose suitable freight modes, such as single road transportation, single air transportation, single ocean transportation, single railway transportation and various intermodal transportation, so as to save costs and avoid risks in advance. Also using GIS technology for dynamic location optimization of the existing logistics service site and then according to the data processing to select the appropriate new logistics service network so as to effectively improve the quality of agricultural logistics services.

5.4 Improve the Professional Level of Agricultural Logistics Employees

With the use of GIS technology in the field of agricultural logistics, the information management of agricultural logistics is more and more in-depth, which means that the skills and operation technology of employees need to be further strengthened, otherwise it will affect the quality of logistics services. Employees are more specialized, and they need to master the whole logistics process, learn GIS technology, and make the optimal transportation and distribution scheme under special circumstances. There are also agricultural logistics practitioners who should not only learn in technology, but also innovate. The dynamic logistics trading platform established by GIS technology can use data model processing to integrate resources more reasonably in the current market, gradually form a service system that matches the current agricultural market demand, strengthen information management, and improve the competitiveness of agricultural logistics enterprises.

5.5 Accelerate the Business Restructuring of Small and Medium-Sized Logistics Enterprises

The main problem of agricultural logistics stations is that they can't solve the "last mile" problem well, because the logistics infrastructure is imperfect, some logistics service outlets are only located at the county level, and there are no villages and towns below the county level. Some logistics enterprises save costs and use buses or intercity buses for piggyback transportation, which can't guarantee the safety of goods and increase costs. The use of GIS technology accelerates the cooperation mode of villages and towns, accelerates the business reorganization of small and medium-sized agricultural logistics enterprises, standardizes the delivery links and processes of rural logistics, and uses information navigation to manage the whole process of goods in real time, reduce the cost caused by uncertain factors in the transportation process, improve the quality of logistics services, and reduce the operating costs of small and medium-sized agricultural logistics enterprises.

6 CONCLUSION

With the rural revitalization strategy put forward, more and more e-commerce enterprises or traditional enterprises are stationed in rural areas to promote agricultural development. Whether it is a traditional enterprise or a fast-growing e-commerce enterprise, the core lies in logistics management. The logistics infrastructure in rural areas is imperfect, and it has not completely sunk to villages or communities. The use of GIS technology can combine the actual geographical coordinates of rural areas with the rural logistics information system to achieve targeted improvement. This paper analyzes the demand of agricultural logistics, the application of GIS technology in agriculture, the interaction and practical application of GIS and logistics information system, and finally analyzes the practical significance of the application of GIS technology in agricultural logistics. From a comprehensive point of view, it is considered that the application of GIS technology in agricultural logistics is feasible. We should pay close attention to the dividend of the information age, transform the concrete practical problems into mathematical model problems by using computer and information technology, and then make practical market analysis by using economics and other principles, and choose the optimal scheme with the lowest cost, greater profit and higher logistics service quality. GIS technology is applied to agricultural logistics to realize logistics information sharing resources sharing more intelligent agricultural logistics more rationalization so as to make the whole agricultural logistics system run efficiently.

REFERENCES

1. Wu Fuqiang.(2021). Design and development of logistics information system based on GIS technology [J]. *Electroacoustic Technology*, 45 (12): 73-75.
2. Hu Yujing, Huang Ying.(2020).Application of dynamic routing algorithm based on BDS/GIS in logistics distribution system [J]. *Logistics Technology*, 39 (09): 89-95.
3. Chen Xuemei. (2020).Application of GIS in agricultural logistics [J]. *Hebei Enterprises*, No.366 (01): 89-90.
4. Lv Chengcheng. (2021) .Research on the application of GIS in agricultural logistics [J]. *Rural Economy and Technology*, 32 (08): 77-79.
5. Li Xinle.(2020). Research on Sustainable Development of Rural Logistics Based on GIS Technology [J]. *Hubei Agricultural Sciences*, 59 (19): 195-198.
6. Xu Yan Haonan, Xu Yang, Ho Lee, etc. (2021).Analysis on the application of GIS technology in logistics information system [J]. *China Logistics and Purchasing*, No.631 (18): 56.
7. Diao Peng, Su Junde.(2023).Design and experimental study on cold chain logistics distribution system of plateau Natsuna based on GIS [J]. *Southern Agricultural Machinery*, 54 (05): 34-37 +41.
8. Ge Hongyi. (2010).Research and implementation of grain logistics information platform based on GIS [D]. Henan University of Technology.
9. Sangirova R U ,R U S ,O I Y , et al.(2020).Features of GIS application in agriculture and logistics[J].*IOP Conference Series: Materials Science and Engineering*, 918(1):012140-.
10. Julius R ,Rimantas S .(2015).Review of the Monograph by Oleksandr Velychko “Logistics in the System of Management of Enterprises in Agrarian Sector of

Economy”[J].Management Theory and Studies for Rural Business and Infrastructure Development, 37(4):598-602.

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