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Application Of Fuzzy Ahp on Transportation Mode Selection: The Case of Cut Flower Business

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ABSTRACT
The aim of this study, which was carried out in an enterprise exporting cut flowers, is to determine the criteria that are important in the selection of transportation types used by cut flower enterprises in international trade and to rank them according to their importance. For this purpose, face-to-face interviews were conducted with the personnel in charge of logistics of an enterprise operating in the cut flower sector and engaged in export activities. As a result of the data obtained from these interviews and detailed literature review, the criteria affecting the choice of transportation type of the enterprise were determined as speed, cost, reliability, traceability and flexibility and the officials compared these criteria in pairs according to their importance. The data obtained from the comparisons were analyzed with the Fuzzy Analytic Hierarchy Process (FAHP) method, one of the multi-criteria decision-making methods. As a result of the analysis, it was determined that the criteria with the highest level of importance for the cut flower business were speed and reliability, while cost and traceability had a medium level of importance and flexibility had a low level of importance.

Keywords: Logistics, Foreign Trade, Transportation, Fuzzy AHP, Cut Flowers.

1. INTRODUCTION

Today, as a result of the rapid development of international trade, the change in customer expectations has brought businesses to face different problems. One of the most important tools for businesses to offer their products to international markets is transportation activities. However, businesses have to take into account the characteristics of the product and the state of the market while carrying out transportation activities. In addition, each type of transportation has its own characteristics. Businesses have to consider these criteria when deciding on the type of transportation. This situation makes it difficult for businesses to decide on the type of transportation.

The study was conducted in an enterprise exporting cut flowers. The cut flower sector, which is handled within the scope of the study, has started to have significant effects on the economies of the country with the export volume and employment created in recent years. In parallel with the increasing importance of cut flowers on national economies, their international trade has also increased (Doldur, 2008, s. 27). However, since the life cycle of cut flowers is very short, it is very important that logistics activities are carried out effectively and transportation type selection is made correctly in order to preserve their freshness in the time period between harvesting and delivery to the market.

The aim of this study is to determine the criteria that an enterprise operating in the cut flower sector considers in the selection of the transportation type used in export activities and to determine the importance ranking of these criteria.

In the study, the data obtained as a result of face-to-face interviews with business officials operating in the cut flower sector and engaged in international trade were analyzed with the Fuzzy Analytic Hierarchy Process (AHP) method.

As a result of the literature review, it was determined that five matrices are generally used in Fuzzy AHP. For this reason, as a result of the data obtained within the scope of the study and the literature research, the factors affecting the choice of transportation type are grouped under five different headings: speed, cost, reliability, traceability and flexibility.

The criteria affecting the choice of carrier type of the enterprise were compared pairwise according to their importance levels by the company officials subject to the study. Fuzzy AHP method was applied to the data obtained as a result of pairwise comparisons and the impact ratios of the criteria were ranked according to their importance levels.

In the second part of the study, the importance of transportation mode selection for businesses is mentioned and information about the Fuzzy AHP method used in the study is presented. In addition, some of the studies in the literature where Fuzzy AHP method is applied in logistics and transportation activities are presented. In the third section, the methodology of the study is presented. In the fourth section, the Fuzzy AHP method is applied in the light of the data obtained and the findings obtained as a result of the analysis are presented. In the conclusion section, the findings are interpreted and recommendations are made.

2. CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

Transportation activities play an important role in the supply chain in the movement of products from the place of production to the end consumer. As a result of globalization, the world has become a common market for businesses. The extension of distances in international trade has increased the delivery times of the products and this situation has created different problems for businesses. These problems have led businesses to choose the most suitable type of transportation for them in order to gain competitive advantage in international trade. However, the fact that the degree of importance of features such as speed, cost, reliability, traceability and flexibility of transportation types varies according to businesses makes the choice of transportation type even more complex. For this reason, businesses must also take into account customer expectations, product and market characteristics when making transportation type selection decisions. In this respect, the choice of transportation mode is a critical decision for businesses. Decision making can be defined as determining the most appropriate one among different options by considering the problems that need to be solved at all levels of management with all dimensions (Toksarı and Toksarı, 2003, s. 51). Within the scope of the study, Fuzzy AHP method was used to rank the criteria affecting the transportation type preferences of an enterprise exporting cut flowers and to determine the order of importance of these criteria.

