Study on the Selection of Fruit and Vegetable Distribution Center in A County

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Abstract: With the development of economy, people's demand for fruits and vegetables is increasing. A county as the province one of the main fruit and vegetable export base, advantageous geographical conditions, natural artificial planting, guarantee the quality of fruits and vegetables, fruit and vegetable products in addition to A county for consumption in this region and other places, but because of the lack of regulation of fruit and vegetable distribution center, leads to a big problem of fruits and vegetables, seriously hindered the development of A county agricultural economy. On the basis of collecting relevant data of county A, use heuristic algorithm and mileage saving method to plan the location of its fruit and vegetable distribution center and put forward countermeasures and Suggestions.

1. Research background

A county as the province one of the main fruit and vegetable export base, advantageous geographical conditions, natural artificial planting, guarantee the quality of fruits and vegetables, fruit and vegetable products in addition to A county for consumption in this region and other places, because of the lack of unified management of fruit and vegetable distribution center, the farmers have no fixed sales channels, and lead to A lot of fruit and vegetable products exist “rotten vegetables in the field, fruit hanging in A tree”, while fruit wholesalers go to the countryside for goods which cost high transport costs, lead to cheaper price for the farmers, the phenomenon causes the sale price of fruit and vegetable grow, in the time of the fruit and vegetable products demand soared, The current situation of fruit and vegetable circulation of “this kind of poor sales, difficult to sell and expensive to buy” seriously restricts the development of the agricultural economy of A fruit and vegetable.

2. Optimization analysis of the location of fruit and vegetable distribution center in A county

2.1 Establishment of distribution center location model

Assuming the region exists between m customers can satisfy the production base and consumption demand of hub, n production base and a consumer customers, the total cost of logistics information system consists of the three, mainly includes: distribution costs from customers to distribution center, transportation cost, variable cost and fixed cost of distribution center, and thus determine the distribution center, the optimal location of the region, The minimum total cost of the logistics system is required to select the location of the distribution center. The distribution network of fruit and vegetable logistics system in A county.

In order to simplify the problem and facilitate the calculation, this paper selects two major production bases, five candidate distribution centers and eight demand customers for analysis.

2.2 Basic assumptions of the model

Any model cannot be established without the formulation of basic assumptions. In order to simplify and rationalize the problem description, the basic assumptions of the model are as follows:

a) Constant speed is maintained in the process of transportation and distribution. There is no traffic jam or other traffic accidents.

b) Don’t consider the rest time of the delivery staff, and finish the work on time and continuously.

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c) Only in a certain range of candidate sites for new distribution centers.

d) The demand of consumer customers is determined and known.

e) Distribution center to consumer customers and transportation from production base to distribution center constitute the entire logistics system transportation.

f) Transport costs can be roughly estimated, and the linear relation between transport costs and transport volume is directly proportional, and the unit variable cost of each transport is known.

g) The fixed cost and investment cost of the distribution center are known.

h) Expenses are related to the type of commodities.

2.3 Model establishment

Set the total transportation cost of F (x), the site selection of distribution center, its purpose is to play in agricultural production, fruit and vegetable wholesalers, fruits and vegetables logistics adjustment between consumers, in solving A county fruit and vegetable distribution exist “unsalable, cheap, difficult to find goods, buy expensive” distribution problems at the same time, make it as much as possible in the process of running the lowest total cost, the implementation of the transport hub fixed costs, investment costs, keep the unit variable cost, transportation cost per unit, such as the sum of the minimum, therefore, to establish objective function is as follows:

$$\min F\left(x_{hi}, y_{ij}, x_i\right)=\sum_{h=1}^{m}\sum_{i=1}^{n} c_{hi}x_{hi}+\sum_{i=1}^{n}\sum_{j=1}^{l} h_{ij}y_{ij}+\sum_{i=1}^{n} z_i v_i (w_i)^r+\sum_{i=1}^{n} z_i f_i$$

Where represents the unit transportation cost from production base h to distribution center I, and represents the freight volume from production base h to distribution center I; Represents the unit transportation cost from the distribution center I to the customer j, and represents the freight volume from the distribution center to the customer demand; Value (0, 1, if in the establishment of the hub, then the value is 1, not to build the distribution center, then the value is 0), for and in and out of the goods quantity, volume, such as fixed costs without contact, for the hub unit of the goods by the variable costs (about in and out of the amount of goods, such as warehouse management fees or handling fees, etc.) because of economic batch into consideration, so the hypothesis.

