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Location Model of Fresh Agricultural Products Logistics Distribution Center Based on Network Nodes

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Abstract: *The high logistics cost of fresh produce is the main problem that restricts the distribution of produce. How to reduce the logistics cost of fresh agricultural products, improve the utilization rate of logistics facilities, and improve distribution efficiency and service levels has become the key to research. As an important hub for fresh agricultural products, the fresh agricultural product distribution center can effectively integrate supply and demand information and is the key to ensuring the efficiency of fresh agricultural product distribution, especially to meet the urban fresh agricultural product distribution needs. The fresh agricultural product urban logistics distribution center has the characteristics of small service radius, small scale, many distribution batches and high distribution frequency. The service radius and the scale of the distribution center determine the function of the distribution service. In order to save costs while ensuring distribution efficiency and logistics service levels, it is necessary to scientifically and rationally plan the location of urban distribution centers for fresh agricultural products. Despite extensive research on the location of logistics distribution centers, there are still some shortcomings. First, by analyzing and summarizing the existing literature, the theory and research methods of urban logistics distribution centers for fresh agricultural products are summarized, the characteristics of urban logistics distribution centers for fresh agricultural products are analyzed, and the status of logistics centers for fresh agricultural products is summarized. Influencing factors and site selection process introduced the basic principles and steps of immune algorithm. Secondly, based on the location theory of distribution centers, a cost model for the location of urban logistics distribution centers for fresh agricultural products is established. The model takes into account economic and social factors, including distribution costs, fixed costs, operating costs, waste costs and carbon emission costs. In the case of traffic congestion, a carbon emission factor is introduced to calculate the environmental cost of the allocation process. Finally, combined with the calculation steps of the immune algorithm, the solution steps are designed for the location model of the urban fresh agricultural products logistics distribution center, and the actual calculation examples are studied using MATLAB software programming, and the distribution center is obtained based on the low model. Through the method of this article, the transportation speed of fresh agricultural products logistics distribution center location has been increased by 13%.*

Keywords: *Network Node, Fresh Farm Products, Location of Logistics Distribution Center, Immune Algorithm*

1. Introduction

1.1 Background and Significance

With the development of the information revolution and the comprehensive deepening of reforms, China's modernization process continues to advance, the industrial structure is constantly adapted, the consumption of residents is constantly upgraded, and the demand for logistics is constantly growing. As an important industry of the national economy, the logistics industry has more and more room for development [1]. According to statistics, the output of fresh agricultural products in China reached 1.305 billion tons in 2017, and the number of fresh agricultural products markets above 100 million yuan was 578, with a transaction volume of 963.42 billion yuan [2]. Compared with 2016, the

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production of fresh agricultural products, the market and trading volume of fresh agricultural products are steadily increasing, and residents' demand for fresh agricultural products seems to be gradually increasing. At present, the distribution costs of agricultural logistics products for fresh agricultural products are still very high, with low efficiency and low service levels, which severely restrict the sales of fresh agricultural products [3]. In order to meet the increased logistics demand brought about by consumption upgrades, it is necessary to establish a complete urban logistics distribution system to ensure the efficient and safe distribution of fresh agricultural products [4].

In theory, the current research on the distribution location of agricultural products focuses on the single goal of reducing costs and shortening delivery time. This work studies the introduction of freshness of fresh agricultural products and the concept of green and low-carbon logistics, and studies the optimal detection problem in the multi-objective state, and enriches the content of the multi-objective model [5]. In addition, this document introduces a logistics service level model based on delivery time to evaluate the solution results of the cost model, which has specific reference value. The demand for fresh agricultural products in cities continues to grow. The method of delivering fresh agricultural products from urban logistics distribution centers has gradually become the main method of urban logistics. It is of practical significance to choose the location of the distribution center in the city distribution mode [6]. From a practical point of view, agricultural products have the characteristics of vulnerability, vulnerability and poor specifications. Therefore, compared with industrial products, urban logistics and the distribution of agricultural products have higher requirements. Scientific and reasonable selection of distribution centers can ensure the efficiency of logistics distribution and reduce logistics costs [7]. The timeliness and accuracy of urban logistics distribution are of great significance for realizing the value of agricultural products, improving customer satisfaction and expanding the scope of corporate customers. In addition, reducing urban logistics and distribution costs and improving distribution efficiency can help companies improve financial returns [8].

1.2 Related Work

Because of the importance of choosing the location of the fresh agricultural product logistics distribution center, more and more scholars and researchers have invested in this area, and have achieved quite good results [9]. Sangirova puts forward a method above speed for fresh farm products. Although this method can improve the transportation speed very well, it does not take into account factors such as the cost of the venue, which will cause the cost to increase greatly, which is obviously unreasonable [10]. Krishnan proposed to determine the location method in order to ensure economic benefits. However, this will lead to low logistics speed and low customer satisfaction, which makes it difficult to guarantee the return rate of users [11]. Therefore, this paper uses the network node fresh agricultural product logistics distribution center location model research to select the fresh agricultural product logistics distribution center location. Ensure that the logistics speed can be improved while ensuring economic benefits, and customer satisfaction [12].