First developed by Thomas L. Saaty (1980), AHP (Analytic Hierarchy Process) is one of the multi-criteria decision-making methods and is used to rank and select appropriate alternatives among different alternatives using multiple criteria in decision making (Russell & Taylor, 2003, s. 86). In this approach, a hierarchy of criteria is first developed from general to specific or from uncontrollable to controllable. In traditional AHP, a nine-point criterion is used. As a result of pairwise comparisons of experts, their preferences among the available alternatives are scaled from 1 to 9 and converted into equal, moderate, important, very important or extremely important (Chan et al., 2008, s. 3830-3831). The pairwise comparisons are used to synthesize the local eigenvector of the matrices of each element of the hierarchy using the eigenvalue method. These matrices are reciprocal and positive. In addition, the matrices obtained show the relative priority of the option evaluated in a ratio scale relative to other options (Gül et al., 2018, s. 4672). Finally, the consistency ratio of the analyzes is calculated. If the analysis is consistent, the alternatives are ranked according to their importance and the decision is taken according to the alternative with the highest importance (Candan, 2019a, s. 279). Despite its simple implementation and widespread use, this method has been criticized for its inability to adequately deal with the uncertainties related to the transformation of decision makers' perception of the issue into precise numbers (Chan et al., 2008, s. 3830-3831).

Researchers have integrated fuzzy theory into traditional AHP in order to cope with the uncertainties experienced in traditional AHP and to improve the analysis results. Since fuzzy sets can better mimic human behavior, Fuzzy AHP has been widely used instead of traditional AHP (Moslem & Duleba, 2019, s. 2). Fuzzy AHP eliminates the uncertainty by transforming the verbal statements given by experts into fuzzy numbers according to the importance scale determined by Chang (1996) (Akyurt & Karadayı, 2020, s. 42). In this respect, Fuzzy AHP is very important for the decision-making processes of enterprises.

As a result of the detailed literature review, no study was found on the determination of the criteria affecting the selection of the transportation type of the cut flower exporting enterprises considered within the scope of the study. Some of the studies in the literature where Fuzzy AHP method is applied in logistics and transportation activities are listed below.

Akyurt and Karadayı (2020) conducted their study in order to make recommendations for the selection of cargo aircraft by Fuzzy Gray Relational Analysis method by weighting the selection criteria of the aircraft to be selected for airline cargo transportation with Fuzzy AHP method. As a result of the analyzes, they determined that the most suitable aircraft is B777F.

Kaewfak et al. (2019) aimed to effectively prioritize international logistics routes and improve their logistics performance. In this context, they analyzed possible routes based on transportation cost, time, risk and quality criteria with Fuzzy AHP and TOPSIS methods.

Jung et al. (2019) focused on the factors that shippers consider important when choosing a transportation mode and weighted the criteria determined by the Fuzzy AHP method. As a result of the study, they found that the most important criteria in transportation selection are reliability and convenience.

Peker at al. (2019) used Fuzzy AHP to weight the environmental innovation performance of logistics enterprises and Fuzzy VIKOR methods to rank them. As a result of the study, they determined that the two most important criteria of environmental logistics performance are green design and green energy.

Moslem and Duleba (2019) applied the Fuzzy AHP method to sustainable urban transportation development problems in Mersin province, taking into account the preferences of citizens. As a result, they found that traceability, openness and limited use time are the most important criteria.

