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Research Article

EVALUATION OF LOCATION SELECTION PROCESS OF LOGISTICS VILLAGES USING ANALYTIC HIERARCHY PROCESS AND ELECTRE METHODS: A CASE STUDY FOR TURKEY

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ABSTRACT

The need for logistics has been one of the biggest issues to be resolved for all settlements in all eras of humanity. Infrastructure problems are likely to occur over time in cities that have grown more than expected. It is accepted all over the world today that the solution of the logistics problem in such settlements is to improve the infrastructure and balance the transportation demand between different modes of transportation and to establish special centers where integrated activities will be carried out. Choosing the location of these logistics centers by decision makers raises a "prioritized" cost problem. A subject became widespread in the last decade in Turkey has been selected. The current situation of the logistic villages has been evaluated and a construction ranking has been obtained.This study constituted a verification for the state-ordered construction sequence. It is believed that simple and understandable construction needs can guide decision makers in the logistics village study area.
Keywords: Urban planning, logistics, urban freight transport, logistics village, Multi-Criteria Decision-Making (MCDM), sustainability.

1. INTRODUCTION

It is very likely that various infrastructure problems will arise in cities that are rapidly becoming over-grown, with population saturation. One of the most important of these problems is that the road network will be inadequate to meet the increasing demand for traffic over time. Highway transportation is one of the most frequently used transportation types within the logistics industry. Since the 1970s, in Europe, the logistics industry has attempted to reduce the amount of traffic that it causes in the road network. Thus, the aim is to develop a logistics industry infrastructure which balances the transport demands between different modes of transport and to set up special centers where logistics activities are integrated. Thus, a sustainable freight transportation infrastructure will be established by reducing the harmful effects of road traffic on the environment. These special centers, which are widely known as 'Logistics Villages', have been established in our country since 2006 and TCDD (Turkish State Railways) is carrying out establishment / operation studies with respect to distributing the freight in equilibrium. Within the

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scope of this study, general information about logistics villages is given and it is aimed to rank the logistics villages in Turkey that are either already established or in the planning / establishment stage, in terms of construction preference. In order to be able to achieve this ranking, firstly, 5 criteria and 26 sub-criteria, which are effective in choosing the location of the villages, were determined, and a questionnaire was prepared. Using the Analytic Hierarchy Process (AHP), which is used in various disciplines including the field of logistics, the criterion weights of a 17-person group of experts from the public sector, private sector and academicians were selected. Expert Choice program was used for these weights (and to control Microsoft Excel), and the importance of these criteria were determined by analysis in Microsoft Excel program using ELECTRE I method which is a decision making method based which sorts the logistics villages according to the given criteria. In the light of this ranking, some evaluations and suggestions are made in order to assist decision makers and contribute to the literature on logistics villages which exist or are in the process of construction. Policy followed about logistics villages in Turkey is not so wide a field study investigating. This is a way to 'pre-feasibility development' could be perceived as a method of study is very comprehensive and a special case study for Turkey and is expected to provide guidance to decision makers.

2. LITERATURE REVIEW

The most problem-prone aspect in cities for logistics activities is transportation with three critical areas: firstly, traffic problems followed by emission problems and then rising costs. Time wasted and the loss of work caused by traffic congestion have forced experts to focus on solving these traffic problems and, as a result, various studies have been done in the field of logistics [1, 2].

Another important reason for seeking solutions to logistics problems is the problem of land use brought about by the development and growth of cities. For example, land availability in growth areas such as Hamburg is limited. For this reason, the establishment of new logistics zones has taken place beyond the city area. This causes the land to be used ineffectively and creates new traffic congestion. In order to improve urban and regional planning, the Turkey's new logistic features and land-use efficiency were investigated by means of traffic models and it was observed that logistic site selection was effective in reducing traffic congestion [3, 4].

