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RESIDENTIAL LAND USE CHANGE AND URBAN SPRAWL THROUGH ANALYTIC HIERARCHY PROCESS (AHP) IN MERSIN, TURKEY

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Abstract

Urbanization is evolving as a result of technology, industrialization and economic development. Considering urban areas as a source of economic income in developing countries such as Turkey is one of the most important factors that negatively affect resources in urban planning studies. A skewed construction started in and around the cities and negative consequences such as the destruction of areas with high natural and economic values are the main problem that needs to be taken under control.This study aims to investigate increasing residential land-use demands that sprawling lands towards high-quality land. For this purpose, firstly, the study area has been examined in terms of 4 land uses as housing, agriculture, forest and tourism. Land use suitability analyzes were made by using the AHP method and the results obtained were transferred to the GIS database and a suitable land use map for the study area was created. Land use changes in 2010 and 2018 were determined and compared with the help of GIS techniques for each area use in the study. The analysis was used to determine land-use suitability for planning residential areas and their sprawl on agricultural, forest and tourism areas in the vicinity of urban structure. As a result of the study, it was determined that the total urban area increased by 50% in the 8-year period. The residential land use sprawl occurred in agriculture, forest and tourism areas with suitable or semi-suitable potentials. Suggestions have been made in order not to continue the loss of land with high potential in different sectors.

Key words: analytic hierarchy process (ahp), land suitability analysis, urban planning

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1. Introduction

Uncontrolled population growth, accelerating industrialization, and the accompanying unplanned urbanization in the last century have caused many environmental problems. The main reasons for these environmental problems faced by countries are the lack of spatial utilization of natural resources and the lack of sustainable natural resource planning (Criado et al., 2019; Riitano et al., 2020). The projects aimed at solving the problem mostly remain on paper or cause new problems to be encountered in the implementation phase due to the lack of models reflecting the real conditions (Küçükönder and Karabulut, 2007). Spatial planning studies carried out in cities as a result of different needs were often not sufficient in solving these problems. The research area has increased due to factors such as geographical location, climatic characteristics, the rapid development of agriculture, industry, trade, and exports, declaring a free zone, being a port city, population growth rate, migration, and rapid urbanization. For this reason, there has been a significant deterioration in the urban structure. As a result, with the onset of unplanned urbanization in city centers and their immediate surroundings, the destruction of urban green areas has led to negative consequences such as the transformation of agricultural and forest areas into residential areas. Although it is possible to partially compensate for the

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problems caused by the transformation of cultural areas such as residential areas, the destruction of the natural universe causes irreversible consequences especially in coastal settlements (Klaučo et al., 2017).

The land use assessment determines the appropriate site selection for the uses and ensures the direction of development and the prevention of wrong decisions (Duc, 2006). In addition, the reasons for the emergence of problems arising from land-use transformations are the non-spatial evaluation of natural resources and the lack of sustainable natural resource planning.

To investigate the effects of residential areas on other uses, the research area is divided into 3 main groups considering reasons mentioned above, satellite images, available printed maps, current plans;

1. The city is surrounded by agricultural areas and occupies more space than urban land in the research area. Considering the reconstruction plan decisions of the city, the dominance of the urban housing structure in central of the city comes to the forefront. The city, which was founded on high-quality agricultural land, continued to develop from the same center based on fertile land. Therefore, it was considered that it would be appropriate to examine the impact of residential areas on agricultural areas.

2. The coastal settlement density of Mersin is quite high due to the suitability for coastal settlements and being the first meeting up point with the Mediterranean Sea for eastern provinces of Turkey. Especially the multi-stored construction starting from the coastal side adversely affects the physical structure of the city and occupies areas with high tourism potential. For this reason, evaluating the impact of urban structure on tourism areas, which will be an important gain for Mersin, was another field use during the study.

3. The research area, which is the second-largest city in the country in terms of forest areas, is an ecologically important region. The fact that the climate in the region is quite hot in the summer has created the need for second housing in forest land. For this reason, to prevent unplanned housing in forest areas, suggestion areas have been created for forest land.

The research made for solving problems often remain on paper and new problems are encountered due to the lack of modeling that reflects the real conditions in the implementation phase (Küçükönder and Karabulut, 2007). Persons and institutions closely related to planning can produce flexible solutions based on changes in land-use planning. In addition, political requests, legal conditions, support of decision-makers, and cooperation between implementing agencies can be specified as basic conditions for the implementation of a plan (Yılmaz, 2005). The use of the Analytical Hierarchy Process (AHP) gains importance in this context which is based on expert and participatory views and allows for a quantitative assessment.

Ensuring the sustainable planning of the above-mentioned uses is of great importance for cities such as Mersin, whose development process continues. Present and future demands of the society should be determined and included in the planning process for sustainable land-use planning. In addition, it is important to resolve conflicts of interest pressure groups and the balance of uses. Therefore, it is necessary to ensure that public interest-pressure groups and sector experts, as well as decision-makers, participate in different stages of the planning process.