Candan (2019b) evaluated the efficiency of eight OECD member countries in rail freight transportation. The criteria determined in this context were weighted with the Fuzzy AHP method and the ranking was made with the VIKOR method. As a result of the study, the most successful country was Poland and the least successful country was Slovakia.
Sirisawat and Kiatcharoenpol (2018) focused on the classification and elimination of barriers to reverse logistics activities in the electronics industry. Within the scope of the study, 29 barriers and 14 solutions were identified as a result of literature review and expert opinions, and Fuzzy AHP method was used to determine the weight of each barrier and TOPSIS method was used for ranking.
Gül et al. (2018) used the Fuzzy AHP method for the risk assessment of the routes of oil transportation companies in their study. In this context, they determined nine different criteria depending on the characteristics of the road used and determined that the most important criterion was the narrow road.
Wang et al. (2016) aimed to select the appropriate type of transportation for military logistics to Kinmen Island in Taiwan. Within the scope of the study, Fuzzy AHP method was used and as a result, they concluded that transportation activities carried out by military ships are more suitable than other types of transportation.
Tadić et al. (2015) used Fuzzy AHP and VIKOR methods to select the logistics system for the city. Within the scope of the study, they identified 9 criteria over three different logistics scenarios. While weighting these criteria with Fuzzy AHP, they ranked them with VIKOR method. As a result of the study, they determined that the most appropriate scenario is the second scenario.
Şengül et al. (2012) aimed to select the most suitable public transportation vehicles for municipalities with the Fuzzy AHP method. In this context, expert opinions were taken and pairwise comparisons were made and it was determined that the most suitable public transportation vehicle was 12-meter buses.
Ünver (2010) modeled the supplier selection problem of an enterprise in England by evaluating it with the Fuzzy AHP method. As a result of the study, he determined that the most suitable supplier for this enterprise is J&J company.
Çakır et al. (2009) conducted their study to bring a systematic approach to logistics service provider selection and as a result of their study, they proposed a Fuzzy AHP based logistics service provider selection decision support system.
Acer (2009) created a model with the Fuzzy AHP method for the warehouse location selection problem in and around Istanbul. As a result of the study, he determined that the most suitable warehouse location for Istanbul and its surroundings is Gebze and secondly Samandıra.
In their study, Chan et al. (2008) identified qualitative and quantitative decision factors and applied the Fuzzy AHP method to the data obtained in order to make global supplier selection effectively in today's business world. As a result of the research, they made the most appropriate global supplier selection with the renewed Fuzzy AHP method.
As a result of the literature review, studies generally focused on transport mode choice, public transport vehicle choice, city logistics system choice, logistics route choice, warehouse choice, performance efficiency measurement, logistics service provider and supplier choice.

3. METHOD

The data used within the scope of the study were obtained as a result of face-to-face interviews with the personnel responsible for logistics. Fuzzy AHP method was applied to the data obtained. In the Fuzzy AHP analysis, the comprehensive fuzzy analytical hierarchy process analysis method developed by Chang (1996) and the fuzzy number ranking method developed by Liou and Wang (1992) were used to rank the results obtained.

4. Application

As a result of face-to-face interviews and a detailed literature review, the criteria affecting the choice of transportation mode were grouped under five main headings: speed, cost, reliability, traceability and flexibility. After determining the criteria affecting the selection of the transportation type, these criteria were transferred to the five-point selection matrix. In face-to-face interviews, authorized personnel were asked to compare all the criteria determined in pairs and the data obtained were recorded in the transportation type selection matrix. Pairwise comparisons of the importance levels of the criteria determined in the light of the data obtained from the logistics officials of the enterprise are given in Table 1.

Table 1. Pairwise Comparison of Transportation Mode Selection Criteria

Criteria	Comparison Table									Criteria
Speed	9	7	**5**	3	1	3	5	7	9	Cost
Speed	9	7	5	**3**	1	3	5	7	9	Reliability
Speed	9	7	**5**	3	1	3	5	7	9	Traceability
Speed	9	**7**	5	3	1	3	5	7	9	Flexibility
Cost	9	7	5	3	1	3	**5**	7	9	Reliability

Cost	9	7	5	3	1	**3**	5	7	9	Traceability
Cost	9	7	5	**3**	1	3	5	7	9	Flexibility
Reliability	9	7	**5**	3	1	3	5	7	9	Traceability
Reliability	9	**7**	5	3	1	3	5	7	9	Flexibility
Traceability	9	7	5	**3**	1	3	5	7	9	Flexibility

The binary importance degrees of the criteria given in Table 1 should be converted into fuzzy numbers. While performing this transformation, the importance intensity scale given in Table 2 should be used.

Table 2. Importance Intensity Scale in Fuzzy Analytic Hierarchy Process

Relative Intensity of Importance	Expression of Intensity Of Importance with Fuzzy Numbers	Expression of Pairs of Intensity Of Importance with Fuzzy Numbers
Equal Importance	(1,1,1)	(1,1,1)
Threefold Important	(2/3, 1, 3/2)	(2/3, 1, 3/2)
Fivefold important	(3/2, 2, 5/2)	(2/5, ½, 2/3)
Sevenfold important	(5/2, 3, 7/2)	(2/7, 1/3, 2/5)
Ninefold important	(7/2, 4, 9/2)	(2/9, 1/4, 2/7)

The criteria compared with each other according to their importance levels in Table 1 were converted into fuzzy numbers using the importance intensity values in Table 2 and shown in Table 3.