According to a study in France [5], while freight transportation within the city accounts for 20% to 30% of vehicle mobility, its environmental impacts account for 16% to 50% of air pollution emissions. For medium-sized cities, transportation activities are disconnected and there is no 'conveniently close' terminal used by the transporters. Transport services are provided at terminals from 80 to 150 kilometers away from the city center [5].

Therefore, studies indicate the importance of the distance of urban distribution centers to urban centers. The increase in the need for urban freight transport in recent years has affected the livability and environmental factors in urban areas. As a natural these circumstances, local authorities implied congestion prising, time constraints and target delivery areas. The problem of freight transport brings logistics operators new challenges which can be addressed in two ways: minimum cost and maximum efficiency. Firstly, as urban distribution centers get closer to the city center, traffic congestion in the city center increases. However, as distribution centers move away from their customers, operators are exposed to very high transport costs [6, 7]. This contradiction highlights the problem of choosing a location with minimum cost and maximum efficiency for urban freight distribution centers [8]. The choice of location should be handled according to critical criteria which include accessibility, security, the existence of multiple transport links, cost, environmental impacts, proximity to suppliers and customers, availability of resources, compliance with sustainable transport rules, capacity for expansion, and service quality [9].

As the number of criteria taken into consideration increases, the 'decision making' process requires an analytical process rather than a simple solution. The analytical decision-making

process is then under investigation under the heading 'multi-criteria decision-making'. Multi-criteria decision making methods are a combination of many disciplines that allow decision makers to evaluate the problem in all its dimensions.

There are many studies in the literature that use multi-criteria decision making methods for the location selection problem of logistic villages. Pham, Ma and Yeo (2017) combined Delphi and Topsis methods for a logistics center site selection problem in China. They pointed out that freight demand, market proximity, production area, customer and transportation costs affect the selection process [10]. Zhang, Zhang, Li, Liu and Yang (2017) used the intuitive FTOPSIS method to choose the most suitable logistics center in a rural area [11]. Agrebi, Abed and Omri (2017) have made a ranking with the ELECTRE method, using 6 criteria for security, the presence of multimodal transport connections, proximity to consumer, proximity to the provider, costs, and sustainable freight transport regulations for 3 alternatives [12]. Pramanik, Dalapati and Ray (2018) conducted a logistic village site selection study using a single value neutrosophic (A general form of logic where each proposition takes separate values for accuracy, inaccuracy and uncertainty) decision tool to find the most suitable location based on 6 criteria (cost, distance to provider, distance to customer, government regulations, quality of service and environmental impacts) [13]. Li, Yang and Liu (2019) have developed a data envelopment model for the efficiency assessment of the industrial area of Wuhan province [14]. Yazdani, Chatterjee, Pamucar and Chakraborty (2020) aimed to develop a two-stage decision-making model to find the most preferred region for the establishment of logistics centers in the autonomous communities of Spain. In the first stage, the communities considered are compared against five evaluation criteria (GDP per capita, surface area, export % GDP, debt, unemployment rate) using data envelopment analysis (DEA) to identify efficient and inadequate alternatives. In the second stage, a model was designed to evaluate the performance of productive communities using full community (R FUCOM) and unified compromise solution (R CoCoSo) methods [15]. The AHP and ELECTRE I methods used within this study are multi-criteria decision making methods that are frequently used in the literature [16]. Danisment and Kose (2020) used AHP and ELECTRE methods in the solution of the filling material selection problem for mattress production in the furniture industry, they weighted with AHP for 4 main criteria and selected the most suitable filling material with ELECTRE [17]. Żak ve Kruszyński (2015) used operational, tactical and strategic three class criteria, using AHP and ELECTRE III methods integrated to make multi-criteria evaluations of 18 urban transportation projects. As a result of the study, it is concluded that the combination of ELECTRE III and AHP methods are user-friendly and reliable methods. When it comes to practical findings, it has been suggested that the proposed methodology can be used to create city budget and city investment plans, giving priority to project implementation in relation to strategic, tactical and operational goals [18]. Akmaludin et al. (2020) concluded that the use of the Analytical Hierarchy Process (AHP) and the ELECTRE Elimination method in the selection of the best programmers may be a decision support in the selection process [19]. Erdogan, Altinirmak and Karamasa (2016) compared multi-criteria decision making methods with each other in a performance research they conducted for food companies and showed that they gave close results. The selection of AHP and ELECTRE within the scope of the our study is that they are complementary processes, AHP output is input for ELECTRE, data is suitable for this use and they are easy methods to apply [20].