2. Study area

The city of Mersin, where the research was conducted, is located between 32° 56 'and 35° 11' east longitudes and 37° 26 'and 36° 01' north latitudes. Mersin is surrounded by Adana in the east, Niğde in the northeast, Konya in the north, Karaman in the northwest, Antalya in the west, and the Mediterranean Sea in the south. The research area covers the city center and its immediate surroundings, where the city has a tendency to develop and is mostly determined according to the distribution of secondary residential settlements (Fig. 1).

Mersin has the distinction of being the 9th largest city of Turkey in terms of its area of 15,853 km². Today, it is the 10th most populated city in Turkey. While Mersin was a small settlement with a population of 8047 in the 1870s, it turned into a city with a population of 47000 in 1927 after 57 years. With this development, Mersin has become one of the most important cities of the Mediterranean (Mersin Provincial Culture and Tourism Directorate, 2019). The population reached 1.814.468 in 2018 (Turkish Statistical Institute, 2019). Mersin is a city in demand with Turkey's longest uninterrupted coastline, Mediterranean climate features, and soil structure with high agricultural fertility. At the same time, as Mersin is the first place where cities in the east of Turkey meet the sea, it can be said that the demand for second housing is high in this region. Under the influence of these features, rapid change and development in housing areas continued and the impact on land use increased over the years.

3. Methods

The use of geographic information systems and satellite-based images in planning can be used as an effective tool to monitor, analyze and visualize the changes of various land uses in different time periods. (Biotto et al., 2009; Piekarczyk, 2014; Schaefer and Thinh, 2019). In this study, with the help of spatial multi-criteria analysis, it is aimed to determine the areas of suggestion for urban use in Mersin. For this reason, a suitable land use map was prepared for Mersin with the AHP method. To detect spatial changes in urban form, land use maps of 2010 and 2018 were created with the help of satellite images and compared with land use suitability maps determined by the AHP method. Theoretically, two types of evaluations can be mentioned in the valuation of the data in the decision-making process.

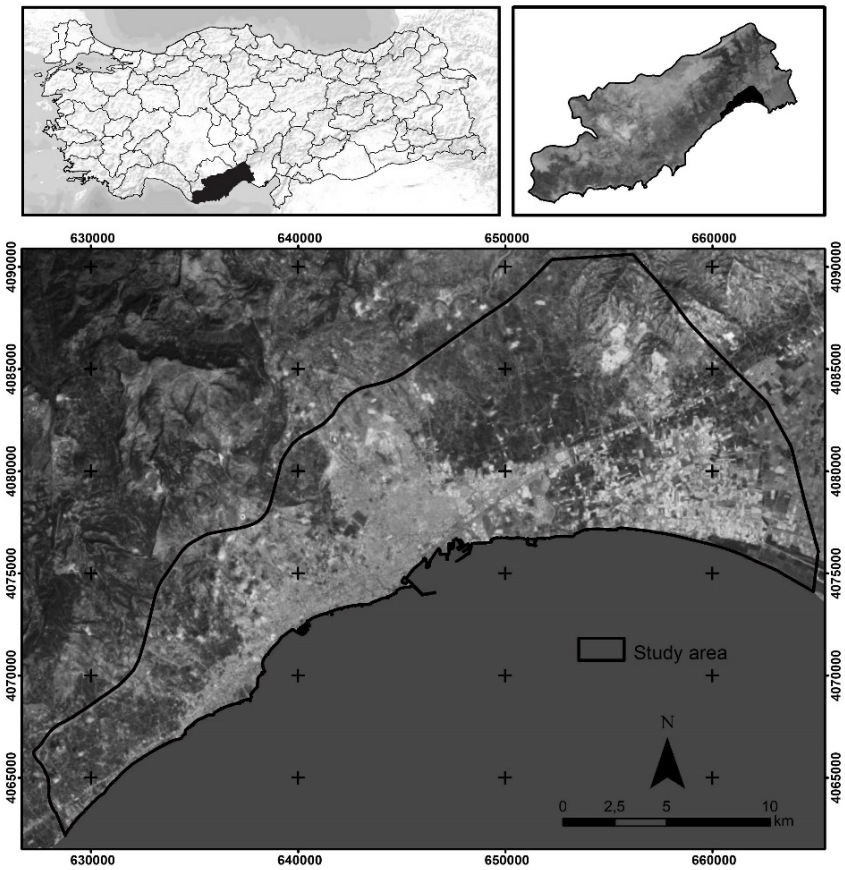

Fig. 1. Study area

The first is an intuitive assessment, often non-objective. The second is logical analysis, which requires a more objective approach and requires an analytical method. The Analytical Hierarchy Process used in this research is a process in which individuals and experts who are effective in the decision-making process can determine alternatives and selection criteria for these alternatives and make their importance rankings

AHP was first introduced by Thomas L. Saaty in the 1970s and is one of the most common technics that is using to solve complex decision-making problems today (Erdoğan, 2019; Kangas, 1992, Sitorus et al., 2019; Zahedi, 1986). This technique is primarily a measurement theory based on priorities derived from a pairwise comparison of experts and decision-makers. It is a technique that can be used to overcome the complex decision-making process in physical planning including application examples in different areas and especially in the selection of residential areas (Cheng and Li, 2001; Kangas, 1992; Yılmaz, 2005; Zahedi, 1986).

