Research on Influencing Factors of Hema Fresh E-Commerce Logistics Service Quality Based on AHP and Fuzzy Comprehensive Evaluation

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Abstract. Due to the rapid development of the fresh food e-commerce industry, the problems of fresh food e-commerce logistics are also emerging. In order to effectively reduce the logistics service quality problem of fresh food e-commerce, this paper takes Hema fresh e-commerce as an example, determines the weight of each index through the analytic hierarchy process, and evaluates the development degree of each influencing factor based on the fuzzy comprehensive evaluation method. The results show that, in the operating environment of Hema Fresh e-commerce, the service awareness of employees has the most important impact on the quality of logistics services, and the development environment of Hema Fresh e-commerce has a good economic foundation. This research can provide a reference for fresh food e-commerce enterprises to improve service quality and logistics operation efficiency.

Keywords: Fresh e-commerce logistics · logistics service quality · influencing factors

1 Introduction

In recent years, with the rapid development of economy and society and the transformation of people's consumption patterns, the number of fresh food e-commerce has been expanding. Fresh food e-commerce refers to the direct sales of fresh products on the Internet by means of e-commerce. Fruits, vegetables, fresh meat, etc. Fresh food e-commerce develops with the general trend of e-commerce. 2012 is regarded as the first year for the development of fresh food e-commerce. The development of fresh food e-commerce in my country is full of twists and turns. When the industry entered a period of ebb, the outbreak of the epidemic in late 2019 made fresh food e-commerce usher in a "rebirth". During the Spring Festival epidemic prevention period, Hui Daojia and Walmart Daojia saw a surge in orders, and the market size exceeded 360 billion yuan. At the same time, the popularity of fresh food e-commerce in 2020 has once again attracted more capital to enter the market. At present, the fresh food e-commerce model is gradually diversified, and the average daily active number in 2020 will be more than 8 million. In the future, with the development of my country's cold chain logistics, the rise

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of the new retail e-commerce model, and the transformation of the young generation's thinking about purchasing fresh food e-commerce, the scale of my country's fresh food e-commerce market is expected to grow rapidly.

At the same time, the problem of fresh food e-commerce logistics service quality is becoming moreand more prominent. Due to the quality of logistics service, it is not uncommon for customers to complain and customer negative comments, which not only restricts the rapid development of the logistics industry, but also brings problems to the fresh food e-commerce industry. Development has brought serious obstacles. Therefore, studying the logistics service quality of the fresh food e-commerce industry has very important theoretical and practical significance for the logistics industry and the fresh food e-commerce industry. This paper studies the influencing factors of fresh food e-commerce logistics service quality based on AHP, in order to provide some theoretical support for fresh food e-commerce logistics service quality.

2 Model Construction of Influencing Factors of Fresh Food E-Commerce Logistics Service Quality

2.1 Analysis of Influencing Factors Based on Analytic Hierarchy Process

AHP is a practical multi-scheme or multi-objective decision-making method. It is a combination of qualitative and quantitative decision-making analysis methods. It is often used in multi-objective, multi-criteria, multi-factor and multi-level unstructured Complex decision-making problems, especially strategic decision-making problems, have a very wide range of practicability, and there are five specific steps:

(1) Establish a hierarchical structure model

The goal of decision-making, factors to be considered and decision-making objects are divided into the highest layer, the middle layer and the lowest layer according to their mutual relationship, and a hierarchical structure diagram is given. The highest level refers to the purpose of the decision, the problem to be solved. The bottom layer refers to the purpose of the decision maker and the problem to be solved. The bottom layer refers to the alternatives when making a decision. The middle layer refers to the factors considered and the criteria for decision-making.

(2) Constructing the judgment matrix

Comparing each factor in pairs, and evaluating the grades according to their importance, construct a judgment matrix.

(3) Hierarchical single ordering and its consistency check

The eigenvector of the largest eigenvalue of the judgment matrix is normalized and denoted as W, and the elements of W are the sorting weights of the relative importance of the same level of factors to a factor of the previous level. This process is called hierarchical sorting, and then consistency is required. If it passes the consistency test, the formula can be used to calculate the weight of each indicator; if it fails the test, the data needs to be adjusted to make it have satisfactory consistency.

