Research on Milk Run Model of Rural Logistics Based on "Internet +"

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Abstract: This paper analyzes the problems and causes of "last mile" of rural logistics, puts forward the model of rural milk-run based on "Internet +", and formulates a model and algorithm for transportation planning, which provides a feasible solution for rural logistics distribution.

1. Background Analysis

In recent years, with the rapid development of the Internet, China's rural e-commerce has developed rapidly. The total retail sales in rural e-commerce reached 1.37 trillion yuan, an increase of 30.4% over the same period last year. Although the sales volume of rural e-commerce has increased rapidly, rural e-commerce accounts for only one-ninth of the national online retail sales, which has not yet reached the expected growth. According to market research, the biggest obstacle hindering the further development of rural e-commerce lies in the "last mile of logistics" in rural areas, which is mainly manifested in the following aspects: Packages cannot be delivered to farmers in time, the time spent in logistics points is often longer; it is inconvenient for farmers to receive and send express delivery in rural areas. Rural logistics research involves rural modernization, agricultural value-added efficiency and farmers' income. Solving the last mile of rural logistics is an important direction to solve the problems of agriculture, countryside and farmers, maintain rural stability, meet rural consumption demand, improve commodity quality and achieve precise poverty alleviation.

2. Analysis of the Causes of Rural Logistics Problems

2.1 Lack of Information Exchange Platform for Rural Logistics

Most of the information systems established by domestic logistics enterprises are based on the collecting platform of their own logistics business, only for the users who use this system. However, the logistics needs of rural users are individualized and diversified, and the types of logistics enterprises they choose are various and miscellaneous. There is no perfect information exchange platform among logistics enterprises. Enterprises cannot take advantage of their respective advantages to undertake more logistics business, making scattered logistics in rural areas. Demand cannot be aggregated into large-scale logistics services.

2.2 High Cost of Rural Logistics Distribution

Compared with cities, there are fewer logistics network in rural areas in China. Only EMS can provide logistics services to towns and villages. Most logistics companies only provide logistics services to county towns, and then complete the distribution and collection of the next level logistics through Township logistics agents. However, due to the asymmetry of logistics information, the no-load rate of collection and distribution is higher, which leads to the high cost of logistics agents in many towns and villages.

2.3 Logistics timeliness is unsatisfactory

Because Rural Township logistics agents are facing the problem of uneconomical transportation, they often reduce the standard of logistics distribution and take delivery once a day in order to reduce losses and improve economic benefits. Although this method improves vehicle loading rate and reduces logistics transportation costs, it greatly reduces customer satisfaction, damages the credibility and brand reputation of logistics companies, and is not conducive to the sustainable development of logistics companies.

3. Establish milk run mode of rural logistics based on "Internet +".

3.1 Build "Internet +" Rural Logistics Demand Platform

Rural logistics has different characteristics from urban logistics, such as scattered space, small scale of logistics per unit area, long distance and uneconomical transportation. These characteristics make the development of rural logistics more challenging. In order to make the rural logistics and distribution have scale advantages, we must make full use of the advantages of the Internet. Based on the "Internet +", the rural logistics demand platform is a logistics cloud service platform that integrates information, modernization and mobility. This platform takes logistics enterprises and rural users as the core subjects, cloud computing, Internet of things, big data as the technical support, through the establishment of large data analysis system, the logistics demand data of rural customers are stored, analyzed and transmitted, and shared through mobile terminals, timely information communication and communication among logistics enterprises are established, so as to integrate and maximize logistics capacity resources. Utilization is the principle to realize the optimization of transportation capacity and cost.
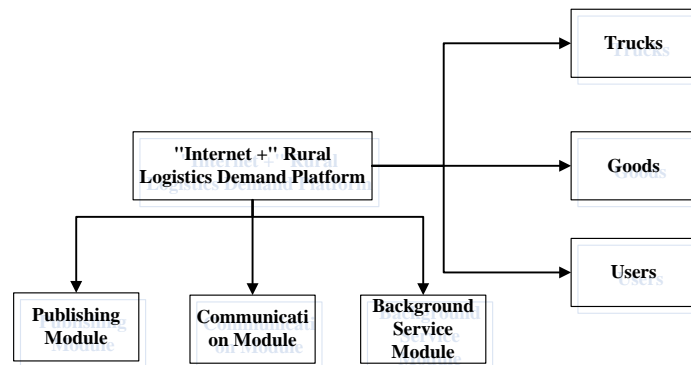

Fig 1. "Internet +" rural logistics demand platform

The service platform includes information publishing module, communication module and background service module. In the information dissemination module, rural users can publish the demand of logistics pick-up and distribution, and logistics enterprises can publish their own transportation capacity and distribution schedule, which solves the problem of information asymmetry in agricultural logistics market. In the communication module, rural users can evaluate the service situation of logistics enterprises, and logistics enterprises can evaluate the level of peer service, thus promoting logistics enterprises to improve service and coordination. In the background service module, the platform carries out qualification audits for rural users and logistics enterprises, collects, verifies and analyses relevant information, arranges the optimal capacity for logistics enterprises, and provides timely logistics services for rural users.