The main step in making the land suitability decision making is to quantitatively determine both the individual and cumulative effects of the different land suitability criteria indicated by x1, x2, ..., xn. The use of the Analytical Hierarchy Process (AHP) gains importance in this context which is based on expert and participatory views and allows for a quantitative assessment (Bagheri et al., 2012; Feltynowski and Szajt, 2021; Talpur, 2014). Accordingly, AHP was used to assign the weight scores in the first stage of this study. The method carried out within the scope of the study was examined in 5 stages (Fig. 2). Firstly, natural and artificial thresholds affecting the main land-use decisions put forward with land use maps, QuickBird satellite images dated 03.07.2010 with 0.6 m resolution, and Landsat 8 satellite image dated 05.11.2018. In the second stage; collected data were digitized using GIS techniques ArcGIS 10.2 program was used at this stage. The third stage includes land-use decisions with a multi-criteria land suitability analysis. Basically, mathematical models based on these methods and their outputs use in land use planning need to be analyzed geographically (Akbulak, 2010; Biatto et.al., 2009; Carver, 1991; Cengiz and Akbulak, 2009; Küçükönder and Karabulut, 2007; Laskar, 2003; Rahman and Saha, 2008). In this fourth stage, thematic maps of the research area, QuickBird satellite image and master plan prepared in 2010 were used. Analytic Hierarchy Process applied in 2010 and the proposed land use maps were presented. In the fifth stage of the study, the existing land use maps prepared in 2018 were compared with the proposed areas in 2010. Evaluations of spatial changes, digitized satellite imagery and projection plans of the area were interpreted by overlapping with GIS technique.

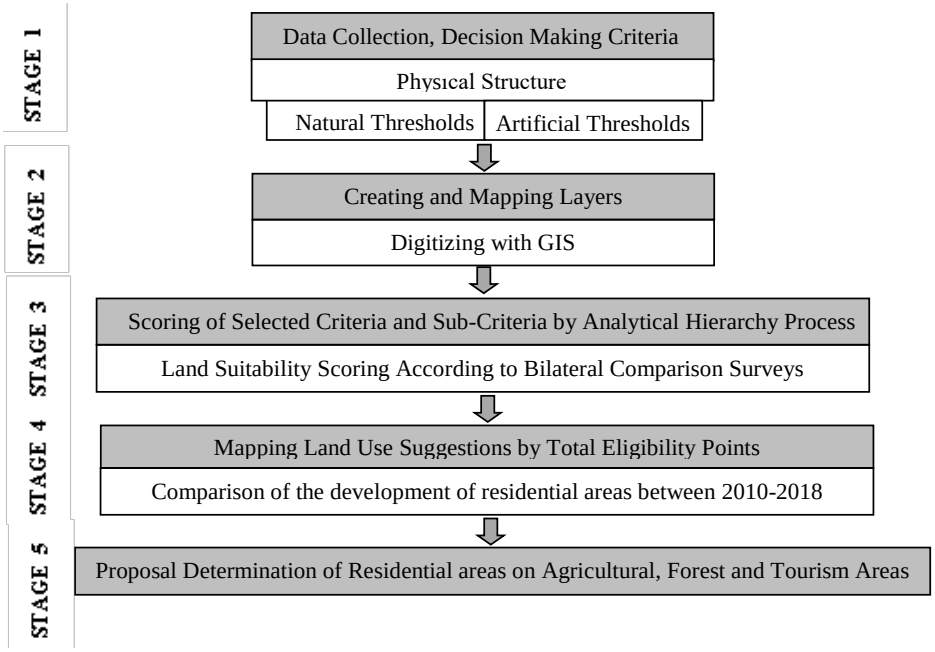

Fig. 2. Study flow chart

3.1. Analytic Hierarchy Process (AHP)

In this study, data layers are digitized in a geographic information systems environment, which is used as an effective tool in the integration of analytical hierarchy technique with spatial planning. The analytical hierarchy technique was used for the weighted scoring of the criteria to be used in evaluation and analysis later on. The study carried out for this purpose generally consists of four stages.

1. Establishing the hierarchy
2. Creation of decision (pairwise comparison) matrices
3. Calculating relative weights of criteria and sub-criteria
4. Calculation of the consistency ratio

The mathematical model of multi-criteria decision making is generally expressed as (Mendoza, 1997; Nijkamp and Van Delft, 1977; Yılmaz, 2005) Eqs. (1-2):

$$S = f(X1, X2, ...Xn) \quad (1)$$

where: S= Suitability measure of the area, x_1,x_2,……,x_n= Criteria affecting the suitability of the field.

A more general mathematical expression of (Eq. 2):

$$S = \sum_{i=1}^{n} WiXi \quad (2)$$

where: S = Total suitability score, W_i = i. weight value of conformity criteria, X_i = i. sub-criterion score of the conformity criterion, n =Total number of land conformity criteria.