(4) Hierarchical total ordering and consistency check

Consistency test should also be carried out on the overall ranking of the hierarchy. Although the single-level ranking has passed the consistency test, in the

Table 1. Hema Fresh Logistics Service Quality Influencing Factor Model

Target layer	Criterion layer	Indicator layer
Analysis of factors affecting the quality of fresh e-commerce logistics services A	Environmental factors B_1	Market price fluctuations of fresh agricultural products C_1
		Consumer Food Safety Awareness C_2
	economic factors B_2	Economic Basis C_3
		Logistics cost C_4
	Technical factor B_3	Logistics infrastructure C_5
		Service Network Technology C_6
	Human Factors B_4	Management's Quality Awareness C_7
		Employee's Service Awareness C_8

comprehensive inspection, the inconsistency of each level may still accumulate, causing serious inconsistency in the final analysis results.

On the basis of consulting a large number of relevant literatures, this paper refers to the research on factors affecting the quality of fresh food e-commerce logistics services by scholars, and conducts research from five dimensions: environmental factors, economic factors, technical factors, and human factors. There are two sub-dimensions of fresh agricultural product market price fluctuation and consumer food safety awareness. Economic factors include two sub-dimensions of economic base and logistics cost, technical factors include two sub-dimensions of logistics infrastructure and service network technology, and human factors include management's quality awareness and employees' service awareness [2].

First, establish a hierarchical structure model of influencing factors, as shown in Table 1:

Secondly, referring to relevant research knowledge and inviting 5 experts in fresh food e-commerce logistics to compare the two factors, score the importance, and construct the judgment matrix of factors at all levels.

Calculate the eigenvalues, eigenvectors and consistency test indicators of each judgment matrix Normalize the judgment matrix A by column (even if the sum of the column elements is 1):

$$b_{ij} = a_{ij} / \sum a_{ij} \tag{1}$$

Sum the normalized matrix by row:

$$c = \sum b_{ij} (i = 1, 2, 3...n) \tag{2}$$

$$\omega = (\omega_1, \omega_2, \omega_3)T \tag{3}$$

$$\omega_i = c_i / \sum c_i \tag{4}$$

Find the largest eigenvalue corresponding to the eigenvector.

We use the above method to calculate, we can get ω_1: 0.216824742, similarly ω_2: 0.557807918, ω_3: 0.160583239, ω_4: 0.064784101.

The obtained eigenvector ω is [0.230,0.648,0.122]T.

Consistency check:

In the actual evaluation, we will have some errors when constructing the judgment matrix, so that sometimes inconsistent mistakes will be made. For example, it has been judged that C_1 is more important than C_2, and C_2 is more important than C_3, then C_1 should be more important than C_3. It would be a logical error to judge that C_1 is more or equally important than C_3. This requires us to perform a consistency check.

For this, we need to calculate CI and CR, which have a calculation formula, which are only related to the largest eigenvalue and eigenvector, that is, the calculation result of our previous step. We use these two values to test the consistency. It is generally believed that when CI < 0.1 and CR < 0.1, the consistency of the judgment matrix is acceptable, otherwise the judgment matrix is rebuilt.

Looking at the average random consistency index of the same order, we know that CR $= 0.0774$. It can be seen from this that if CR < 1, the constructed judgment matrix has reliable consistency.

2.2 Analysis of Influencing Factors Based on Fuzzy Comprehensive Evaluation

Fuzzy comprehensive evaluation method is a comprehensive evaluation method based on fuzzy mathematics [3]. This comprehensive evaluation method transforms qualitative evaluation into quantitative evaluation according to the membership degree theory of fuzzy mathematics, that is, using fuzzy mathematics to make a general evaluation of things or objects restricted by many factors. Includes the following steps:

(1) Classification of factors

In order to facilitate the weight distribution and evaluation, the evaluation factors are divided into several categories according to their attributes.

(2) Establish a judgment set

It is a collection of comment grades composed of various total evaluation results that the evaluator may make to the evaluated object, and is generally divided into 3–5 grades.

(3) Establish a weight set

The weight reflects the importance of each factor, which will have a great impact on the evaluation results.

(4) Single-factor evaluation

The evaluation is carried out from one factor alone to determine the membership degree of the evaluation object set, which is called a single-factor fuzzy evaluation.

Table 2. Index System of Factors Influencing the Quality of Hema Fresh E-commerce Logistics Service

Target layer	Criterion layer	ω	Indicator layer	ω
Analysis of factors affecting the quality of fresh e-commerce logistics services A	Environmental factors B_1	0.216824742	Market price fluctuations of fresh agricultural products C_1	0.0625
			Consumer Food Safety Awareness C_2	0.1875
	economic factors B_2	0.557807918	Economic Basis C_3	0.166666667
			Logistics cost C_4	0.083333333
	Technical factor B_3	0.160583239	Logistics infrastructure C_5	0.125
			Service Network Technology C_6	0.125
	Human Factors B_4	0.064784101	Management's Quality Awareness C_7	0.0625
			Employee's Service Awareness C_8	0.1875

(5) Fuzzy comprehensive evaluation

The fuzzy comprehensive evaluation result vector of each evaluation object is obtained by synthesizing the fuzzy weight vector and the fuzzy relation matrix using a suitable fuzzy synthesis operator.