Table 3. Expression of Impact Ratios in Fuzzy Numbers

	Speed	Cost	Reliability	Traceability	Flexibility
Speed	(1, 1, 1)	(3/2, 2, 5/2)	(2/3, 1, 3/2)	(3/2, 2, 5/2)	(5/2, 3, 7/2)
Cost	(2/5, ½, 2/3)	(1, 1, 1)	(2/5, ½, 2/3)	(2/3, 1, 3/2)	(2/3, 1, 3/2)
Reliability	(2/3, 1, 3/2)	(3/2, 2, 5/2)	(1, 1, 1)	(3/2, 2, 5/2)	(5/2, 3, 7/2)
Traceability	(2/5, ½, 2/3)	(2/3, 1, 3/2)	(2/5, ½, 2/3)	(1, 1, 1)	(2/3, 1, 3/2)
Flexibility	(2/7, 1/3, 2/5)	(2/3, 1, 3/2)	(2/7, 1/3, 2/5)	(2/3, 1, 3/2)	(1, 1, 1)

In this study, the Scope Analysis Method in Fuzzy AHP developed by Chang in 1996 was applied according to the following steps (Chang, 1996, s. 650-655). First, the fuzzy synthetic scope value (S_i) is calculated.

$$S_i = \sum_{j=1}^{m} M_{g_i}^{j} \otimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j} \right]^{-1} \tag{1}$$

The $\sum_{j=1}^{m} M_{g_i}^{j}$ value in Formula (1) is obtained by fuzzily summing the scope values (j=1,2,....m) in Formula (2) (Şengül et al., 2012, s. 151).

$$\sum_{j=1}^{m} M_{g_i}^{j} = \left(\sum_{j=1}^{m} l_j ,\quad \sum_{j=1}^{m} m_j ,\quad \sum_{j=1}^{m} u_j \right) \tag{2}$$

The value in Formula (2) is calculated by summing the values in the first (*l*), second (*m*) and third (*u*) rows of the values converted into fuzzy numbers according to the impact ratios in Table 3. For example, when the *l* values in the speed row are added, 1+3/2+2/3+3/2+3/2+5/2=7.167, when the *m* values are added, 1+2+1+2+3= 9, when the *u* values are added, 1+5/2+3/2+5/2+7/2=11.

$$\sum_{j=1}^{m} M_{g_t}^{j} = \begin{bmatrix} 7.167 & 9 & 11 \\ 3.133 & 4 & 5.333 \\ 7.167 & 9 & 11 \\ 3.133 & 4 & 5.333 \\ 2.905 & 3.667 & 4.8 \end{bmatrix}$$

To obtain the value of $\left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{g_i}^{j} \right]^{-1}$, the operations in Formula (3) should be applied.

$$\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}=\left(\sum_{i=1}^{n}l_i,\quad \sum_{i=1}^{n}m_i,\quad \sum_{i=1}^{n}u_i\right) \qquad (3)$$

To get the value of $\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}$, each column in the $\sum_{j=1}^{m}M_{g_i}^{j}$ matrix is summed.

$$\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_t}^{j} = (23.505 \quad 29.667 \quad 37.467)$$

The $\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}\right]^{-1}$ value is calculated using formula (4).

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}\right]^{-1}=\left(\frac{1}{\sum_{i=1}^{n}u_i},\quad \frac{1}{\sum_{i=1}^{n}m_i},\quad \frac{1}{\sum_{i=1}^{n}l_i}\right) \qquad (4)$$

To calculate $\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}\right]^{-1}$, each value in the $\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}$ matrix is divided by 1 and the inverse of the results is taken to obtain the following matrix.

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_t}^{j}\right]^{-1} = \left(\frac{1}{23.505} \quad \frac{1}{29.667} \quad \frac{1}{37.467}\right)^{-1} = (0.043 \quad 0.034 \quad 0.027)^{-1}$$

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_t}^{j}\right]^{-1} = (0.027 \quad 0.034 \quad 0.043)$$

Finally, to calculate S_i, the $\sum_{j=1}^{m}M_{g_i}^{j}$ and $\left[\sum_{i=1}^{n}\sum_{j=1}^{m}M_{g_i}^{j}\right]^{-1}$ values are multiplied as shown in Formula (1).

$$S_i = \begin{bmatrix} 7.17 & 9 & 11 \\ 3.13 & 4 & 5.33 \\ 7.17 & 9 & 11 \\ 3.13 & 4 & 5.33 \\ 2.90 & 3.67 & 4.8 \end{bmatrix} x \ (0.027 \quad 0.034 \quad 0.043)$$

$$S_i = \begin{bmatrix} 0.191 & 0.303 & 0.468 \\ 0.084 & 0.135 & 0.227 \\ 0.191 & 0.303 & 0.468 \\ 0.084 & 0.135 & 0.227 \\ 0.078 & 0.124 & 0.204 \end{bmatrix}$$