4. Research findings

4.1. Determination sub-criteria of land use suitability analysis for land use suggestions

Three main study areas were selected for the determination of the land suitability and identifying future projections. Analytical Hierarchy Process was applied to determine the weights of the criteria and conformity analysis was conducted for residential areas on agriculture, forest, tourism uses in 2010.

AHP technique was used for the "Basic Criteria" and "Sub-Criteria" categories to weight the criteria as an expression of the importance of each other and determination the order of priority (Table 1). Sub-criteria titles were determined by the project team and the scoring was done by experts from the relevant public institutions and organizations.

Dual comparison questionnaires were prepared with specified given in Fig. 3. These questionnaires were applied to selected experts who had the authority to give opinions and information about the sectoral uses in the research area independently. The opinions of the experts operating in the region and working in different institutions related to housing, agriculture, forestry, and tourism sectors and mostly in the managerial positions regarding the priorities of the criteria were obtained through dual comparison matrices. Then, the received opinions were analyzed according to the AHP algorithm and the relative importance of the criteria. At this stage, a weighted scoring study was conducted to guide the land suitability analysis, which would affect usage decisions. The total suitability scores according to the linear combination model given below are assigned to the base maps in the GIS program considering the weight values determined by the decision-makers.

Table 1. Categories of AHP

1. Main Criteria	***2. Criteria***		***3. Sub- Criteria***	
Ecological Conditions	Soil	Land Capability Class	Class I to Class VIII	
		Soil Depth	Deep > 90cm	
			Medium Deep 51-90cm	
			Shallow 21-50cm	
			Very shallow 0-20cm	
		Erosion	None or Slight	
			Moderate Erosion	
			Severe Erosion	
			Very Severe Erosion	
	Topography	Slope	Flat and close to 0-2%	
			Slightly sloping 3-6 %	
			Medium Slope 7-12%	
			Steep 13-20%	
			Very Steep 21-30%	
			Steep> 30%	
		Aspect	S, N, E, W, SE, SW, NE, NW	
	Geological Structure			
	Flora		Forest	
			Sparse scrub	
Land Uses	Existing Land Uses		Agriculture	Garden Field
				Greenhouse
			Motorway	
			Coastal Use	
Economy Conditions				

The weight value of the criteria determined for each sector in the model was obtained from the AHP technique. The scores of the sub-criteria of suitability criteria are given by authors and the Eq. (2) is used;

$$S = \sum_{i=1}^{n} WiXi \qquad (2)$$

where: S = total suitability score or impact level score, Wi = i. the weight value of the suitability criteria or the level of impact factors; Xi = i. the sub-criterion score of the suitability criteria or the level of other sub-activities that create the impact; n = total number of land suitability criteria or total number of impact factors.

The questionnaires were weighted with AHP method and the resultant scores and sub-criteria given by the project team were assigned to the base maps in the GIS environment and the suitability maps for field use were developed.

4.2. Determination of land use changes based on land suitability map

4.2.1. Determination of spatial transformation in agricultural area

There are fertile agricultural areas in the eastern and western development corridors of Mersin. A significant portion of these areas was opened to planned or unplanned construction during the development of the city. Unstructured areas have also been under pressure today. Especially in the western part of the city, it is seen that the zoning has increased. The increasing demand for housing in this region has led to the fragmentation and parcellation of the fertile agricultural lands in the region.

The suitability criteria of agricultural areas were determined as land capability class, slope, erosion, soil depth, vegetation, and available uses. Bilateral comparison questionnaires were applied to 5 experts working in Mersin Directorate of Agriculture and data results of AHP analysis are given in Table 2. The average of all experts' relative evaluation results are examined in Table 2, it is seen that the land capability class is the most important criteria according to the importance level of 0.246. Soil depth is the second important criterion with 0.211. Fig. 3 shows the agricultural suitability areas prepared with the AHP technique and the agricultural area uses determined in 2010 and 2018. In terms of agricultural suitability, the study area is divided into 3 categories as suitable area, semi-suitable area, and unsuitable area. As seen in Fig. 3, residential areas have developed over agricultural areas that are determined by experts as suitable for production towards the northwest direction of the study area. Directing urban development to areas with low agricultural productivity determined in the northeast and east wool is very important in terms of the protection of agricultural areas and the sustainability of productivity. Residential occupation sprawl on agricultural land use is shown in Table 3.

As indicated in Table 3, only 11% of the 34939.7 working area is not suitable for agriculture. When the distribution given in Fig. 3 and the area calculations given in Table 3 are taken into account, it is seen that only one-third of the sprawl of the residential area in a suitable line for the residential

area. Similarly, residential spread in semi-eligible areas doubled over 8 years (1865.58 ha to 3739.76 ha).

This situation, as stated before, shows that Mersin has fertile agricultural land. It is inevitable for housing development to be on agricultural land, as it is an area suitable for such a wide range of agriculture. However, it is necessary to ensure that this development is in the unsuitable and semi-suitable area as much as possible.