1.3 Main Content

In order to solve the location of the fresh agricultural product logistics distribution center, this article first analyzes the previous methods of dealing with this problem through the literature research method. Reduce a lot of unnecessary troubles. Then the immune algorithm is used to calculate several locations to calculate the locations with high service satisfaction and low cost, and finally the best location is selected. Through the method of this article, the transportation speed of the fresh agricultural product logistics distribution center location has been increased by 13%, and the user satisfaction has also been greatly improved.

2. Research Method Based on Network Node Fresh Agricultural Product Logistics Distribution Center Location Model

2.1 Immune Algorithm

(1) Collective symbols

i: supply point of fresh agricultural products;

d: A collection of demand points for fresh farm products;

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j: Collection of alternative distribution centers for fresh farm products;

(2) Variable

X_{IJ}: The amount of transfer from the feed point i to the distribution center j

V: Average speed of delivery vehicles in the city

P: Coal emission factor of fresh produce during the distribution process

T_{ij}: The transportation time of fresh agricultural products from the i-th supply point to the j-th alternative distribution center can be expressed as $T_{ij} = l_{IJ} / V$;

T_{JD}: The transportation time of fresh agricultural products from the Jth alternative distribution center to the Dth demand point, which can be expressed as: $T_{JD} = L_{JD} / V$;

T_{IJD}: The total transportation time of fresh agricultural products from the i-th supply point to the j-th alternate distribution center and then to the d-th demand point;

θ: Represents the deterioration rate of fresh agricultural products during the distribution process;

γ: Urban traffic congestion coefficient;

μ: The cost of deterioration and loss per unit of fresh farm products;

$$\mu_J = \begin{cases} 1, \text{Distribution center J is selected} \\ 0, \text{otherwise} \end{cases};$$

$$\gamma_{JD} = \begin{cases} 1, \text{Demand point D is distributed by distribution center J} \\ 0.\text{otherwise} \end{cases};$$

$$W_{IJ} = \begin{cases} 1, \text{Distribution center J is delivered by distribution center J} \\ 0, \text{otherwise} \end{cases};$$

Delivery cost refers to the transportation cost from the distribution center to the demand point, expressed as the product of transportation volume, distance and unit price. The problem studied in this paper is the logistics and distribution of urban fresh agricultural products. Assume that the unit transportation cost does not change within the city, and the percentage change is only proportional to the transportation distance and the transportation volume [13]. Delivery cost can be expressed as the product of unit distribution rate, transportation volume and distribution distance. With the goal of the lowest 1P distribution cost at the demand point, the distribution model can be constructed as follows:

$$p_I = \sum_{J \in j} \sum_{D \in d} Y_{JD} C Q_{JD} l_{JD}; J \in j \tag{1}$$

Restrictions:

$$\sum_{J \in j} Y_{JD} = 1, D \in d \tag{2}$$

$$Y_{JD} \in \{0,1\}, J \in j, D \in d \tag{3}$$

Among them, type 2 means that each demand point is allocated by the backup distribution center; type 3 is variable 0-1. This paper uses the backward transfer method to determine the distribution volume of the distribution center, that is, according to the actual demand of the demand point, use Equation 1 to solve it, and determine the total cost of each demand point. The total cost of the distribution scope determined by the distribution center is the lowest. It also needs Y_{JD} to replace the distribution volume of the distribution center.

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(2) Supply cost

Based on the calculation result of the minimum distribution cost model, we can know the distribution volume of each alternative distribution center j, and then according to the distribution volume of the distribution center, from which supply point the alternative distribution center is selected to minimize the cost of the supply cost model [14-15]. Supply cost can be expressed as the product of unit allocation rate and total demand allocation point and allocation distance. For the lowest bidding cost in the alternate distribution center, the bidding cost model can be constructed as follows:

$$p_2 = \sum_{J \in j} \left(W_{IJ} l_{IJ} C \sum_{J \in j} \sum_{J \in d} Y_{JD} Q_{JD} \right), I \in i \tag{4}$$

$$\sum_{I \in i} W_{IJ} Y_{JD} = 1, J \in j; D \in d \tag{5}$$

$$W_{IJ} \in \{0.1\}, I \in i; J \in j; \tag{6}$$

Among them, formula 5 means that each alternative distribution center is provided by a supply point; formula 6 is variable 0-1.

By solving the above supply cost model, we can obtain the supply point of each alternative distribution center to minimize the cost of the supply cost model, that is, determine the price of ijw to determine the supply range of each supply point. After determining the supply range of the supply point, the supply from the supply point i to the distribution center j can be obtained [16].