3.2 Establishment of rural logistics circulation mode based on "Internet +"

Traditional rural "last mile of logistics" adopts the direct delivery mode, which means township logistics agents take delivery to county-level processing centers every day. In this logistics mode, the logistics trucks carry less cargo each time, but the delivery and delivery frequency is higher, which leads to higher operation costs of township logistics agents. The pattern is shown below:
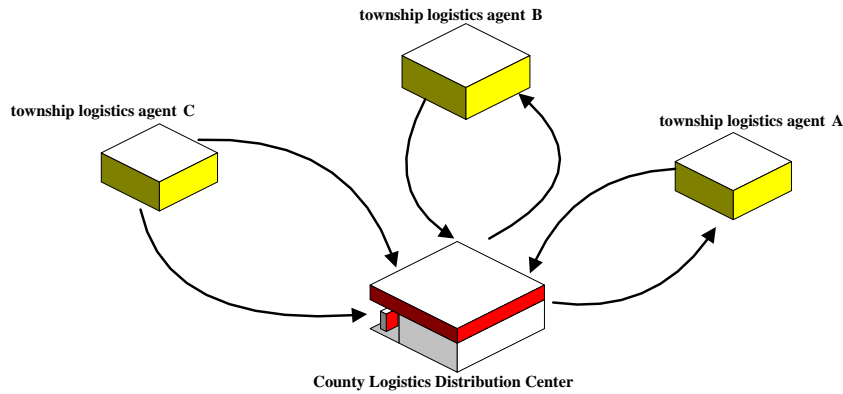
Fig 2. Rural "last mile of logistics"

Milk-Run, originally used in manufacturing industry, refers to the mode of loading and delivering goods from multiple outlets of the same transport vehicle in the industrial park. This mode reduces the whole transportation cost through the "milk route". Due to the uncertainty of demand information, the application of Milk-Run mode in other industries has certain limitations. Therefore, this paper puts forward the construction of "Internet +" rural logistics demand platform, breaking the barriers of information asymmetry between logistics providers and suppliers, and applying Milk-Run mode to rural logistics delivery. This model is as follows:
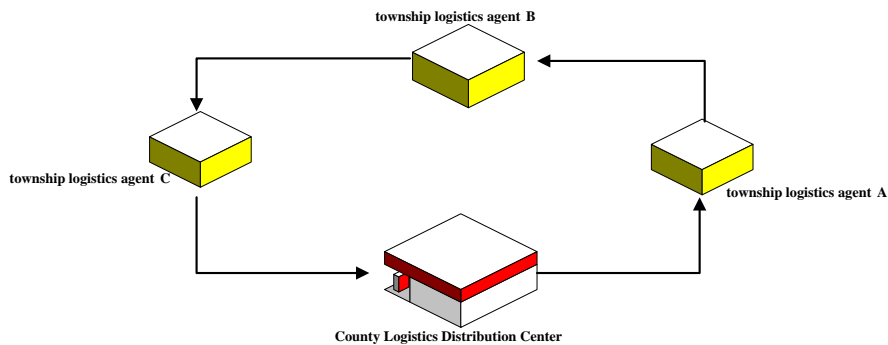

Fig 3. Applying Milk-Run mode to rural logistics delivery

Compared with the traditional direct delivery mode, Milk-Run model of rural logistics based on "Internet +" not only integrates the logistics demand of temporary logistics, reduces the input of vehicles, increases the loading rate of transport vehicles, but also avoids the double distance from the logistics distribution center, reduces the transportation cost, and makes the township Logistics agents less input in cost and higher output. This can greatly improve the enthusiasm of township logistics agents to join, and realize the expansion of the size of logistics network.

3.3 Vehicle Routing Model for Milk-Run of Rural Logistics

In order to establish the optimal transportation route, this paper proposes a CVRP model based on the maximum of the volume of goods collected and delivered as a single variable. In the model, the vehicle routing optimization problem can be described as having N township logistics agents, each township agent's location coordinates T and delivery volume are known, and a certain number of vehicles with volume V are dispatched by the county logistics distribution center to deliver goods to several township agents, requiring a reasonable arrangement of vehicle routing to minimize the total distance. Ant colony algorithm is used in the model solving method. The algorithm adopts distributed positive feedback parallel computer mechanism, which is easy to combine with other methods and has strong robustness. The calculation process of the algorithm is as follows.

Place M trucks in the N towns randomly. The probability of selecting the J town by the number K truck in the I town is as follows:

$$P^k(i,j) = \begin{cases} \dfrac{[\tau(i,j)]^\alpha \cdot [\eta(i,j)]^\beta}{\sum\limits_{s \in tabu_k}[\tau(i,s)]^\alpha \cdot [\eta(i,s)]^\beta}, & if\ j \notin tabu_k \\ 0, & otherwise \end{cases}$$

Among them:

$\tau(i,j)$: It represents pheromone concentrations on edges (i, j);

$\eta(i,j) = 1/d(i,j)$: It represents inspiring information. D represents the distance between I town and J town;

α and**β** reflect the relative importance of pheromone and heuristic information.

$tabu_k$: It represents a list of cities that the K truck has visited.

When all trucks complete the tour, update the pheromone according to the following formula.

$$\tau_{ij}(t+n) = \rho \cdot \tau_{ij}(t) + \Delta\tau_{ij}$$
$$\Delta\tau_{ij} = \sum_{k=1}^{m}\Delta\tau_{ij}^k$$
$$\Delta\tau_{ij}^k = \begin{cases} \dfrac{Q}{L_k} & ij \in l_k \\ 0 & otherwise \end{cases}$$

Among them: Q is a constant. l_k is the path of the K truck in this iteration.

When all trucks complete a tour, the taboo form is filled. Ant colony algorithm obtains the optimal solution by comparing several feasible solutions.

4. Conclusion

In the long run, the milk run mode of rural logistics based on "Internet +" enhances the enthusiasm of township agents in logistics business, which is conducive to the realization of the township logistics distribution strategy of logistics companies.

Acknowledgements

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