According to the previously listed Hema fresh e-commerce influencing factor model and the weight of each factor obtained by using the AHP method, the Table 2 can be drawn, as shown in Table 2.

The index system of the influencing factors of Hema Fresh e-commerce logistics service quality is shown in the Table 3, and then the comment level domain of the influencing factors of Hema Fresh e-commerce logistics service quality is determined. Set the comment level to 5, that is, $E = \{E_1,E_2,E_3,E_4,E_5\}$, which means E_1 is very good (very large), E_2 means good, E_3 means general, E_4 means poor (smaller), E_5 means that It is very poor (very small), and the comments represent the development of the factors affecting the e-commerce of Hema Fresh [4].

Quantify the evaluated objects from each factor one by one, and determine the membership degrees of the evaluated objects to each level of fuzzy subsets from the perspective of factors. As shown in the Table 3, 15 experts are selected for evaluation, and three membership degrees are reserved [5]. Decimal, and then get the fuzzy relation matrix.

Table 3. Evaluation of factors affecting logistics service quality and membership degree

Evaluation index			Comment grade					Comment grade membership degree					
Target layer	Criterion layer	Indicator layer	E_1	E_2	E_3	E_4	E_5	E_1	E_2	E_3	E_4	E_5	Sum≈
A	B_1	C_1	0	2	3	8	2	0	0.1	0.2	0.5	0.1	1
		C_2	3	2	8	2	0	0.2	0.1	0.5	0.1	0	1
	B_2	C_3	5	1	6	3	0	0.3	0.1	0.4	0.2	0	1
		C_4	4	5	5	1	0	0.3	0.3	0.3	0.1	0	1
	B_3	C_5	4	3	7	1	0	0.3	0.2	0.5	0.1	0	1
		C_6	2	5	6	2	0	0.1	0.3	0.4	0.1	0	1
	B_4	C_7	1	3	6	5	0	0.1	0.2	0.4	0.3	0	1
		C_8	1	2	8	4	0	0.1	0.1	0.5	0.3	0	1

Therefore, the fuzzy relation matrix can be obtained.

$$\tilde{R} = [a_{ij}]m \times n = m \times n \tag{5}$$

Among them, n represents the number of index systems, and m represents the number of evaluation levels. Represents the membership degree of each index i on each comment of j calculate $\omega_1 \times R_1$.

The results of using the software to calculate the weight of each indicator are shown as follow: c1 is 0.2121, c2 is 0.0707, c3 is 0.3267, c4 is 0.1634, c5 is 0.0755, c6 is 0.0755, c7 is 0.0571, c8 is 0.0190.

According to the calculation results of the analytic hierarchy process, it can be seen that among the secondary indicators of the influencing factors of Hema Fresh e-commerce logistics service quality, the environmental factor has the highest weight, which is 0.216824742, and the environmental factor is the most important compared with other factors. Among the three-level indicators of the factors affecting the logistics service quality of Hema Fresh E-commerce, consumers' food safety awareness and employees' service awareness are rated the highest at 0.1875, indicating that the 15 experts surveyed have a high opinion of Hema Fresh E-commerce employees. The evaluation of service awareness is relatively high, and Hema Fresh E-commerce is ideal for the management of employees' service awareness. Consumers' awareness of food safety is also increasing with the development of society. At the same time, the management awareness of Hema Fresh e-commerce management is not in place, and the price fluctuations in the fresh food market are still very large, and these factors will pose a threat to the quality of Hema Fresh e-commerce logistics services. The future management direction should also start from two aspects: strengthening managers' management awareness of employees and responding to market price fluctuations.

3 Conclusion

Based on the existing related research, this paper constructs a hierarchical index system of factors affecting the logistics service quality of Hema Fresh e-commerce through the analytic hierarchy process, and determines the weight of each influencing factor. The development degree of each influencing factor is studied by fuzzy comprehensive evaluation method. This research can provide a theoretical basis for fresh food e-commerce enterprises to improve the quality of logistics services, improve customer satisfaction and improve operational efficiency, but the accuracy and objectivity of this paper in the selection of indicators need to be further tested, and future research can focus on this direction to start with, in order to achieve a more in-depth study on the factors affecting the quality of fresh food e-commerce logistics services.

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