3. DESCRIPTIVE STATISTICS

Table 3.1. Descriptive statistics for experts who answered the questions

Data Characteristics / # of Expert	*Age*	*Gender*	*Education Level and Discipline*	*Type/Place of Interview*	*Experience*
Expert 1	68	Male	Phd (Logistic Manegement)	via internet	+ 40 years- Private Sector
Expert 2	38	Male	Phd (Business)	via internet	+ 10 years- Private Sector
Expert 3	40	Female	Msc (Logistics)	via internet	+ 15 years- Private Sector
Expert 4	43	Male	Phd (Transportation)	via internet	+ 20 years-Academic
Expert 5	55	Male	Phd (Transportation)	via internet	+ 30 years-Academic
Expert 6	57	Male	Phd (Transportation)	Face to Face	+ 30years-Academic
Expert 7	47	Male	Phd (Transportation)	Face to Face	+ 20 years-Academic
Expert 8	66	Male	Phd (Mechanical Engineering)	via internet	+ 40 years-Academic
Expert 9	50	Male	Phd (Transportation)	Face to Face	+ 25 years-Academic
Expert 10	44	Female	Phd (Urban Planner)	via internet	+ 20 years-Academic
Expert 11	30	Male	Msc (Transportation)	Face to Face	+ 5 years-Academic
Expert 12	45	Male	B.P.E.S.S. (Political Science)	via internet	+ 20 years- Private Sector
Expert 13	44	Female	Phd (Transportation)	via internet	+ 20 years-Academic
Expert 14	38	Female	Msc (Logistics)	via internet	+ 15 years- Private Sector
Expert 15	41	Male	Phd (Transportation)	via internet	+ 15 years-Academic
Expert 16	56	Male	Pdh (Maritime Transport Management Engineering)	via internet	+ 30 years -Public Sector
Expert 17	52	Male	Phd (Transportation)	Face to Face	+ 25 years-Academic

The demographic characteristics of the expert group to which the surveys were applied are given in the Table 3.1. The surveys were conducted on 17 experts, men and women who working in logistics and transportation. The method of the questionnaires and experts' experiences in the sector are given in the Table 3.1.

4. METHODOLOGY

The AHP method is a convenient method for solving large-scale problems. It is also very easy to implement, and preparation of a detailed survey is sufficient for AHP implementation. The process is simple because the combined results obtained with a large number of surveys are done by taking geometric averages. The ELECTRE is a decision-making method that requires provision of the criterial weights from the outside. In this aspect, the AHP and ELECTRE methods complement each other [21, 22].

Location of logistic villages which intended to be established in Turkey can be seen in Figure 4.1. Within the scope of the study, 5 criteria and 26 sub-criteria were used. Firstly, some examples were evaluated for determination of the criteria which are suitable for selection of the location of the logistics villages. The Gray Relational Analysis method was used as the method of decision making in a study for the Black Sea Region and similar sub-criteria were selected in the location

selection [23]. A study of the choice of port location using the more advanced model Fuzzy AHP technique has also shown that similar sub-criteria are generally used for location selection [24].

Figure 4.1. Locations of logistic villages which intended to be established

The criteria for the study are based on the accepted criteria used for the logistics villages in Europe as well as on the degree of applicability in Turkey. The criteria used for the AHP method and the sources which were selected for these criteria are shown in Table 4.1.

