Application of the Center of Gravity Method of Site Selection for Cold Chain Logistics Park in Jiexi County

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Abstract. In this paper, the actual situation of Jiexi County, the transportation network, market demand, and land resources are investigated and analyzed. The site selection of the fresh vegetable and fruit logistics park in Jiexi County was evaluated by using the precise center of gravity method and the literature survey method, and the site selection recommendation with feasibility and advantages was put forward.

Keywords: Jiexi County; logistics park; center of gravity method

1 Introduction

Suitable fresh fruits and vegetables logistics park can integrate a variety of fresh fruits and vegetables enterprises, through the park to build a platform to enable different enterprises in the supply chain to achieve resource sharing and synergies, to improve the overall operational efficiency of enterprises in the region, and to drive the development of the local fresh food industry on a large scale. Jiexi County has good conditions for the construction of fresh fruits and vegetables logistics park, the implementation of the site selection program can promote the efficiency of the local circulation of agricultural products and the development of the agricultural economy, and at the same time can provide useful reference for the planning of the site selection of Jiexi County Fresh Fruits and Vegetables Logistics Park. Using fuzzy hierarchical analysis, Yao Yueqiang and others summarized the important hindering factors affecting the development of cold chain logistics of agricultural products as high cold chain cost and commodity loss, backwardness of cold chain infrastructure, and low degree of marketization of agricultural products trading[1].

Xiao Wanyi combined with the actual situation of the development of agricultural logistics in Jiangxi Province on its site selection using a combination of quantitative analysis and qualitative analysis of the method, that is, for the alternative site selection

C. W. K. Chen et al. (eds.), *Proceedings of the 9th International Conference on Engineering Management and the 2nd Forum on Modern Logistics and Supply Chain Management (ICEM-MLSCM 2024)*,
Advances in Engineering Research 243,
https://doi.org/10.2991/978-94-6463-531-7_8

using a set of coverage model to derive alternative options, and then use hierarchical analysis to select the optimal program[2], Li Mengjue et al. through the analysis of advantages and disadvantages of various types of siting models to choose the mixed-integer planning method to complete the study of the site selection of agricultural logistics centers. [3]Yu Yang constructed a site layout model of agricultural products logistics park with the lowest total cost based on the site selection model, and solved the optimal site selection scheme using genetic algorithm in the Pearl River Delta region as an example[4]. Meraklh and Yaman studied the site selection problem of agricultural products distribution centers with no limitation of storage capacity[5]. Zhalechian and Tavakkoli made an in-depth analysis of the economic problems related to site selection and selected the optimal scheme in the study of agricultural products distribution centers. analyzing the economic, political, and social factors related to site selection to construct rationality. Using geographic information system (GIS) and spatial analysis technology, the site selection of fresh fruits and vegetables logistics parks is optimized[6]. Charles et al. published a study on the development of logistics parks in the United States, analyzing how to formulate the park's development goals and construction strategies between the U.S. governmental departments, corporations, and community groups and institutions and how to jointly construct and develop logistics parks[7]. These technologies can help decision makers to consider various factors such as geography, economy and society comprehensively and select the optimal site selection plan[8].These parks optimize the supply chain and improve the logistics efficiency through a complete and efficient logistics system, which realizes the fast, safe and efficient circulation of fresh fruits and vegetables, and effectively improves the added value and market competitiveness of agricultural products[9]. Foreign research also focuses on the application of cold chain logistics technology in fresh vegetables and fruits logistics parks, such as temperature control technology, RFID technology, Internet of Things technology, etc., which have been widely used in fresh vegetables and fruits logistics parks in foreign countries[10]. The application of these technologies can greatly improve the quality and safety of fresh fruits and vegetables, and reduce the loss and waste

2 Center of Gravity Method Operation

This method uses an analytical approach to derive the ideal coordinate location of a logistics center based on influencing factors such as distance and weight, and site selection is made accordingly. It is assumed that there are n resource points and demand points within the site selection range, and the amount of resources at each point is denoted byG_i (i=1,2,…,n) and its coordinates are denoted by (X_i, Y_i). In this paper, we will apply the kilometer-center of gravity method to perform the optimal siting operation, and seek the optimal solution through the continuous iterative process of the iterative convergence method.