(4) Fixed costs

Fixed costs refer to the main costs incurred during the construction of the distribution center, which are mainly determined by the construction scale of the distribution center, the land price of the site and other factors in the construction cost or relative rental cost of the distribution center. . The fixed cost can be expressed as the product of the fixed construction speed of the distribution center and the number of distribution centers. With the goal of lower fixed cost A, the distribution model can be constructed as follows [17]:

$$p_3 = \sum_{J \in j} U_J F_J \tag{7}$$

(2) Operating costs

Operating costs mainly include variable costs and management costs. Variable cost refers to the cost of goods passing through the distribution center, which mainly includes storage cost, loading and unloading cost, collection cost, transportation cost, etc. [18]. After the distribution center is completed, manpower and material resources are required to carry out the normal operation of the distribution center. The operation and maintenance costs incurred during the normal operation of the distribution center have been included in the management costs. The operating cost can be expressed as the product of the operating cost per unit processing volume of the distribution center and the total processing volume of the distribution center. With the goal of lower operating cost P_4, the distribution model can be constructed in the following way [19-20]:

$$p_4 = \sum_{J \in j} \sum_{D \in d} F_J Q_{JD} \tag{8}$$

(2) Loss cost

The freshness of fresh produce refers to the overall quality characteristics of fresh produce in its physical and chemical aspects [21]. The freshness of fresh produce depends on the transportation time of fresh produce and temperature changes during transportation. The main links where the freshness of fresh produces changes include: circulation and storage.

(3) Freshness function of fresh produce

The freshness of fresh produce will have a certain impact on consumer demand, and the decrease in freshness of fresh produce will lead to lower sales prices, which will cause some losses [22]. Therefore, it is necessary to reasonably measure the cost of losing fresh produce during transportation. From this hypothesis, it can be seen that the deterioration rate of fresh agricultural products in the distribution and transportation process is stable, and the loss of freshness is related to the transportation time and transportation distance (considering the actual road conditions and congestion in the city), here is the introduction of fresh agricultural products The freshness function represents the general law of fresh produce that changes with the transportation time [23].

$$\varphi_T = (1-\theta)^2 \tag{9}$$

(2) Carbon emission cost

With the introduction of the concept of green logistics, low pollution, low energy consumption and low emissions have become the focus of the modern logistics industry. In order to comply with the development of green logistics and low-carbon logistics, in the entire logistics operation process, every link must pay attention to protecting the environment, saving energy and reducing emissions. In urban logistics and distribution, vehicles are mainly used for distribution. Car exhaust contains a lot of harmful gases, which is the main cause of urban environmental pollution [24-25]. Therefore, in the process of selecting the location of the urban logistics distribution center, the vehicle emissions during the distribution process, that is, carbon emissions, must be considered. Reasonable calculation of carbon emissions and its scientific basis are the main issues in carbon emissions calculations. This article studies the location of urban logistics distribution centers. In order to better meet the city's sustainable development strategy, carbon emissions during the distribution process are measured to replace lower carbon emissions [26].

$$p_6 = PY\sum_{i\in I}\sum_{j\in J} W_{IJ} X_{IJ} l_{JI} + PY\sum_{i\in I}\sum_{d\in D} Y_{IJ} Q_{IJ} l_{JI} \tag{10}$$

Restrictions:

$$U_J \in \{0,1\}; J \in j \tag{11}$$

$$P \geq 0 \tag{12}$$

In Equation 10, the first term is the cost of exhaust gas emission during the transportation process from the fresh agricultural product supply point to the fresh agricultural product distribution center; the second term is the exhaust gas emission during the process of delivering goods from the fresh agricultural product distribution center to the demand point Processing costs. Equation 11 is the constraint variable.

(2) Model construction

The article comprehensively considers the minimum comprehensive cost mathematical model of the urban logistics distribution center for fresh agricultural products as follows [27]:

$$\begin{aligned} MINp = p_1 + p_2 + p_3 + p_4 + p_5 + p_6 = \sum_{I\in i}\sum_{J\in j} U_J C X_{IJ} l_{IJ} + \\ \sum_{J\in j}\sum_{D\in d} Y_{JD} C Q_{JD} l_{JD} + \sum_{J\in j} U_J F_J + \sum_{J\in j}\sum_{D\in d} F_J Q_{JD} \end{aligned} \tag{13}$$

Restrictions:

$$\sum_{J\in j}\sum_{D\in d} Y_{JD} Q_{JD} = \sum_{I\in i} X_{IJ} \tag{14}$$

$$X_{IJ} \geq 0, I \in i; J \in j \tag{15}$$

$$\sum_{J\in j} Y_{JD} = 1 \tag{16}$$

$$Y_{JD} \in \{0,1\} \tag{17}$$

$$\sum_{I\in i} W_{IJ} Y_{JD} = 1 \tag{18}$$

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$$W_{IJ} \in \{0,1\} \tag{19}$$

$$\sum_{J\in j}\sum_{D\in d} Y_{JD}Q_{JD} \geq Q_D \tag{20}$$

$$\sum_{J\in j}\sum_{D\in d} Y_{JD}Q_{JD} = \sum_{I\in i} X_{IJ} \tag{21}$$

$$X_{IJ} \geq 0, \sum_{J\in j}\sum_{D\in d} Y_{JD}Q_{JD} = \sum_{I\in i} X_{IJ} \tag{22}$$