Table 4.1. Criteria, sub-criteria and sources

CRITERIA	SUB CRITERIA	SOURCE
DEMAND	Capacity	General Directorate of Turkish State Railways
	Area	General Directorate of Turkish State Railways
	Growth Rate of City	Turkish Statistical Institute (2014)
	Number of Companies with International Capital	Ministry Of Development https://osbbs.sanayi.gov.tr/default.aspx (access 10.08.2017)
	Number of Free Zones	Ministry of Economy https://www.ekonomi.gov.tr access 10.08.2017
	Import Amount	Turkish Statistical Institute (2016)
	Export Amount	Turkish Statistical Institute (2016)
SOCIAL AND INFRASTRUCTURAL FACILITIES	Safety	TSI Indicator Values of Life Index in Cities, 2015
	Network Water and Sewage Access Ratio	TSI Indicator Values of Life Index in Cities, 2015
	Number of Registered Light Trucks and Trucks in the City	TSI, Number of vehicles for cities 2016.
	Organized Industrial Zone Number	Ministry Of Development https://osbbs.sanayi.gov.tr/default.aspx (access 10.08.2017)
	Satisfaction Rate of Public Transportation Services	TSI Indicator Values of Life Index in Cities, 2015
COST	Land and Land Metering Unit Values	President of Revenue Management- http://www.gib.gov.tr/yardim-ve-kaynaklar/yayinlar/arsa-ve-arazi-asgari-metrekare-birim-degerleri access:20.07.2017)

COST	Housing Price Index Change	The Central Bank of the Republic of Turkey Housing Price Index Change, 2016 April 2016-April 2017
	Employment Rate	TSI Indicator Values of Life Index in Cities, 2015
ENVIRONMENT	Distance to the Nearest Stream (km)	atlas.gov.tr
	Distance to Living Faults	General Directorate of Mineral Research and Exploration http://yerbilimleri.mta.gov.tr/anasayfa.aspx
	Land Cover/Flora	atlas.gov.tr
LOCATION	Distance to the Nearest Airport (km)	General Directorate of Turkish State Railways
	Distance to the Nearest Railway (km)	General Directorate of Turkish State Railways
	Distance to the Nearest Port (km)	General Directorate of Turkish State Railways
	Distance to the Nearest Organized Industrial Zone (km)	General Directorate of Turkish State Railways
	State Route Access Distance (km)	General Directorate of Turkish State Railways
	Capacity of the Nearest Airport (Carried Freight-Tonne)	Turkish Statistical Institute (2015)
	Provincial and State Road Lengths in Provincial Boundaries	Turkish Statistical Institute (2013)
	Railway Length in Provincial Boundaries	Turkish Statistical Institute (2013)

5. EVALUATION AND RESULTS

In the study, a questionnaire was applied to a group of 17 experts composed of public and private sector members and academicians. For questionnaires that seek expert opinion, 17 is a sufficient number, so the smoothest 17 questionnare results were used. Responses given by this expert group were initially processed as data with Microsoft Excel and then Expert Choice Educational Version. A small number of inconsistent responses were combined in accordance with the rule from the Expert Choice Inconsistency tab, using the geometric mean [16] of the criteria weights found in the 17 different surveys. Subsequently, the weights of importance for each criterion were found according to the values normalized to 1 (representing 100%). These significance weights are shown in Table 5.1.