Can therefore be concluded that the main part of the objective function, from left to right to see, the first part is the hub to the transportation cost of production base, the second part to the customer demand to the distribution center distribution costs, the third part is the hub variable cost, the fourth for the hub fixed costs, for fixed costs is a constant, as the year, depreciation year by year, compared with the previous cost, the proportion of small, so it can be removed. Therefore, the final total logistics cost is the sum of the transportation cost from the distribution center to the production base, the total distribution cost from customers to the distribution center and the variable cost of the distribution center.

2.4 Constraint conditions

a) The supply capacity of the production base is greater than the total amount of freight transferred from each production base, while the demand is greater than the total amount of cargo transferred from the customer.

b) The distribution center does not consume or produce goods, so the amount of goods transferred into the distribution center should be equal to the amount of goods transferred out.

c) Considering the number and capacity of distribution centers, the number of selection of distribution centers should be less than the total number of candidate distribution centers, and the capacity should be greater than 0.

2.5 Empirical analysis

Through the field investigation of fruit and vegetable logistics in A county, the heuristic algorithm was used to solve the problem of the location of the distribution center, and the theory of the method was studied with examples to explore the feasibility and practicability of the method.

A county fruit and vegetable production base, more demand is relatively broad, in order to

simplify the calculation, intuitive see calculation process, this article considers the conditions such as traffic, population intensive selection of two major production base of G1, G2 in (respectively), 8 about the needs of the customer (separately in Q1, Q2, Q3 and Q4, Q5, Q6 and Q7, Q8) and five candidate distribution center address (R1, R2, R3, R4, R5), the heuristic algorithm is calculated, in order to improve the efficiency of A county fruit and vegetable distribution, reach the purpose of the lowest cost at the same time, It is preliminarily planned to establish three fruit and vegetable distribution centers. It is known that the unit variable cost of the distribution center is 200, 210, 180, 240, 200 yuan in order, the specific data of each production base of the distribution center and the unit freight from the distribution center to the customers in need (see Table 1 and Table 2).

Table 1 unit freight and supply capacity of each production base to the candidate distribution center

Candidate distribution center to production base production of unit freight and production capacity						
production base	production capacity	Candidate distribution center to each production base unit freight				
		R1	R2	R3	R4	R5
G1	22700	12	13	13	15	17
G2	13500	13	13	14	14	15

Table 2 unit freight and customer demand from distribution center to demand customers

Distribution center	max capacity	Unit freight to customer required							
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
R1	11000	10	11	11	12	12	13	12	14
R2	14000	8	8	10	11	12	12	13	14
R3	12000	7	8	8	9	7	7	8	10
R4	12000	8	7	7	9	9	8	9	10
R5	9000	11	13	13	14	8	8	9	9
quantity demanded		6000	4000	3000	4000	6000	4000	4000	1000

First of all, according to the constraint conditions of the algorithm to the first child (total demand customer demand is not greater than the total supply hub, the hub of the maximum capacity greater than or equal to the sum of the sum of the demand), it is not difficult to draw in accordance with the constraint conditions of the sub-problems hub combinations (R1, R2, R3), (R1, R2, R4), (R2, R3 and R4), a total of three.

Secondly according to the constraint conditions of the present problems of the algorithm, we choose combination hub (R1, R2, R3) to calculate the total freight of the whole logistics system, the combination of distribution center is an imbalance between supply and demand, we can use Table operation method, the simulation for a balance between supply and demand problem for production base to the hub of transportation cost calculation, concrete dispatching plan (see Table 3, as shown in Table 4) :

Table 3 unit freight rate from production base to distribution center (R1, R2, R3)

Production base	production capacity	Unit rate to distribution center		
		R1	R2	R3
G1	22700	12	13	13
G2	13500	13	13	14
G3	800	0	0	0
maximum capacity		11000	14000	12000

Table 4 distribution center combination (R1, R2, R3) to the required customer unit freight rate

distribution center	maximum capacity	Demand the customer's unit rate								
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
R1	11000	10	11	11	12	12	13	12	14	0
R2	14000	8	8	10	11	12	12	13	14	0
R3	12000	7	8	8	9	7	7	8	10	0
demand		6000	4000	3000	4000	6000	4000	4000	1000	5000

1) Use the minimum element method to find the initial feasible solution

The problem for the imbalance between supply and demand, we convert them to supply and demand balance, to its initial dispatching scheme analysis, the minimum element method can be the first choice in the tariff rate of the smallest, according to the corresponding demand, supply, the most shuffled on the cell can be a lot of, if the output of one row (column) (sales) have met, have the bank (column) in the other case. Until the fundamental feasible solution is obtained. Specific transport plan (as shown in Table 5) :

Table 5 initial distribution and transportation scheme from distribution center to production base

production base	production capacity	The distribution and transportation plan of the distribution center		
		R1	R2	R3
G1	22700	11000	11700	
G2	13500		1500	11200
G3	800		800	
maximum capacity		11000	14000	12000

The total freight cost of the initial dispatch plan is:

11000 x 12+11700 x 13+1500 x 13+ 12,000 x 14+800 x 0=471600.