Formula 13 is the lowest cost model for location selection in the distribution of fresh agricultural urban logistics products [28]. The first element on the far right of the equation is the cost of transportation from the supply point to the distribution center. The second element is the transportation cost from the distribution center of fresh produce to the point of demand. The third element is the construction cost or rental cost of the urban fresh logistics distribution center, that is, the fixed cost; the fourth element is a series of processing and processing of fresh agricultural products after entering the distribution center, including: warehousing, loading and unloading, collection, transportation, etc. , These projects will be charged. After the distribution center is completed, in order to make the distribution center operate normally, manpower and material resources need to be invested. These are collectively referred to as variable costs. The operation and maintenance costs incurred during the normal operation of the distribution center have been included in the management cost, and the variable cost and management cost constitute the operation of the distribution center. Cost [29-30].

Between them,

Equation 14 ensures a balance between supply and demand.

Equation 15 is a non-negative constraint.

Formula 16 means that each demand point for fresh produce is allocated by only one alternative distribution center.

Formula 17 shows that when 0jdy =, the demand point d will not be distributed by the backup distribution center j; when 1jdy =, the demand point d will be distributed by the backup distribution center j;

Equation 18 indicates that each alternative distribution center is provided by a power point.

Equation 19 shows that when 0ijw =, supply point i does not provide alternative distribution center j, when 1ijw =, supply point i provides alternative distribution center j.

Formula 20 indicates that the number of backup distribution centers delivered to the demand point is not less than the demand point; Formula (3-22) indicates that the performance balance of each backup distribution center is guaranteed.

Formula 21 indicates that both the delivery volume and delivery distance of fresh produce are non-negative numbers.

Equation 22 means ensuring that the alternative distribution center has at least one supply point.

2.2 Method of Positioning Selection

(1) Literature reading method. Through extensive reading of relevant domestic and foreign documents, determine the research direction, and construct a site selection model through analysis and summary of multiple methods.

(2) Combination of theory and practice. Adopt theoretical research methods in terms of conceptual elaboration, theoretical research, domestic and foreign research status, and location selection methods of agricultural product logistics; adopt empirical research methods in determining the location of agricultural product distribution centers.

(3) Combination of qualitative and quantitative. The article uses qualitative analysis methods to analyze the development of agricultural product logistics in foreign developed countries and my country, the development of agricultural product logistics, and the determination of gray correlation index; in the use of cost minimization model solution, gray correlation method index correlation

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coefficient calculation, etc. The content uses quantitative analysis methods. Figure 1 Analysis of this article:

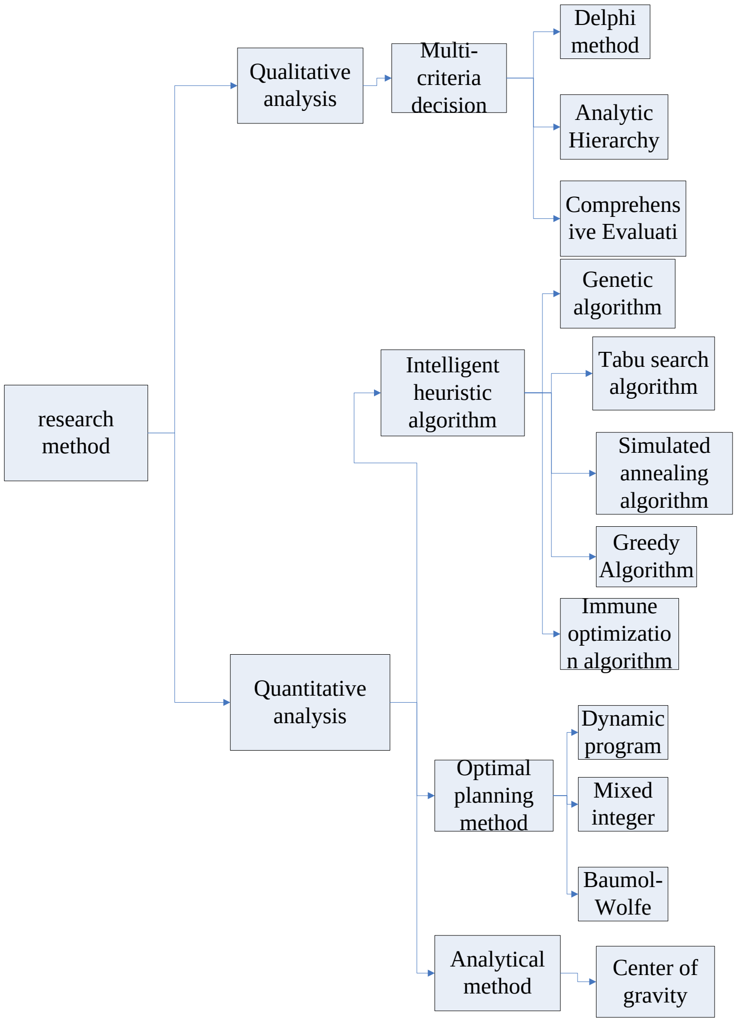

Figure 1: Summary of site selection research methods

3. Network Node Fresh Agricultural Product Logistics Distribution Center Location Model Research Experiment

The distribution center serves specific users and realizes the distribution of multiple varieties and small batches of goods through a complete distribution function and information network. Distribution centers are different from general warehouses and logistics centers. Compared with the warehouse, the distribution center has the characteristics of short storage period, high degree of modernization and fast response speed.

Distribution centers are different from warehouses. Generally, warehouses only perform storage and storage functions. Distribution centers are also different from logistics centers. Logistics centers pay more attention to the macro role. The difference between distribution center and logistics center is shown in Table 1.

Table 1: The difference between a distribution center and a logistics center

project	Logistics Center	delivery center
Service object	Provide comprehensive and professional	Strong professional
The main function	Has strong storage capacity	Mainly distribution, supplemented by storage
Service area	Big	small

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Features	Large quantities, small varieties	Fast speed, high frequency, many varieties

The functions of the distribution center mainly include: collection and distribution functions, storage, custody, classification, distribution, circulation, processing and information processing.

(1) Sending and receiving function

Logistics distribution is the bridge between supply and demand. First, the distribution center collects scattered small batches of goods and simply handles them; then, the distribution center distributes and distributes according to the needs of the demand points, and finally realizes the functions of collection and delivery. This feature highlights the role of the distribution center media, linking supply and demand and reducing resource waste.

(2) Storage and storage functions

In the e-commerce environment, when buyers and sellers conduct transactions, most companies must rely on third-party distribution centers to conduct transactions, except that some companies rely on their own complete logistics distribution systems to directly deliver goods to consumers. The storage, storage and transportation of goods, processing and other processes. The safety stock quantities of different products are conventional. Generally, fresh produce has a short shelf life and a short amount of inventory to be stored.

(3) Classification and distribution function

Classification and distribution are also key functions of the distribution center. The distribution center collects many types of products from suppliers and small batches. Distribution centers must be classified according to customer needs. These products must be sorted before being stored. Improve the efficiency of distribution and make products reach customers as soon as possible. The quality level of the distribution center service is mainly reflected in the classification and distribution efficiency of the distribution center.

(4) Traffic and processing functions

In order to meet the increasing demand for logistics and improve the service level of the distribution center, the distribution center has begun to improve the operation of the distribution center, and gradually has the ability to perform certain logistics processing tasks. The distribution and processing operations of the distribution center mainly include barcode construction and pasting, cutting, bending, weighing, assembly and repackaging. The circulation and processing functions improve the processing efficiency of the distribution center and bring significant economic benefits to the distribution center.

(5) Information processing function

The more society develops and the more complex the information, the greater the impact of information on departments and companies. How to use the commercial value implied in information is a key issue in information processing at present. The logistics distribution center communicates with the supply and demand parties, and involves the transmission and processing of a large amount of information in the entire enterprise, including the demand information of the supply point, the supply information of the supply point, and the information and inventory information processing of the distribution center. The development of logistics modernization requires that the distribution center be able to process and release relevant information in a timely and accurate manner to meet the growing logistics demand and improve logistics efficiency and service levels.

4. Location Model of Fresh Agricultural Product Logistics Distribution Center Based on Network Nodes

4.1 Location Model of Urban Logistics Distribution Center for Fresh Agricultural Products

The supply point of fresh produce is usually the production site of fresh produce or the base where large-scale produce is grown. In this article, the distribution of fresh agricultural products of graduate students in cities, and the relatively scattered upstream areas of fresh agricultural products, it is necessary to focus on the large-scale vegetable market first, and then the urban distribution and sales of the latter. Fresh produce. This article takes H company as an example. In order to solve the cost problem and logistics waste caused by the direct distribution method of the supply point, the company considers the characteristics of high frequency and low frequency, and takes the demand point as a collection. A batch of fresh produce is distributed in the city. , Use the total minimum cost model to

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select the distribution center of fresh produce from the demand point, and only consider the distance between the distribution center and the demand point and related costs to determine the location of the distribution center.