Table 5.1. Criteria, sub-criteria and significance weights

CRITERIA	WEIGHT	SUB-CRITERIA	WEIGHT
DEMAND	0.196	Capacity	0.034
		Area	0.038
		Growth Rate of City	0.023
		Number of Companies with International Capital	0.017
		Number of Free Zones	0.017
		Import Amount	0.031
		Export Amount	0.035
SOCIAL AND INFRASTRUCTURAL FACILITIES	0.101	Safety	0.019
		Network Water and Sewage Access Ratio	0.018
		Number of Registered Light Trucks and Trucks in the City	0.011
		Organized Industrial Zone Number	0.033
		Satisfaction Rate of Public Transportation Services	0.021
COST	0.311	Land and Land Metering Unit Values	0.175
		Housing Price Index Change	0.098
		Employment Rate	0.039
ENVIRONMENT	0.193	Distance to the Nearest Stream (km)	0.044
		Distance to Living Faults	0.083
		Land Cover/Flora	0.066
LOCATION	0.199	Distance to the Nearest Airport (km)	0.008
		Distance to the Nearest Railway (km)	0.042
		Distance to the Nearest Port (km)	0.037
		Distance to the Nearest Organized Industrial Zone (km)	0.030
		State Route Access Distance (km)	0.042
		Capacity of the Nearest Airport (Carried Freight-Tonne)	0.014
		Provincial and State Road Lengths in Provincial Boundaries	0.013
		Railway Length in Provincial Boundaries	0.012
TOTAL	Σ=1.000	TOTAL	Σ=1.000

6. SENSITIVITY ANALYSIS

After the integrated application of AHP and ELECTRE methods, a sensitivity analysis study was conducted for the cases where the cost and demand were doubled separately. Sensitivity analysis was carried out again on the Expert Choice software, by changing the AHP weights. The results obtained are given in the Table 6.1. Looking at the results obtained here, it is seen that Izmit preserves its rank even if the importance of cost or demand doubles. This situation shows

that Izmit is indispensable in terms of logistics. For Eskişehir and Denizli, it is seen that the rankings rise when the importance of cost doubles, and the rankings decline when the importance of demand doubles. The reason of this situation is that the land costs are lower compared to other alternatives and the area and capacity variables play a very active role in the rankings. When İzmir is examined, a different situation comes to the fore. The doubling of the importance of the demand does not sufficiently reduce the cost. For this reason, the doubling of the importance of demand in İzmir, where the cost of land is high, decreases the ranking considerably. It is possible for İzmir to rise to the third rank as the doubling of the cost decreases the importance of the demand by almost half. Sivas, Mardin and Bitlis preserved their place in the last three in any case. There were no major leaps or dramatic declines for Bilecik, Erzurum, Kahramanmaraş and Balıkesir. Kayseri has reached the 2nd place when the importance of the demand doubles due to its large area and capacity values. There is a similar situation for Konya. İstanbul Halkalı ranks 4th when the importance of cost doubles, and maintains its ranking when the importance of demand doubles. This situation reveals that Halkalı, which is known to have a small rear area (hub), is not ready to meet a new demand and this situation coincides with the reality. It is interesting that in case of doubling the importance of demand in Yeşilbayır, Istanbul, its rank will decrease despite the huge area, capacity, import and export values. It is noteworthy that if the cost importance doubles, it does not make a big leap. Mersin ranking has not changed in any case. When the importance of the cost doubled, Uşak fell from the 5th to the 6th place, as land costs are relatively higher than Denizli and Eskişehir. When the importance of the demand doubled, it fell to 8th place due to its limited capacity and area, low growth rate and low import-export ratios. When the importance of cost doubled, Samsun moved from the 7th to the 6th place. When the importance of the demand doubled, it rose to 5th place. While the land prices are not considered very low, the relatively high capacity value for the area may have been effective in this leap. Kars ranked 4th when the importance of cost doubled, and fell to 12th when the importance of demand doubled. This is expected when looking at the low area, capacity, import and export figures.