After calculating the S_i value, the obtained fuzzy numbers should be ranked. Although there are various ranking methods in the literature, the fuzzy numbers in this study are ranked according to the Liou and Wang method. In this method, fuzzy numbers are calculated according to the total integral method as shown in Formula (5) (Liou & Wang, 1992; Şengül et al., 2012, s. 153).

$$I_T^{\alpha}(S_i) = \frac{1}{2}[\alpha u + m + (1-\alpha)l] \qquad (5)$$

The α value used in Formula (5) is an optimism value in the closed interval (0-1). When α approaches zero, it represents a very pessimistic forecast, while when it approaches one, it represents a very optimistic forecast. Within the scope of the study, the α value is taken as 0.8. After the value calculation process, Liou and Wang method is used to rank the importance of the criteria. According to Liou and Wang method, Formula (5) will be used to rank the fuzzy numbers.

$$I_T^{\alpha}(S_i) = \frac{1}{2}\begin{bmatrix} (0.8x0.468 + 0.303 + 0.2x0.191) \\ (0.8x0.227 + 0.135 + 0.2x0.084) \\ (0.8x0.468 + 0.303 + 0.2x0.191) \\ (0.8x0.227 + 0.135 + 0.2x0.084) \\ (0.8x0.204 + 0.124 + 0.2x0.078) \end{bmatrix} = \begin{bmatrix} 0.358 \\ 0.167 \\ 0.358 \\ 0.167 \\ 0.151 \end{bmatrix}$$

When normalizing the matrix, each row of the $I_T^{\alpha}(S_i)$ matrix is divided by the sum of the rows and the weight vector ($W_{\text{Impact ratios}}$) of the I_T^{α} (S_i) matrix is obtained. The influence ratios of the criteria affecting the choice of transportation mode are given below.

$$W_{\text{Impact ratios}} = \begin{bmatrix} 0.358/1.2 \\ 0.167/1.2 \\ 0.358/1.2 \\ 0.167/1.2 \\ 0.151/1.2 \end{bmatrix} = \begin{bmatrix} 0.298 \\ 0.139 \\ 0.298 \\ 0.139 \\ 0.126 \end{bmatrix}$$

In order to prove the accuracy of the result obtained, a consistency check, which is a procedure of AHP, should be performed (Leung and Cao, 2000, s. 103). In order to determine the consistency of the data obtained as a result of the application, firstly, the fuzzified numbers should be clarified and then the consistency test should be calculated as in AHP. In this study, the consistency test developed by Kwong and Bai (2003) was used. For the stabilization process, the $(l+4m+u)/6$ operation is applied for each value in Table 3 and the following matrix is obtained.

$$\begin{bmatrix} 1 & 2 & 1.028 & 2 & 3 \\ 0.511 & 1 & 0.511 & 1.028 & 1.028 \\ 1.028 & 2 & 1 & 2 & 3 \\ 0.511 & 1.028 & 0.511 & 1 & 1.028 \\ 0.337 & 1.028 & 0.337 & 1.028 & 1 \end{bmatrix}$$

This matrix is obtained by multiplying the weight vector values of the defuzzified matrix and a new matrix is obtained.

$$\begin{bmatrix} 1 & 2 & 1.028 & 2 & 3 \\ 0.511 & 1 & 0.511 & 1.028 & 1.028 \\ 1.028 & 2 & 1 & 2 & 3 \\ 0.511 & 1.028 & 0.511 & 1 & 1.028 \\ 0.337 & 1.028 & 0.337 & 1.028 & 1 \end{bmatrix} \text{x} \begin{bmatrix} 0.298 \\ 0.139 \\ 0.298 \\ 0.139 \\ 0.126 \end{bmatrix} = \begin{bmatrix} 1.538 \\ 0.716 \\ 1.538 \\ 0.716 \\ 0.612 \end{bmatrix}$$

The consistency index (CI) is calculated according to the equation shown in Formula (6).

$$CI= \frac{\lambda_{max} - n}{n-1} \quad (6)$$

The λ_{max} max value is calculated using the equation in Formula (7).

$$\lambda_{\max} = \frac{1}{n}\sum_{i=1}^{n}\frac{(AW)_i}{w_i} \quad (7)$$

The $\lambda_{\max}$ value is calculated below:

$$\begin{bmatrix} 1.538/0.298 \\ 0.716/0.139 \\ 1.538/0.298 \\ 0.716/0.139 \\ 0.612/0.126 \end{bmatrix} = \begin{bmatrix} 5.156 \\ 5.159 \\ 5.156 \\ 5.159 \\ 4.857 \end{bmatrix}$$

λ_{max}= (5.156+5.159+5.156+5.159+4.857)/6= 5.097

The CI value is calculated using the equation in Formula (6).