This article uses MATLAB2016a software to analyze the model. The basic parameters of the immune algorithm are: population size 100, storage capacity 10, maximum number of repetitions 100, crossover probability 0.5, mutation probability 0.4 and variety evaluation parameter 0.95. According to the research on the growth and growth potential of H Company, the number of distribution centers is limited to six. In this calculation example, Table 2 lists the number of different distribution centers, alternative points of different schemes, program execution time, algorithm copy number and cost. Figure 2 shows the total cost:

Table 2: Program running time, algorithm iteration number and cost of different distribution center location schemes

Location plan	operation hours	Iteration time	Delivery cost	Fixed cost	total cost
A	58.55	8	69292.2	95070	164362.2
B	67.49	23	52272.61	113570	165842.61
C	67.42	42	40715.63	129770	170485.63
D	69.31	68	29685.73	150070	179755.73
E	72.61	56	26299.51	170440	196739.5

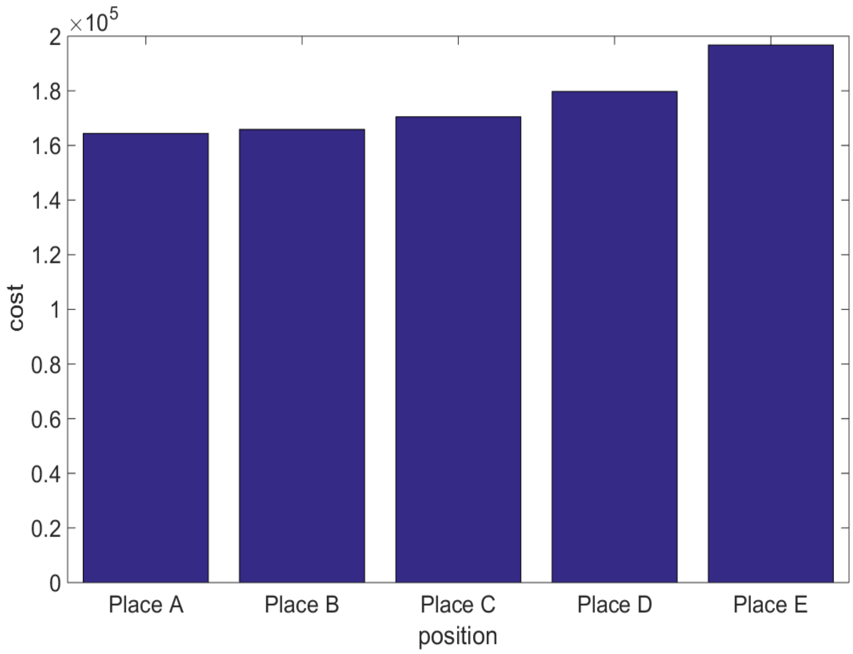

Figure 2: The total cost of different distribution center location options

It can be seen from Table 2 that in order to ensure that the position patterns of different assigned center numbers tend to converge, this article limits the maximum number of iterations of the immune algorithm to 100 times. The location plan of the fresh produce urban logistics distribution center is based on a comprehensive cost model, which takes into account the loss of fresh produce and the cost of carbon emissions. The number of distribution centers are 2, 3, 4, 5, and 6, respectively. As far as the execution time of the algorithm is concerned, the execution time of different schemes has little difference. Because the number of iterations in Fig. 1 is significantly lower than other designs, the running time of Fig. 1 is also shorter; in terms of cost, as the number of distribution centers increases, the cost of distribution centers also increases and gradually increases at demand points. 5 has the highest cost.

4.2 Site Selection Results

According to the location plan derived from the cost model, the delivery time-based logistics service level assessment model is used to evaluate different plans. In this example, the customer can tolerate the logistics service level of the distribution center. In order to make the logistics service level

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evaluation model closer to the actual situation, please use the actual distance instead of the straight line distance when calculating the distance from the distribution center to the demand point. The time definition in this article refers to the delivery time of fresh produce from the distribution center to each demand point from the perspective of the company; the definition from the demand point (customer) refers to the maximum waiting time for the customer, that is, the customer's tolerance time. Taking into account the actual distribution of the company and the characteristics of fresh produce, the results of these five plans were evaluated in detail. Table 3 and Figure 3 list the service levels:

Table 3: Cost and service level of different distribution center location options

Location plan	Cost from distribution center to point of demand	Cost difference	Service Level
A	164362.2	0	58.12%
B	165842.61	0.90%	80.33%
C	170485.63	2.80%	95.31%
D	179755.73	5.44%	98.08%
E	196739.5	9.45%	96.59%