Table 6.1. Sensitivity Analysis Results

City	Logistic Village	Rankings Found by Calculations	Rankings Found When Costs Doubles	Rankings Found When Demand Doubles
İZMİT	KÖSEKÖY	1	1	1
ESKİŞEHİR	HASANBEY	2	1	4
DENİZLİ	KAKLIK	3	2	5
KAYSERİ	BOĞAZKÖPRÜ	3	5	2
KONYA	KAYACIK	3	7	3
İZMİR	KEMALPAŞA	4	3	10
UŞAK	UŞAK	5	6	8
İSTANBUL	YEŞİLBAYIR	5	4	9
ERZURUM	PALANDÖKEN	6	4	8
MERSİN	YENİCE	6	6	6
İSTANBUL	HALKALI	6	4	6
SAMSUN	GELEMEN	7	6	5
BALIKESİR	GÖKKÖY	8	8	7
BİLECİK	BOZÜYÜK	8	7	7
KAHRAMANMARAŞ	TÜRKOĞLU	9	7	8
KARS	KARS	9	4	12
SİVAS	SİVAS	10	9	10
MARDİN	MARDİN	11	10	11
BİTLİS	RAHOVA	11	10	12

7. CONCLUSIONS

Within the study, the ELECTRE steps which are widely applied in multi-criteria decision making problems [16, 25], were applied and a ranking undertaken. In order to quantify the land cover conditions from the sub-criteria used in the study, a group of four academicians ranked them from 1 to 7, where (1) is the best case and (7) is the worst case, as reported in Table 7.1. (This process was carried out in order to put the land cover sub-criterion, which is a qualitative feature, into a quantitative ranking.) This already obvious ranking was made simultaneously in different locations, according to the fertility status of the land, and all four experts made the same ranking as expected. The scoring for this ranking is given in Table 7.1. The flow chart of the ELECTRE method is shown in Figure 7.1. This flowchart shows the steps of the ELECTRE process gradually and simply.

Table 7.1. Land cover and point value in the region in which the logistics center is established

City	Logistic Village	Land Cover	Point
İSTANBUL	HALKALI	Continuous city structure adjacent to non-irrigated arable lands	3
İZMİT	KÖSEKÖY	Industrial and commercial units adjacent to discrete city structure	2
ESKİŞEHİR	HASANBEY	Industrial and commercial units adjacent to non-irrigated arable lands	2
BALIKESİR	GÖKKÖY	Non-irrigated arable lands	6
UŞAK	UŞAK	Discrete city structure	1
DENİZLİ	KAKLIK	Non-irrigated arable land and discrete city structure fusion	1
SAMSUN	GELEMEN	Industrial and commercial units	2
BİLECİK	BOZÜYÜK	Non-irrigated arable land	6
ERZURUM	PALANDÖKEN	Continuously irrigated arable lands /industrial and commercial units fusion	2
MERSİN	YENİCE	Industrial and commercial units	2
KAHRAMANMARAŞ	TÜRKOĞLU	Discrete city structure adjacent to continuously irrigated arable lands	1
İZMİR	KEMALPAŞA	Mixed agricultural areas - industrial and commercial units intersection	2
KONYA	KAYACIK	Grassland, plant change areas, fruit gardens, irrigated arable fields, discrete city structure	5
KARS	KARS	Grasslands surrounded by non-irrigated arable lands	5
KAYSERİ	BOĞAZKÖPRÜ	Mixed agricultural areas, non-irrigated arable areas, natural meadow fusion	4
İSTANBUL	YEŞİLBAYIR	Non- irrigated arable lands /industrial and commercial units fusion	2
SİVAS	SİVAS	Mixed agricultural areas, non- irrigated arable land, scarce plant areas	4
MARDİN	MARDİN	Continuously irrigated areas	7
BİTLİS	RAHOVA	Non-irrigated arable lands	6