4.2.2. Determination of spatial transformation in forest land

The suitability criteria of forest areas were determined as land capability class, slope, erosion, soil depth, vegetation, and existing uses, and questionnaires were applied to 4 experts working in Mersin Regional Directorate of Forestry. When the average of all experts' relative evaluation results is Fig. 3. Residential area change between 2010-2018 depending on agricultural land considered, it is seen that erosion is the most important criterion according to the severity of 0.256 (Table 4). Soil depth is the second important criterion with 0.215. Fig. 4 was prepared with expert opinions which were identified with the AHP technique. Study areas are divided into 3 categories as suitable areas, semi-suitable areas, and unsuitable areas for taking development decisions of forest areas.The development of urban development areas in 2010 and 2018 on the forest area potential is also shown on the map.

As seen in Fig. 4, residential areas have developed towards areas with high forest area potential. Undoubtedly, areas suitable for the development of forest areas should not be opened for residential use. Nevertheless, as can be seen from the calculations given in Table 5 with the help of ArcGIS.

Table 2. AHP results of land suitability criteria for agricultural areas

Experts	*Consistency ratio*	*Land capability class*	*Slope*	*Erosion*	*Soil depth*	*Vegetation*	*Current uses*
Exp. 1	0.054	0.461	0.106	0.036	0.273	0.080	0.044
Exp. 2	0.060	0.442	0.176	0.072	0.175	0.077	0.058
Exp. 3	0.108	0.058	0.190	0.415	0.160	0.154	0.023
Exp. 4	0.059	0.043	0.047	0.367	0.241	0.203	0.099
Exp. 5	0.043	0.226	0.066	0.248	0.207	0.200	0.052
Art.m.	0.064	0.246	0.117	0.228	0.211	0.143	0.055

Table 3. Residential land occupation on agricultural land between 2010-2018

Land suitability	*Agriculture (ha)*	*%*	*Residential area on agricultural land 2010 (ha)*	*%*	*Residential area on agricultural land 2018 (ha)*	*%*	*Difference (ha)*	*%*
Suitable	16078.95	46.02	5786.53	75.01	7054.58	62.29	1268.05	35.11
Semi suitable	14766.59	42.26	1865.58	24.18	3739.76	33.02	1874.18	51.89
Unsuitable	4094.16	11.72	61.85	0.80	531.46	4.69	469.61	13.00
Total	34939.7	100.00	7713.96	100.00	11325.8	100.00	3611.84	100.00