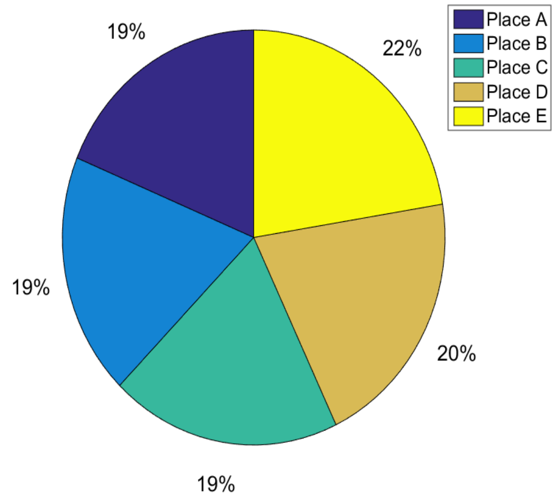

Figure 3: Costs of different distribution center location options

In order to determine the location of fresh produce, the urban logistics distribution center is mainly analyzed from two aspects: in terms of cost, option 5> option 4> option 3> option 2> option 1. The cost difference between option 5 and option 4 is the largest. First, as the number of distribution centers increases, the fixed costs and operating costs of the distribution centers also increase accordingly; secondly, compared with Option 4, the number of distribution centers in Option 5 is more distributed in higher rents. Regions, therefore, the number of distribution centers in Option 5 increases. The cost increase is relatively large. In terms of service level, plan 4> plan 5> plan 3> plan 2> plan 1. According to the given alternative plan of the company's distribution center, the logistics service level of the integrated distribution center and the company's total cost limit, the conclusion is that, Option 4 is the best position result.

By comparing the service level and loss cost of the original plan and the new plan, the specific comparison results are shown in Table 4:

Table 4: Comparison of the original delivery plan and the new delivery plan

Program	Comprehensive logistics service level	Loss cost
original plan	58.19	160.12
new plan	98.08	148.2

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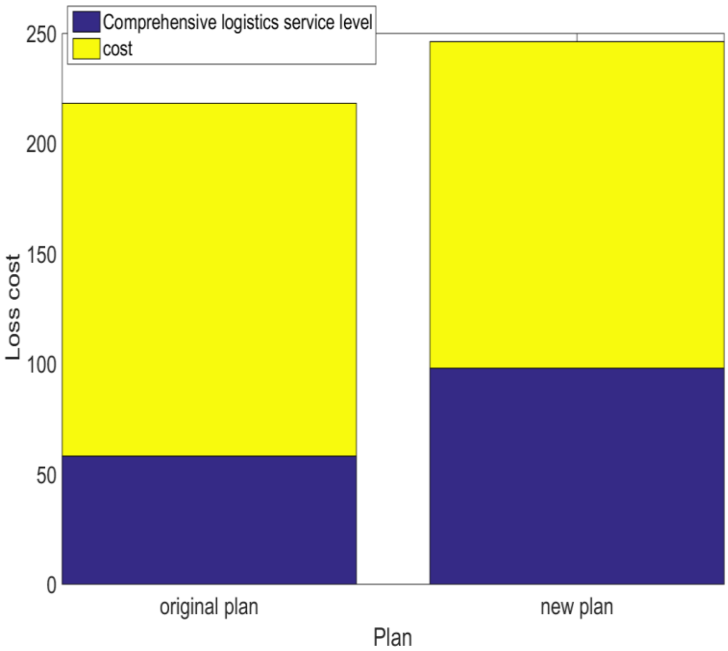

Figure 4: Comparison of the original delivery plan and the new delivery plan

According to Figure 4, the overall level of logistics services in the new plan is 68.55% higher than the original plan, and the loss cost is reduced by 8%. The huge improvement in the overall level of logistics services in the new plan will help improve customer satisfaction and customer loyalty on the one hand, and on the other hand will help stabilize business activities. Although the distribution center location plan proposed in this article will bring higher fixed costs and management costs to the company in the early stage, from the perspective of the company's long-term development, the location strategy is of strategic significance and can enable the company to be in the field service. In an advantageous position in the competition.

4.3 Sensitivity Analysis of Logistics Service Level and Time

By analyzing the relationship between delivery time and logistics service level, the degree of influence of the delivery time of fresh agricultural products on the logistics service level is obtained. The time interval is 5 minutes, and the change curve of the logistics service level of each distribution center location plan and the logistics service level of different location plans under different customer tolerable time levels are calculated. As shown in Table 5 and Figure 5:

Table 5: Logistics service level under different customer tolerable time

Program	15（%）	20（%）	25（%）	30（%）	35（%）	40
A	39.65	48.27	58.21	65.43	69.23	73.86
B	50.69	70.75	80.33	82.03	86.32	91.02
C	65.88	84.56	95.23	99.61	100	100
D	78.27	89.21	98.8	100	100	100
E	83.53	90.44	96.95	100	100	100

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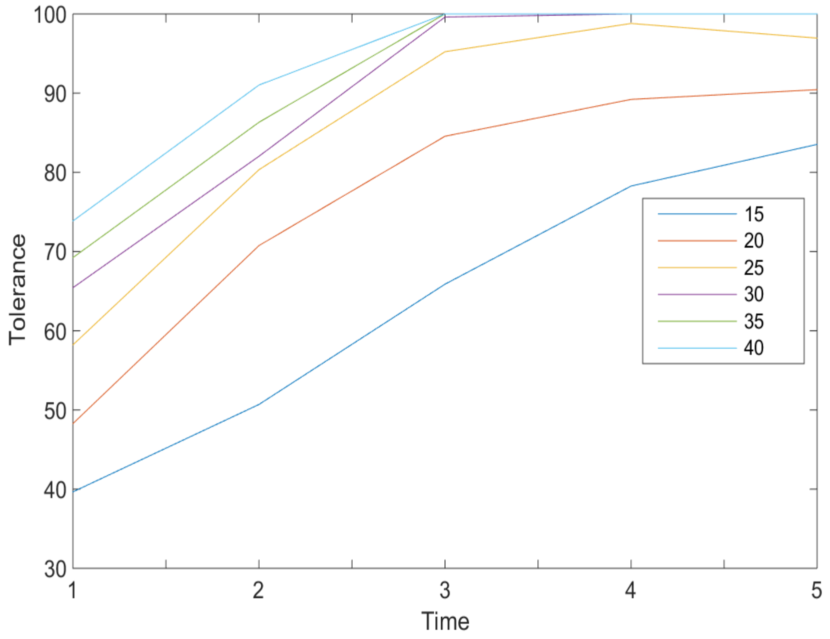