First, the initial coordinates of the logistics center (x_0, y_0)are obtained as the starting point by calculation, and the total transportation cost T_0 is calculated. Take (x_0, y_0)as the starting siting location, substitute the partial derivative of 0 minimum value formula

to calculate the new optimal location (x_1, y_1) of the logistics center, and calculate the new total transportation cost accordingly. Comparing with T_1 and T_0, if ≥, it indicates that (x0, y0) is the optimal location of the logistics center; if$T_1 \geq T_0$, it indicates that the new location (x0, y0) is optimized compared to the initial location, but if$T_1 < T_0$, Then it is shown that the new position (x_1, y_1)compared to the initial position by the optimized , may not be the optimal location, and need to continue to iterate. The iterative process will continue, each time the new location as the starting point of the next iteration, straight to satisfy the condition$T_{n+1} \geq T_n$, at this time the coordinates $(x_n, y_n)$for the final optimal location. The optimal solution is determined by iterative convergence method.

3 KM-Application of the Center Of Gravity Method

It is concluded above that the longitude and latitude location of the fresh vegetable and fruit logistics park to be built is (x, y). The coordinates of the set center of gravity point in the area where the position is located can be calculated by the center of gravity coordinate formula. Assuming that the position is the initial site selection point:

$$X=\frac{\sum_{i=1}^{n} f_i * x_i}{\sum_{i=1}^{n} f_i} \tag{1}$$

$$Y=\frac{\sum_{i=1}^{n} f_i * y_i}{\sum_{i=1}^{n} f_i} \tag{2}$$

The longitude of ten fresh markets in Jiexi County is shown in the table 1.

Table 1. Longitude and latitude of ten fresh markets required for location in Jiexi County

Farmers' market name	longitude	latitude
River mountain market	115.851	23.437
Datong-vegetable-meat-market	115.845	23.434
River Po farmers' market	115.839	23.432
Grey village market	116.013	23.488
Lihu trade market	116.048	23.368
Hedong market	115.853	23.435
Jingkou market	116.057	23.430
Central market	115.840	23.430
Comprehensive market	116.058	23.430
Fumei New Village market	116.048	23.369

Through the above fresh market longitude and latitude coordinates can obtain the initial coordinates of logistics park site selection, by the area are jiexi county, the calculation rate charge are no change, so ignore the charging standard and the location problem mainly focused on the distance of transportation, so take transport rate f_i is 1 (yuan / ton km), can obtain the initial location coordinates:

$$\frac{\sum_{i=1}^{n} f_i * x_i}{\sum_{i=1}^{n} f_i} X= =115.945 \tag{3}$$

$$\frac{\sum_{i=1}^{n} f_i * y_i}{\sum_{i=1}^{n} f_i} Y = = 23.425 \quad (4)$$

The longitude and latitude (x, y) of the original location of the fresh vegetable and fruit logistics park is (115.925,23.425).

$$T = \sum_{i=1}^{n} c_i = \sum_{i=1}^{n} f_i * j_i = \sum_{i=1}^{n} f_i * \sqrt{(x - x_i)^2 + (y - y_i)^2} = 1.052 \quad (5)$$

The location for the km-center of gravity method is available:

$$\frac{\sum_{i=1}^{n} f_i * x_i / j_i}{\sum_{i=1}^{n} f_i / j_i} X = = 115.940 \quad (6)$$

$$\frac{\sum_{i=1}^{n} f_i * y_i / j_i}{\sum_{i=1}^{n} f_i / j_i} Y = = 23.428 \quad (7)$$

Then bring the new initial location of the fresh fruit and vegetable logistics park (115.940,23.428) into the kilometer-gravity method to obtain the total transportation cost to obtain the new total transportation cost:

$$T = \sum_{i=1}^{n} c_i = \sum_{i=1}^{n} f_i * j_i = \sum_{i=1}^{n} f_i * \sqrt{(x - x_i)^2 + (y - y_i)^2} = 1.049 \quad (8)$$