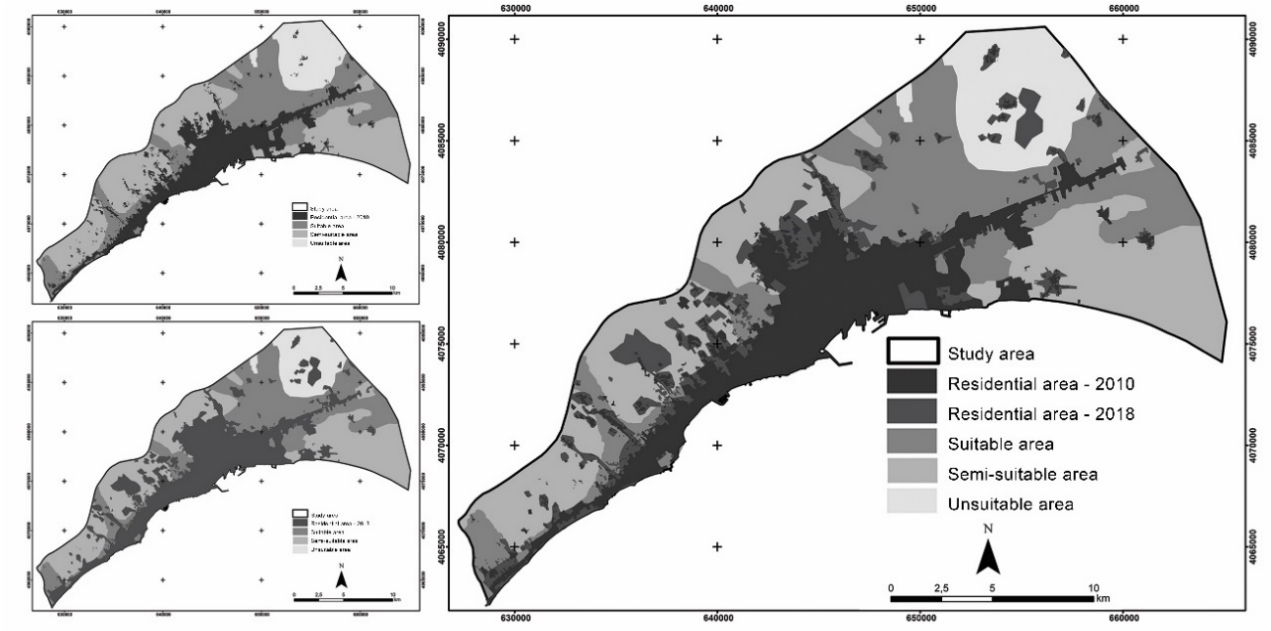

Fig 3. Residential area change between 2010-2018 depending on agricultural land

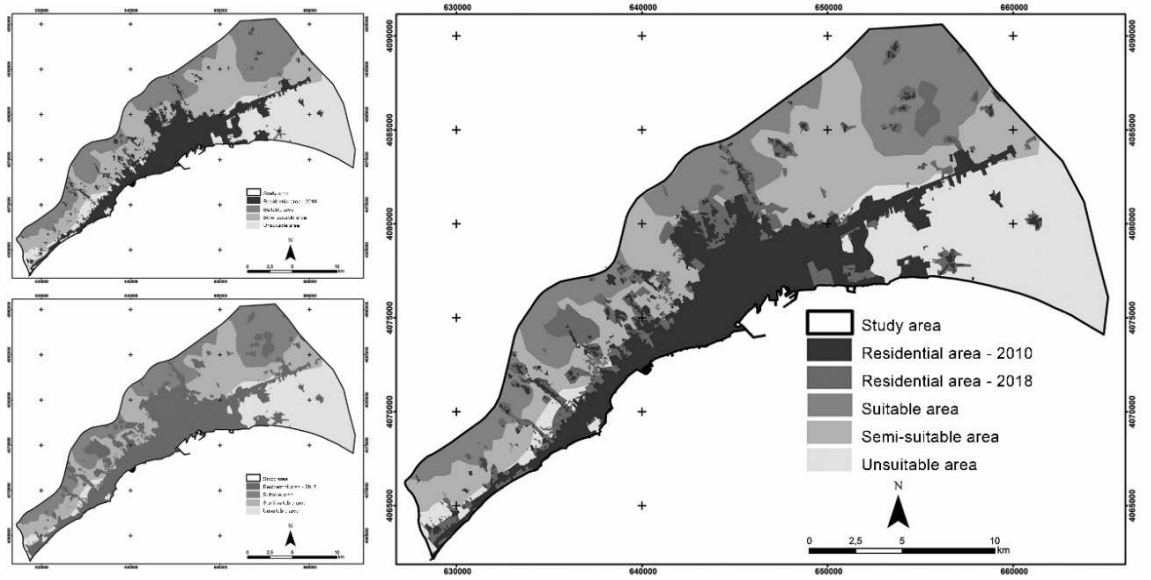

Fig. 4. Residential area change between 2010-2018 depending forest land

Table 4. AHP results of land suitability criteria for forest land

Experts	*Consistency ratio*	*Land capability class*	*Slope*	*Erosion*	*Soil depth*	*Vegetation*	*Current uses*
Exp. 1	0.086	0.150	0.198	0.245	0.070	0.308	0.029
Exp. 2	0.096	0.107	0.055	0.323	0.374	0.111	0.030
Exp. 3	0.086	0.469	0.106	0.206	0.119	0.051	0.050
Exp. 4	0.076	0.067	0.041	0.249	0.296	0.322	0.025
Art.m.	0.086	0.198	0.100	0.256	0.215	0.198	0.034

Table 5. Residential land occupation on forest land between 2010-2018

Land suitability	*Forest land (ha)*	*%*	*Residential area on forest land 2010 (ha)*	*%*	*Residential area on forest land 2018 (ha)*	*%*	*Difference (ha)*	*%*
Suitable	8768.54	25.10	256.83	3.33	1306.98	11.54	1050.15	29.08
Semi suitable	12215.83	34.96	2104.56	27.28	3704.92	32.71	1600.36	44.31
Unsuitable	13955.33	39.94	5352.57	69.39	6313.9	55.75	961.33	26.62
Total	34939.70	100.00	7713.96	100.00	11325.80	100.00	3611.84	100.00

In the 8 years, it is seen that residential area development has developed in the area where the forest potential is high (Table 5). When the area change rates are analyzed, it is seen that the biggest change is on semi suitable land. In addition, it is observed that a large area of 1050 ha, which is the most suitable for forest development, has been opened for residential use. In the real area where residential use should be, the development took place at 960 ha.

4.2.3. Determination of spatial transformation in tourism area

After the 1980s, one of the important dynamics affecting the urban texture is the acceleration of tourism investments. Mersin, the first point where all cities in the eastern and southeastern parts of Turkey meet the sea, has turned into a coastal city where the demand for second housing increases to spend the summer months. Construction in secondary housing form has been realized in Mersin to serve local tourists unlike other tourism regions of Turkey. Mersin has a dense and irregular structure throughout the province with 321 km of coastline, as well as marine pollution of terrestrial origin due to insufficient infrastructure, port activities, agricultural activities, and industrial activities. Additionally, the city center has a 42 km coastline, almost entirely covered by construction.

Suitability criteria of tourism areas were determined as land capability class, proximity to the sea (1km), forest areas, current uses, and slope. Dual comparison questionnaires were applied to 3 personnel working in the Mersin Provincial Directorate of Tourism and the results of the AHP analysis are listed in Table 6.

When the average of the results of the relative evaluation of all experts is considered, it is seen that forest areas are the most important criterion according to the importance of 0.303. Current uses are the second important criterion with 0.270. As a result of the suitability analysis evaluating the types of tourism that are dominant in Mersin with expert opinions, tourism areas have been examined in 3 categories like other area uses (Fig. 5).