Figure 5: Logistics service level under different customer tolerable time

Take Option 4 as an example to analyze the relationship between the customer tolerable time and the logistics service level of the distribution center location plan. The time interval is 5 minutes to analyze the impact of each additional 5 minutes in the customer's tolerable time on the service level. As shown in Table 6 and Figure 6:

Table 6: The degree of customer endurance impact on logistics service level

Number of distribution centers	20-15	25-20	30-25	35-30	40-35
5	13.87	10.05	1.96	1.54	0.31
10	25.32	17.26	9.25	4.67	3.21

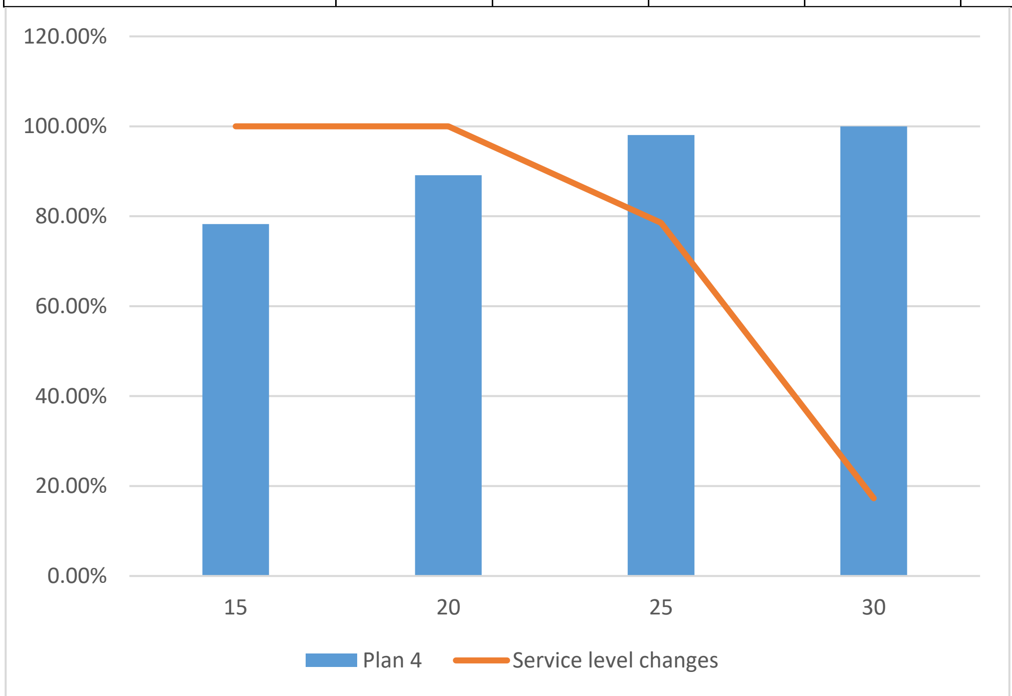

Figure 6: The extent to which customers can tolerate time affect logistics service levels

5. Conclusions

The development of agricultural logistics has a significant impact on agricultural development. China is a big agricultural country. With the advancement of modern agricultural technology, agricultural product logistics is also facing major changes. First, from a theoretical point of view, this article examines the research of agricultural logistics, the distribution of agricultural products and the location of distribution centers, and analyzes the main work done by developed countries in the development of agricultural logistics, such as the United States, the Netherlands, France, Germany and Japan. The deficiencies of logistics development can be drawn from the countermeasures and suggestions for the development of agricultural product logistics in developed countries. Next, create a cost minimization model and gray correlation evaluation method. Finally, empirical research was conducted, and specific data was input into the solution model, and the best position was obtained. Next, use the gray correlation evaluation method to analyze the degree of relevance of the expert evaluation data and find the best position.

However, I still have the following shortcomings: (1) In the cost minimization model of this article, some problems have not been fully resolved. For example, the model assumes that the supplier determines the supply weight based on the supply capacity, but in reality it is difficult to provide this weight. (2) The model assumes that the supply side is insufficient.

In the next task, I will try my best to complete the factors discussed in this article and solve the unstable factors caused by these factors. Draw a perfect end to my academic career.

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