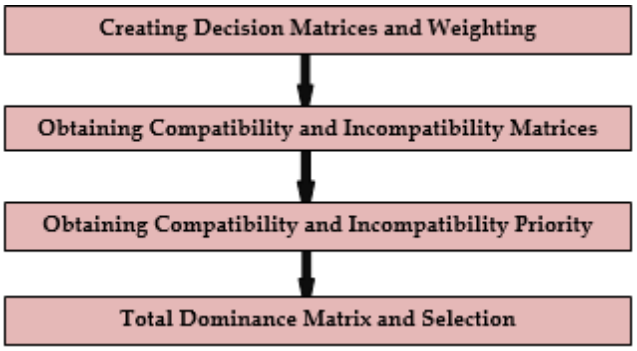

Figure 7.1. ELECTRE method flow chart

As a result of the evaluation, İzmit (Köseköy) stands out as having the most dominant features compared to the other 18 logistics villages. Eskisehir (Hasanbey) is in second place and the third place is shared by the Denizli (Kaklık), Konya (Kayacık) and Kayseri (Boğazköprü) logistics villages. İzmir (Kemalpaşa) is in fourth place and İstanbul (Yeşilbayır) and Uşak are in fifth place. The final rankings and logistics village operational status according to TCDD are given in Table 7.2.

Table 7.2. The final ranking of ELECTRE method and logistics villages operational status

City	Logistic Village	Final Ranking	Logistics Villages Operational Status according to TCDD
İZMİT	KÖSEKÖY	1	Open to Service
ESKİŞEHİR	HASANBEY	2	Open to Service
DENİZLİ	KAKLIK	3	Open to Service
KAYSERİ	BOĞAZKÖPRÜ	3	Projecting and Expropriation Phase
KONYA	KAYACIK	3	Projecting and Expropriation Phase
İZMİR	KEMALPAŞA	4	Construction Phase
UŞAK	UŞAK	5	Open to Service
İSTANBUL	YEŞİLBAYIR	5	Projecting and Expropriation Phase
ERZURUM	PALANDÖKEN	6	Construction Phase
MERSİN	YENİCE	6	Construction Phase
İSTANBUL	HALKALI	6	Open to Service
SAMSUN	GELEMEN	7	Open to Service
BALIKESİR	GÖKKÖY	8	Construction Phase
BİLECİK	BOZÜYÜK	8	Construction Phase
KAHRAMANMARAŞ	TÜRKOĞLU	9	Projecting and Expropriation Phase
KARS	KARS	9	Projecting and Expropriation Phase
SİVAS	SİVAS	10	Projecting and Expropriation Phase
MARDİN	MARDİN	11	Construction Phase
BİTLİS	RAHOVA	11	Projecting and Expropriation Phase

A surprising result from the study is the fall in ranking of the two port cities of Samsun and Mersin. The main reason for Samsun could be the height of its unit square meters of land,

whereas for Mersin it may be that growth rate is relatively low and there are fewer organized industrial zones.

Another important outcome of the assessment is that the four of first five logistics villages, Uşak, İzmit, Denizli and Eskişehir, are already in operation. In this respect, it can be said that the decisions taken by the TCDD when compared with the order of importance obtained, are based on the evaluation criteria used.

It is a remarkable result that İstanbul was only able to take the 5th place with the logistics village of Yeşilbayır, which is a project currently undergoing expropriation. The Halkalı Logistics Village which was formed to accommodate the Halkalı Customs Office and has been serving İstanbul for many years, is now in 6th place, indicating that the Halkalı has lost its popularity. It can be argued that the main reason why the Halkalı Logistics Village is weak is due to both weak infrastructure and information technologies because it was not built as a logistics village and has not achieved the characteristics of European logistics villages. Although it is not possible to expand the Halkalı Logistics Village, it is obvious that it is one of the logistics villages that can work effectively with Europe because of its reputation. It also has the very important advantage of having a customs office in the logistics village. In order to benefit from these advantages, it can be claimed that investment should be made into Halkalı Logistics Village. Good infrastructure investment leading to the integration of logistics villages will be an important achievement for Turkey. This result also corresponds with the results of a SWOT analysis on Halkalı [26].

With regard to the provinces, among the logistics villages in the Mediterranean Region, it has been concluded that Kahramanmaraş is less important than Mersin. All of the three logistics villages in the Aegean Region have entered the top five including Manisa Chamber of Commerce and Industry and Barsan Global Logistic Company It can be said that the region has good logistics infrastructure when considering Manisa Logistics Village which is open to service in a partnership but which is not examined in this study.

