Performance Evaluation of Fresh Agricultural Products Logistics Operation Mode

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Abstract. Based on the actual situation of logistics operation modes of fresh produce, this paper first analyzes the needs and expectations of all participating parties. Secondly, combined with the supply chain operation process, this paper constructs the performance evaluation index system from four aspects: the level of logistics management, the level of information management, the cooperation between the two parties and the potential for future development. Finally, AHP and fuzzy comprehensive evaluation method were used to evaluate the performance of Xinfeng Supermarket. The empirical research shows that the index system established is comprehensive and reasonable, which can provide a scientific basis for the evaluation of the operation of fresh agricultural products.

Introduction

Fresh agricultural products are essential necessities of life in our daily life. At present, its research mainly focuses on the development status of fresh agricultural products logistics, the factors that affect fresh agricultural logistics, the evaluation of fresh agricultural products logistics capabilities, the operation mode of fresh agricultural products logistics and so on. However, there are few studies on the performance evaluation of fresh agricultural products logistics operation mode. But the performance evaluation of fresh agricultural products logistics operation mode is of great strategic importance for the improvement of fresh agricultural products logistics operation mode, the development of rural economy and the promotion of urban and rural co-ordination process.

Literature Review

In the field of performance evaluation of fresh agricultural products logistics operation mode, foreign scholars Rohit Joshi and DK Banwet (2011) selected the return on assets, quality and safety, service level, cost, traceability, innovation and customer relationship as an evaluation indicator [1]. Fu bin Pan and Da Song (2014) established an index system from three aspects: the internal structure of the agricultural super-docking system, the external environment of the system and the operational effects of the system[2]. Xiao li Song and Huan huan Yang (2016) chose to evaluate the performance system in the Internet era according to six aspects of logistics, transportation, informationization, storage management and corporate capital, customer management and service capabilities [3]. Jiaxing Shi and Ruoying Sun (2015) from the fresh electricity supplier agricultural products cold chain logistics information, logistics operations, financial status, customer satisfaction and future development of enterprises and other indicators evaluate their performance [4]. Xiao Yue Huang (2016) takes the community O2O as the background, carries on the performance appraisal from the
fresh agricultural product logistics operation hardware, the quality, the flexibility level and the customer service quality, the use intention level several indexes [5].

According to the existing research, this paper analyzes the main participants and their needs and expectations in the logistics activities of fresh produce and based on the needs and expectations of multiple participants establish performance evaluation index system.

**Analysis of Participants' Needs and Expectations**

Based on the actual situation and many articles reviewed, this paper proposes that the main bodies include farmers, logistics participants and sales participants.

**Farmers’ needs and expectations**

The main needs and expectations of farmers are: (1) Farmer households hope to expand and stabilize sales channels a. (2) Farmer households also hope to obtain accurate market information. (3) Farmers households hope that logistics participants can provide fast and professional cold chain logistics services and real-time logistics dynamics. (4) Farmers households hope other participants can provide the appropriate technical support.

**Logistics participants' needs and expectations**

Logistics participants' needs and expectations of the main participants are: (1) Logistics participants hope that the government can improve the rural road network and have a good software information environment. (2) Logistics participants hope to keep clear communication information.

**Sales participants' needs and expectations**

Sales participants' needs and expectations are: (1) Sales participants hope to achieve higher customer satisfaction and customer repeat purchase rate. (2) Sales participants also hope that fresh produce can speed up circulation, reduce purchase volume and shorten their purchase cycle. (3) Sales participants want to be able to interface with other participants.

**Performance Evaluation Index System**

Based on the analysis of the needs and expectations of the participants and combined with the process of supply chain operation on fresh agricultural products logistics activities refinement, this paper has established a total of 10 three indicators and 24 four indicators.

**Performance evaluation index design principles**

Evaluation criteria design principles are as follows: (1) Scientific principle, performance evaluation index system should first of all be able to scientifically reflect the basic characteristics and operation rules of fresh agricultural product logistics operation mode. (2) Systematic principles, performance evaluation index should be as comprehensive as possible to reflect the overall situation of fresh agricultural products logistics operation mode. (3) Operability principle, in the selection of performance evaluation indicators, we need to fully take into account the data required for indicators to facilitate collection, collection of reliable channels.

**Performance evaluation index selection**

This paper set up the performance of fresh produce logistics activities as the target level. Then this paper combined the supply chain operation reference model to divide the business process, and set "logistics management level" and "information management level" as the guideline layer. At the same time, this article also fully considered the needs and expectations of all participants in the logistics activities of fresh agricultural products, and set the "cooperation status of both parties" and "future development potential" as the guideline layer. The specific performance evaluation index system is shown in Figure 1.
Performance Evaluation

In this paper, the analytic hierarchy process (AHP) and fuzzy comprehensive evaluation are used to evaluate the performance. The empirical research shows that the index system established is comprehensive and reasonable.