As shown in Fig. 5, residential areas spread in the corridors towards the north and northwest direction. It is also seen as the destruction of the

coastline, which already has high tourism potential. In the 8 years when the residential area change is examined, it is seen that the usage areas change continues with the addition to the existing development areas (Table 7).

When the changes in tourism areas are analyzed, it is seen that only 30% of development area has occurred in the unsuitable land over 8 years and the remaining 70% change has occurred in the area with high tourism potential. In addition, it is seen that the biggest change in these rates is in the most suitable areas.

A multi-sectoral and multi-criteria analysis is required to plan all sectors in a certain harmony in the field. The suitability maps for residential areas, agriculture, forestry, and tourism areas were overlapped using the GIS technique. Map cells suitable for a single-use allocated to the use of space in the result map. Weight scores of criteria have been taken into consideration in areas for multiple uses.

After examining the natural data and built environment according to agricultural lands, forest areas, and tourism land use, land suitability assessments were made for all uses. Development proposals for agriculture, forestry, tourism, and residential areas in the study area are combined in the result map (Fig. 6). As can be seen in all sectoral maps, the development of residential areas is also included in this result map. While the housing texture of 2010 covers 7713.96 ha, after 8 years of interruption, in 2018, the housing texture grew by close to 50% and reached 11325.80 ha in total. To sustain housing development in harmony with other sectors, suggestions were determined for residential areas by using natural resources and built environment data.

As seen in the result map, among the proposed new residential areas in the north of the existing residential fabric, agricultural corridors extending to the north are proposed. The regions in the east of the area, where agricultural activities are predominant, have been deemed suitable for agriculture. The eastern coasts of the area have been determined as suitable areas for tourism. This area is important for tourism because it is intertwined with agricultural areas and contains the sensitive ecosystems of the eastern Mediterranean coasts. There is also a protected area in this part of the area. Forest areas have also been proposed as the continuation of agricultural areas.

Table 6. AHP results of land suitability criteria for tourism areas

Experts	*Consistency ratio*	*Land capability class*	*Proximity sea*	*Current uses*	*Forest land*	*Slope*
Exp.1	0.082	0.144	0.143	0.063	0.456	0.195
Exp.2	0.047	0.030	0.189	0.290	0.411	0.080
Exp.3	0.067	0.068	0.208	0.456	0.042	0.226
Art.m.	0.065	0.081	0.180	0.270	0.303	0.167

Table 7. Residential land occupation on tourism areas between 2010-2018

Land suitability	*Tourism land (ha)*	*%*	*Residential area on tourism land 2010 (ha)*	*%*	*Residential area on tourism land 2018 (ha)*	*%*	*Difference (ha)*	*%*
Suitable	11685.07	33.44	824.47	10.69	2536.73	22.40	1712.26	47.41
Semi suitable	12842.41	36.76	4951.75	64.19	5754.39	50.81	802.64	22.22
Unsuitable	10412.22	29.80	1937.74	25.12	3034.68	26.79	1096.94	30.37
Total	34939.7	100.00	7713.96	100.00	11325.8	100.00	3611.84	100.00