Table 2. Literlatitude and total cost of site selection method in Jiexi County

iterations	longitude	latitude	total cost
0	115.945	23.425	1.052
1	115.940	23.428	1.049
2	115.935	23.428	1.047
3	115.931	23.428	1.045
4	115.927	23.429	1.044
5	115.923	23.429	1.042
6	115.920	23.429	1.041
7	115.917	23.429	1.040
8	115.914	23.429	1.039
9	115.911	23.430	1.038
10	115.908	23.430	1.038

Compare T1 with T0, if T1 ≥ T0. (x0, y0) is the optimal location of the logistics park; if T1<T0, it indicates that the new location (x_1, y_1) is compared to the initial location, which is optimized, but may not be the optimal location and needs to continue iteration. The iteration process will continue, each time the new position is used as the starting point of the next iteration, directly satisfying the conditions. At this time, the obtained coordinates (x_n, y_n) are the final optimal location.If $T_{n+1} \geq T_n$,The calculation process is shown in the above table 2.

According to the calculation process described in the above table, when the iterations reach 9, the total transportation cost A9≥A10, the location of the optimal cold chain logistics base is (x_9, y_9), (115.911,23.430), and the location can guarantee 10

fresh markets within the scope of the logistics park. To the cold chain, the total transportation cost of the logistics park is the lowest, which is 1.038.

4 Conclusions

Fresh fruits and vegetables logistics park as an important part of the agricultural logistics park, the development of its agricultural logistics park is closely related. The government of Jiexi County is constantly promoting the development of agricultural supply chain in Jiexi County, focusing on supply chain application and technological industrial upgrading, and promoting modern logistics services. The location of suitable fresh fruits and vegetables logistics park can greatly reduce the cost. This thesis intends to analyze the agricultural products logistics park, fresh fruits and vegetables logistics park for extension, by combining the actual construction of the park in Jiexi County, Guangdong Supply and Marketing Tianye (Jiexi) Cold Chain Logistics Industrial Park analysis of the factors affecting the construction of the park, and on the above the construction of the fresh fruits and vegetables logistics park in Jiexi County, the problems existed in the construction of fresh fruits and vegetables logistics park provides relevant recommendations for reference.Combined with the contents of the article, the following conclusions are obtained:In the fresh fruits and vegetables logistics park site selection in the natural, economic, policy measures, infrastructure, human resources, internal management of the enterprise these six elements are very important, the actual site selection, the first five for the park landing considerations focus on the sixth point as the development of an important part of the impact. Need to give full play to the positive role of government policy as the leading, with a better market environment as the development of space, economic development, natural environment, infrastructure as the external conditions to reduce the cost of the park site. Jiexi County still needs to create a better social and economic environment suitable for the circulation of agricultural products and enhance public awareness. Nowadays, the development and construction of fresh fruits and vegetables logistics park is subject to the development of agricultural supply chain in Jiexi County's 14th Five-Year Plan, which is an important political policy. With a major strategic opportunity, the park should adhere to the concept of win-win cooperation and technical follow-up, accelerate the pace of participation in the construction of interconnection, and enhance the park's overall coordination and collaboration effect in general. Government departments should play a full role in improving other logistics infrastructure, deeply integrating related industries, helping agricultural product logistics parks to reduce costs and improve efficiency, and promoting the high-quality and rapid development of Jiexi County's market economy.

Acknowledgements

This study was supported by the following projects, respectively: Project of China Society of Logistics (2023CSLKT3-166), (Project No. 2024CSLKT3-420); Guangdong Province Philosophy and Social Science Planning Youth Project (GD23YGL28),

(GD24CGL26); Introduction to Cold Chain Logistics",(Project No. 202309); "Research on Strategies for High-Quality Development of Modern Logistics Industry", (Project No. 2024CSLKT1-001); (Project No. 2021ZDJS122); (Project No. 231006021102523); (Project No. 231105635271715).

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