Data acquisition instructions

Xinfeng supermarket has 13 supermarket chains. In this paper, seven supermarket chains are selected, in which the demand for fresh produce in supermarket chains is relatively large, and the heads of their operations are surveyed. This paper uses yaahp V6.0 software to further process and analyze the data. Finally, this paper carries on the second questionnaire survey to the expert, and processes the result with the Excel software, draws the performance level of the new peak supermarket "farmer base + supermarket" mode of operation.

AHP - based index weight calculation

This paper first construct the comparison judgment matrix based on the hierarchical structure model. Then this paper ask seven operational supervisors to do the questionnaire according to the 1-9 judgment method to score the judgment matrix. Finally, this paper uses yaahp V6.0 software to get the consistency test results as shown in Table 1. If CI <0.1 in the result of consistency test, it indicates that the judgment matrix has a good consistency, otherwise, it indicates that the judgment matrix is not qualified and the judgment matrix needs further correction and adjustment.
Table 1. Consistency test results.

| Target level | Consistency check index CIA | Guidelines layer | Consistency check index CIB | Sub-criteria layer | Consistency check index CIC |
|--------------|----------------------------|----------------|-----------------------------|-------------------|-----------------------------|
| A            | 0.0574                     | B1 0.0943       | C1                          | 0.0000            |
|              |                             |                 | C2                          | 0.0825            |
|              |                             |                 | C3                          | 0.0000            |
|              |                             |                 | C4                          | 0.0516            |
|              |                             |                 | C5                          | 0.0176            |
|              |                             | B2 0.0000       | C6                          | 0.0516            |
|              |                             |                 | C7                          | 0.0370            |
|              |                             |                 | C8                          | 0.0707            |
|              |                             |                 | C9                          | 0.0176            |
|              |                             | B3 0.0000       | C10                         | 0.0516            |
|              |                             |                 | C11                         | 0.7500            |
|              |                             |                 | C12                         | 0.6370            |
|              |                             |                 | C13                         | 0.6144            |
| B4           | 0.0000                     |                 | D1                         | 0.6667            |
|              |                             |                 | D2                         | 0.3333            |
|              |                             |                 | D3                         | 0.2797            |
|              |                             |                 | D4                         | 0.6267            |
|              |                             |                 | D5                         | 0.0636            |
|              |                             |                 | D6                         | 0.5000            |
|              |                             |                 | D7                         | 0.5000            |
|              |                             |                 | D8                         | 0.1571            |
|              |                             |                 | D9                         | 0.5936            |
|              |                             |                 | D10                        | 0.2493            |
|              |                             |                 | D11                        | 0.6250            |
|              |                             |                 | D12                        | 0.2385-C3         |
|              |                             |                 |                             | 0.2176-C6         |
|              |                             |                 | D13                        | 0.1365-C3         |
|              |                             |                 |                             | 0.0606-C6         |
|              |                             |                 | D14                        | 0.0914            |
|              |                             |                 | D15                        | 0.6370-C7         |
|              |                             |                 |                             | 0.1172-C8         |
|              |                             |                 | D16                        | 0.1047            |
|              |                             |                 | D17                        | 0.2583-C7         |
|              |                             |                 |                             | 0.6144-C8         |
|              |                             |                 | D18                        | 0.2684            |
|              |                             |                 |                             | D19                |
|              |                             |                 |                             | D20                |
|              |                             |                 |                             | D21                |
|              |                             |                 |                             | D22                |
|              |                             |                 |                             | D23                |
|              |                             |                 |                             | D24                |

The consistency of each index in Table 1 shows that CI <0.1, indicating that the above judgment matrix has good consistency. The selection of indicators and the weights are acceptable.

Then, this paper uses yaahp V6.0 software to calculate the weight result of the influence degree of the lower level index to the upper level index in the performance evaluation index system, as shown in Table 2.

Table 2. The weight result of the influence degree of the lower level index to the upper level index.

| Target level | Guidelines layer | Sub-criteria layer | Indicator layer |
|--------------|-----------------|-------------------|----------------|
| A            | B1 (0.0943)     | C1 (0.5456)       | D1 (0.6667)    |
|              |                 | C2 (0.0860)       | D2 (0.3333)    |
|              |                 | C3 (0.0704)       | D3 (0.2797)    |
|              |                 | C4 (0.2979)       | D4 (0.6267)    |
|              |                 | C5 (0.5000)       | D5 (0.0636)    |
|              |                 | C6 (0.5000)       | D6 (0.5000)    |
|              |                 | C7 (0.5000)       | D7 (0.5000)    |
|              |                 | C8 (0.5000)       | D8 (0.1571)    |
|              |                 | C9 (0.5000)       | D9 (0.5936)    |
|              |                 | C10 (0.5000)      | D10 (0.2493)   |

Performance evaluation based on fuzzy comprehensive evaluation

Combining the weighting result of each index in the table 2 with the result of the second round of expert questionnaire, the performance of Xinfeng supermarket "farmer base + supermarket" is evaluated by fuzzy comprehensive evaluation. This paper invites seven operations supervisors and independently evaluate scores based on their professionalism and anonymously without any
interference from other experts. Scores were based on a 5-point scale (excellent, good, fair, poor and poor), and the 5-point scale was given specific values (90, 80, 70, 60, 50). The final total performance evaluation score is the score of the expert and the weight of the indicator. Fuzzy comprehensive evaluation of seven experts scoring fuzzy relationship matrix as shown in Table 3, in which the indicators at all levels with the code marked in Table 2.