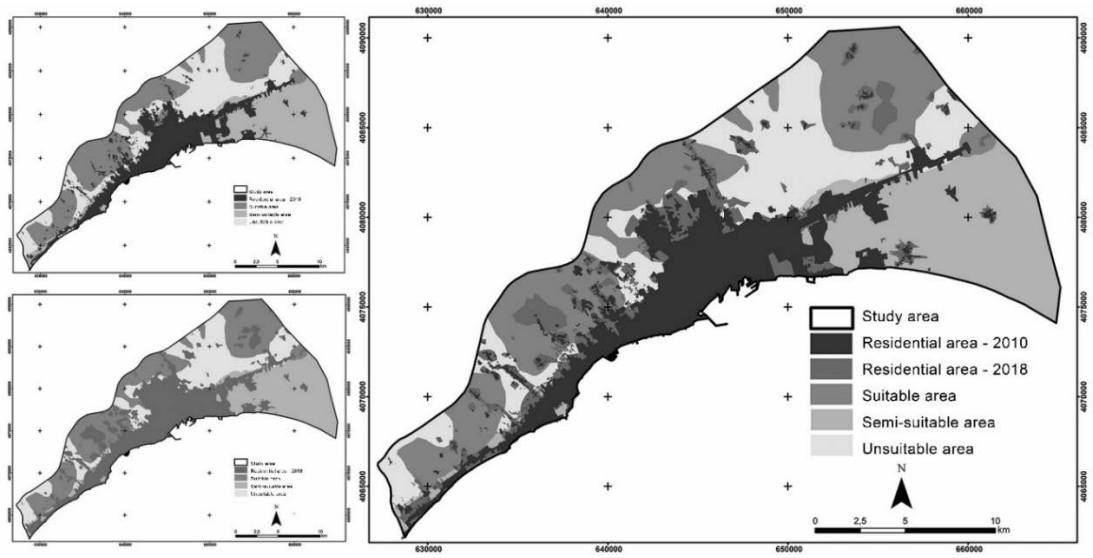

Fig. 5. Residential area change between 2010-2018 depending tourism land

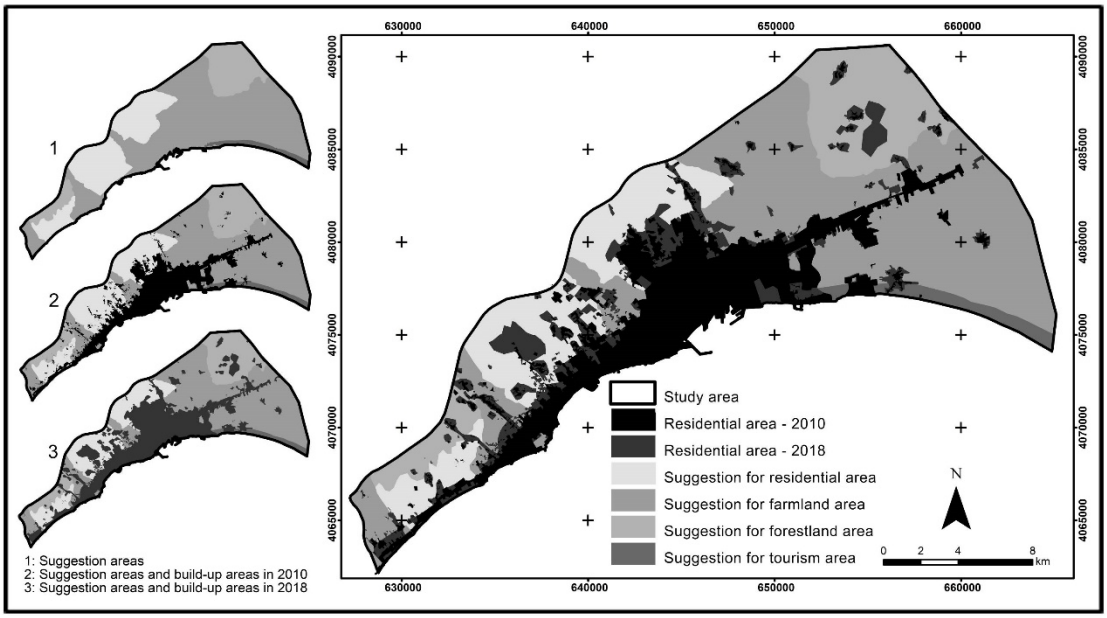

Fig. 6. Result map

5. Conclusions

Mersin is a city whose socio-economic and spatial development process continues rapidly. While its spatial development continues, the tourism potential of the city is under great risk with its fertile agricultural land of thousands of hectares, wide-spread forestland, and climatic conditions, and long coastline. Considering the results of this study, which examines the land-use change suitability for the city of Mersin, it can be said that the spatial growth of the city will continue. However, fertile agricultural lands, sea, and coastal areas come to the fore as the most important physical constraints in the development of the city. This situation creates a limited area selection for residential fabric.

The formation of spatial plan decisions, objective decision inconsistencies, and instabilities can be observed with the participation of socio-political factors in the process. Effective participation in decision-making mechanisms should be ensured in planning decisions of public spaces and attention should be paid to the selection of objective decision-making tools. Using a participatory method by decision-makers in making the right decisions will make this process much easier. For this reason, especially the planning decisions for the development of the urban fabric should be determined with a multi-faceted, multi-participatory process.

As it emerged as a result of the study that agriculture is the most affected land use by the expansion of the urban fabric. The fertile agricultural lands located in the city are used for non-agricultural purposes such as housing, industry, and storage. For the cities as Mersin, which continues to develop and change rapidly, the changes depending on years should be guided by the right decisions. As a result of the evaluations, the following objectives and strategies should be followed in order to protect agricultural lands and ensure their sustainable use.

-Changes in agricultural areas should be limited, agricultural land use decisions should be reviewed from the upper scale to the lower scale, revisions in the plan decisions from the past should be made within the scope of protecting and ensuring the sustainability of agricultural areas.

- Agricultural areas at the periphery of the city should be protected and made a part of the urban ecology in order to ensure the sustainability of the urban ecosystem.

- Ensuring that the citizens of the city have economic access to local agricultural products can only be achieved by making the production in areas close to the city. For this reason, the protection of agricultural lands is very important in terms of the continuity of local production and economic welfare. At the same time, these areas will be very important for the employment of local people.

The land suitability maps have been prepared under the spatial criteria determined in line with the opinions of the experts and decision-making authorities in the research area.

- In Mersin, there have been changes in 2010 which are not based on using maps and expert opinions and development area suggestions. Decisions are taken between 2010 and 2018, regardless of expert opinions, continue to occupy areas suitable for the agriculture, forestry, and tourism sectors. Such neglect of non-recoverable natural resources puts the city's future situation at risk.

- It is more appropriate to protect the agricultural areas in the vicinity of the city center as a buffer zone outside the city and orientation of residential areas to threshold areas to the north of the city center by specific corridors for future planning in Mersin.

- During the preparation and implementation of the development plans, joint work should be ensured

with governmental institutions related to the production of land use decisions of different sectors.

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