CI= (5.097-5) / (5-1)= 0.024

Finally, the consistency index (CI) is divided by the value given by the number of criteria in the consistency table developed by Saaty (1980) and shown in Table 4.

Table 4: Consistency Table

N	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
RI	0	0	0.58	0.90	**1.12**	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Since the number of criteria used in the study is five, the RI value is taken as 1.12 according to the table. The consistency ratio of the study is calculated using Formula (8).

$$CR= \frac{CI}{RI} \quad (8)$$

CR= 0.024/ 1.12 = 0.022

Since the Consistency Ratio (CR) is less than 0.1, it is concluded that the matrix is consistent.

As a result, after the application and the consistency control of the study, the impact ratios and importance levels of the criteria that are effective in the selection of the transportation type of the enterprises engaged in cut flower trade are shown in Table 5.

Table 5. Impact Ratios and Importance Ranks of Criteria in Transportation Mode Selection

Criteria	Impact Rate	Degree of Importance
Speed	0.298	High
Cost	0.139	Medium
Reliability	0.298	High
Traceability	0.139	Medium
Flexibility	0.126	Low

When Table 6 is examined; according to the logistics officials working in the enterprise, speed and traceability have a high degree of importance among the criteria affecting the choice of transportation type of the enterprise. Cost and traceability are of medium importance, while flexibility is of low importance.

5. CONCLUSION

In the study, the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) method was applied to determine the criteria affecting the choice of transportation type of the enterprise, taking into account the data obtained through face-to-face interviews with the logistics unit officials working in an exporting enterprise operating in the cut flower sector.

As a result of detailed literature research and interviews with business officials, the criteria affecting the choice of transportation type in the enterprise are grouped under five main headings: speed, cost, reliability, traceability and flexibility. Within the scope of the study, the opinions of the logistics officials of the enterprise were taken and the impact ratios of the criteria affecting the transportation type selection of the enterprise were determined and the Fuzzy AHP method was applied to the data obtained. In the application of the Fuzzy AHP method; Chang's (1996) comprehensive fuzzy analytic hierarchy process analysis method and Liou and Wang's (1992) fuzzy number ranking method were used. As a result of the Fuzzy AHP application, the criteria affecting the selection of the transportation type of the enterprise were transformed into the selection matrix and the impact ratios and importance levels of the criteria were determined as a result of the calculations made.

As a result of analyzing the data obtained from the logistics unit officials in the study with the Fuzzy AHP method, it was determined that the most important criteria affecting the choice of transportation type in this enterprise operating in the cut flower sector are speed and reliability with the same degree of importance. It is thought that the reason for this result is that the life cycle of harvested cut flowers is very short and they need appropriate storage, maintenance and transportation conditions while being delivered to the target market. Cost and traceability criteria are of medium importance for the enterprise. While cost and traceability are the most important criteria in the selection of transportation type for enterprises operating in different sectors, they are of medium importance for enterprises operating in the cut flower sector due to product and market characteristics. Flexibility, on the other hand, has a low level of importance among the criteria affecting the choice of transportation type of the enterprise. The reason for the low level of importance of the flexibility criterion is that it is not appropriate to transfer cut flowers between different modes of transportation due to their product characteristics. As a result of the study, this enterprise should primarily consider the speed and reliability criteria of the transportation type while determining the transportation type in international trade, and should not ignore the cost and traceability criteria.

The importance levels of the criteria affecting the transportation type used in this study may vary for different sectors. For this reason, the criteria affecting the choice of transportation type for different enterprises should be determined and the importance levels of these criteria should be determined specifically for each enterprise as a result of the analyzes to be made.

In addition, it is thought that the application of the Fuzzy AHP method in the fields of logistics and transportation will reveal positive results for businesses in decision-making processes since it enables the qualitative data obtained as a result of face-to-face interviews to be analyzed by transforming quantitative data.

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