Table 3. Fuzzy relation matrix of expert scoring.

| Target level | Guideline s layer | Sub-criteria layer | Indicator layer | Evaluation set |
|--------------|-------------------|--------------------|-----------------|----------------|
|              |                   |                    |                 | 90  | 80  | 70  | 60  | 50 |
| A            |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
| B1 W=0.2461  |                   |                    |                 | 0.00| 0.14| 0.57| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.57| 0.43| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
| B2 W=0.1464  |                   |                    |                 | 0.00| 0.29| 0.29| 0.43| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
| B3 W=0.1005  |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
| B4 W=0.5070  |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.00| 0.71| 0.29| 0.00|
|              |                   |                    |                 | 0.00| 0.43| 0.43| 0.14| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.29| 0.00| 0.00|
|              |                   |                    |                 | 0.00| 0.29| 0.57| 0.14| 0.00|

The specific algorithm is as follows: Single factorial evaluation of C1:

$$
C1 = (0.6667, 0.3333) \times \begin{bmatrix} 0.00 & 0.43 & 0.43 & 0.14 & 0.00 \\ 0.00 & 0.14 & 0.57 & 0.29 & 0.00 \end{bmatrix} = (0.0000, 0.3333, 0.4762, 0.1905, 0.0000)
$$

(1)

Empathy:

- C2 = (0.0000, 0.00237, 0.6347, 0.3080, 0.0000);
- C3 = (0.0000, 0.3571, 0.3571, 0.2857, 0.0000);
- C4 = (0.1560, 0.5265, 0.2950, 0.0224, 0.0000);
- C5 = (0.1786, 0.2750, 0.3247, 0.1217, 0.0000);
- C6 = (0.0000, 0.0795, 0.1621, 0.1280, 0.0000);
- C7 = (0.1187, 0.3376, 0.3618, 0.1820, 0.0000);
- C8 = (0.1755, 0.4502, 0.3408, 0.0335, 0.0000);
C9 = (0.0000, 0.0000, 0.3198, 0.4481, 0.2321);
C10 = (0.1153, 0.6943, 0.1903, 0.0000, 0.0000).

Single factor evaluation for B2:

\[
\text{B2} = \begin{bmatrix}
0.1786 & 0.3750 & 0.3247 & 0.1217 & 0.0000 \\
0.0000 & 0.0795 & 0.1621 & 0.1280 & 0.0000
\end{bmatrix} =
\begin{bmatrix}
0.0893 & 0.2273 & 0.2434 & 0.1249 & 0.0000
\end{bmatrix}
\]

Empathy:

B1 = (0.0465, 0.3662, 0.4274, 0.1572, 0.0000);
B3 = (0.1329, 0.3658, 0.3566, 0.1449, 0.0000);
B4 = (0.0577, 0.3472, 0.2551, 0.2241, 0.1161);

Calculation method principle Ibid, you can get the total goal A performance evaluation score:

\[
A = (0.0671, 0.3362, 0.3060, 0.1852, 0.0589)
\]

The performance evaluation results and the valuation of the 5-point scale Multiply sum can be obtained:

\[
90 \times 0.0671 + 80 \times 0.3362 + 70 \times 0.3060 + 60 \times 0.1852 + 50 \times 0.0589 = 68.41
\]

This shows that the new peak supermarket "farmer base + supermarket" model of performance level close to normal. Combined with the score of the evaluation set in the fuzzy relation matrix scored by experts in Table 3, it can be seen that Xinfeng supermarket has poor performance in terms of delivery cost, inventory loss rate, policy environment, relevant personnel training and infrastructure, and needs to be carried out the corresponding improvement, in order to improve the Xinfeng supermarket fresh produce "farmer base + supermarket" mode performance.

**Conclusion**

Through the study, this paper draws some conclusions. Firstly, this paper has established a total of 10 three indicators and 24 four indicators. The empirical research shows that the index system established is comprehensive and reasonable. Secondly, the performance of fresh agricultural products logistics activities is not only affected by the operation of the whole fresh agricultural products logistics supply chain, but also affected by the external environment. Finally, this paper use the small see the big way. The results show that the fresh agricultural products logistics activities there is still a big shortage. The government, society and all participating parties should pay enough attention, especially for the standards of service provided by each participating subject, the infrastructure of urban and rural areas, the introduction of related talents, the government's investment in technology and the preferential policies of taxation and other related policies concerns.

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