Considering that the İzmit (Köseköy) project in the Marmara region is considered the most suitable location, then the logistical burden of the Marmara region is not in İstanbul but in İzmit. Bilecik (Bozüyük) and Balikesir (Gökköy) share the eighth place. In this respect, it can be concluded that the South Marmara region is relatively ineffective in terms of logistics and that the logistical intensity of the Marmara is in the Northeast.

It can be said that Samsun (Gelemen) Logistics Village, which is the only logistics village in the Black Sea region, is in the right order according to genre. An element in favor of Samsun is the fact that it is located in the best place in the region because in the Eastern Black Sea there is no other city with an airport, a railroad connection and a port. If another logistics village is to be constructed in the future, Trabzon may be an alternative. Although the lack of a railway connection is a major disadvantage, the logistics village proposal for Trabzon has also been expressed in various studies [23, 27]. According to the 2016 census [28], the optimal operation of the Samsun (Gelemen) project may be a more effective solution. Samsun has already been made in the most favorable way instead of taking such an investment decision in the Black Sea region where 8.98% of the total population lives.

Eskişehir, Konya, Kayseri and Sivas are four logistics village projects in the Central Anatolia Region. According to the ranking, Eskisehir, Konya and Kayseri are really appropriate and are already in place. However, in Sivas, based on the investment required and in light of the economic and social conditions, it can be argued that this logistics village should be postponed pending further evaluation. To sum up, the cities Eskisehir, Konya and Kayseri in the Central Anatolia Region are more attractive than Sivas.

Of the two cities of Eastern Anatolia, Erzurum and Kars, Erzurum is still under construction while it is known that the expropriation and project stages for Kars are ongoing. Looking at the rankings obtained, it can be said that the rollout sequence of TCDD is both suitable and appropriate. In particular, Erzurum is located in the 6th place and has the potential to become a center for the region. Because of its location, in the logistical sense it is the heart of East Anatolia.

When we look at Southeastern Anatolia, Bitlis and Mardin are at the end of the ranking. It can be said that Mardin, which is a border town, is more successful than Bitlis because of the high amounts of import-export, and the number of companies with foreign capital. In this respect, Mardin will be a more appropriate choice than Bitlis. Thus, TCDD has made a correct investment since the construction of Mardin Logistics Village began first.

8. DISCUSSION

In the study, the AHP and ELECTRE methods are preferred to other methods. The outputs of AHP method form input for ELECTRE and the two methods complement each other. In the case of the AHP method, the main reasons are the simplicity of implementation, its scalability, and because its hierarchical structure can be dimensioned to fit a wide range of problems. For the ELECTRE method, both qualitative and quantitative data are available and the computation time is short. This weighting model, formed by a multi-disciplinary expert group of 17 people, has given more realistic results than other multi-criteria decision making methods. For inconsistent situations arising from the ignorance of inter-criterion correlations in methods such as TOPSIS [29], SAW and VIKOR, predictions do not always reflect the real situation, and/or qualitative data cannot be used. In this respect, a predictive solution cannot be achieved where such methods are used. The overlapping of place selection outputs, which are modeled in the study, with the actual place selection is one of the indicators that the method can be successfully used to solve real life problems. Logistics activities are activities with an emphasis on economy. All consumer goods transported between two points and raw materials going to production are directly related to the economies of the country. In addition, the traffic created during the realization of these logistics activities brings both economic and environmental concerns. Both the amount of fuel consumed and high emission rates, and the transportation of raw materials and products affect the society in economic, environmental and social aspects. All transport authorities around the world now agree that freight transport should get out of the monopoly of the road transport. Reducing the road freight transport rates of countries and increasing the use of other types will only be possible by establishing appropriate logistics centers. In this respect, it is thought that this study can fill an important scope gap by evaluating too many criteria in site selection studies. In future studies, the use of more practical and advanced methods will be a more understandable guide for decision-makers.

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