2) Test of optimality

After the initial basic feasible solution of the transportation problem obtained by the minimum element method, the optimal solution of this solution is needed to be solved according to the second step of the operation method on the Table to determine whether it is the optimal solution. The specific inspection method using closed loop method, and tested for solving, scheme according to the dispatching transportation list, starting from the space of not carrying quantity, carrying quantity have encountered the number just twist, each turning point for right, until the return to the starting point, form a loop, and no cross check number calculation, such as check number less than zero, the adjustments of the loop. Specific results (see Table 6) :

Table 6 test number of the initial dispatch scheme

The base variable	Check number
G1R3	13-13+13-14=-1
G2R1	13-12+13-13=1
G3R1	0-12+13-0=1
G3R3	0-14+13-0=-1

3) Scheme adjustment

Find the closed loop even fold point a minimum capacity, adjust the volume of closed loop, the even fold point volume minus the number, the odd point volume and the number, form a new transport scheme, and then the optimal scheme of the new test, if not the optimum solution, continue to test several adjustment, until get the optimal solution, specific results (see Table 7, Table 8) shown below:

Table 7 adjusted transport plan

production base	production capacity	The distribution and transportation plan of the distribution center		
		R1	R2	R3
G1	22700	11000	500	11200
G2	13500		13500	
G3	800			800
maximum capacity		11000	14000	12000

Table 8 test number solution

The base variable	Check number
G2R1	13-12+13-13=1
G2R3	14-13+13-13=1
G3R1	0-12+13-0=1
G3R2	0-13+13-0=0

From Table 8, it can be known that all the test Numbers are greater than or equal to 0, and the optimal operation scheme is obtained. The total cost of this transport plan is:

11000 * 12+500 * 13+11200 * 13+13 * 13500=459600.

Use the same method to calculate the distribution cost from the distribution center to the customers in need, and the specific transport plan (see Table 9) :

Table 9 distribution scheme from distribution center to customers in need

distribution center	maximum capacity	Delivery plan to the required customer								
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
R1	11000				3000			2000	1000	5000
R2	14000	6000	4000	3000	1000					
R3	12000					6000	4000	2000		
Demand		6000	4000	3000	4000	6000	4000	4000	1000	5000

Therefore, it can be concluded that the total cost of distribution from the distribution center to the customers in need is:

12 * 12 * 2000 + 4 * 1000 + 3000 + 4000 + 6000 + 8 x 8 x 10 x 3000 x 1000 + 11 + 8 + 7 + 7 x 4000 x 6000 x 2000 = 281000.

On this basis, the variable cost of the distribution center is considered again:

200 x 110001/2 + 210 * 120001/2 140001/2 + 180 = 20976 + 24848 + 19718 = 65542

According to the objective function, the total cost of the distribution center is equal to the sum of the transportation cost from the production base to the distribution center, the distribution cost from the distribution center to the demand customers and the variable cost of the distribution center. The total cost of the combination of the distribution center is:

459600 + 281000 + 65542 = 806142.

Similarly, it can be concluded that the total cost of other combination schemes of distribution centers is f(R1,R2,R4)=869914, and f(R2,R3,R4)=845380.

Compare all hub combinations total cost, if the lowest total cost, we choose it as a hub for fruit and vegetable distribution nodes, according to the above, it can be found hub combinations (R1, R2, R3) of the lowest total cost, namely the distribution center located in (R1, R2, R3) when the lowest cost, then the hub should be set up in the (R1, R2, R3), to control the total cost, so as to achieve the ultimate goal of the lowest cost.

3. Conclusion

Logistics distribution center is in the logistics system of dominant position, its location determines the rationality and feasibility of the logistics system which has become the most important part of logistics enterprise planning strategy. This article is in view of the situation of A county fruit and vegetable logistics, the logistics distribution center location mathematical model is established, considering both the cost of transportation and the operation cost of distribution center, to reduce the combined total distance and the sharpest. It is beneficial to improve the development of fruits and vegetables in this region and drive the development of agricultural economy in this region.

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