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Changes in Land Use Between the Years of 1990-2018 in Mersin Province Based on CORINE (Coordination of Information on The Environment) System

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ABSTRACT

By determining the change of land use characteristics over the years, changes in urban growth and land use can be revealed. Monitoring of the change in the land cover allows for better protection of forest areas as well as efficient agricultural areas and regular urbanization. Corine System is one of the commonly used methods for the determination of land use. This system established by the European Union countries, is used by Turkey. In this study, changes in urban growth and land use in Mersin province between 1990-2018 were determined using the Corine System Based on the Corine System, simplification was made in the classification. Thus, the change in the land was tried to be revealed more clearly. The changes in land cover in Mersin province have been tried to be presented based on 15 classes considering 1990, 2000 and 2018. Within the scope of the study, the reasons and consequences of the changes occurring in these periods are emphasized. As a result, the changes occurring in the 28 years in the land cover examined in 3 periods are presented within the frame of visual and measurement values. It has been observed that residential areas in Mersin are getting bigger and bigger. Planning for the future in Mersin should be made by considering these changes in land cover.

ÖZ

Anahtar Kelimeler:

Corine Sistemi
Arazi kullanımı,
Mersin.

Arazi kullanım özelliklerinin yıllar içerisindeki değişiminin tespiti ile kentsel büyüme ve arazi kullanımında meydana gelen değişimler ortaya konulabilir. Arazi örtüsünde meydana gelen değişimin izlenebilmesi verimli tarım alanlarının yanında orman alanlarının daha iyi korunabilmesi ve düzenli bir kentleşmenin sağlanmasına olanak sağlar. Arazi kullanımının tespiti konusunda yaygın olarak kullanılan yöntemlerden birisi de Corine Sistemidir. Avrupa Birliği ülkeleri tarafından kurulan bu sistem, Türkiye tarafından da kullanılmaktadır. Bu çalışmada Corine Sistemi kullanılarak 1990-2018 yılları arasında Mersin ilindeki kentsel büyüme ve arazi kullanımında gerçekleşen değişiklikler tespit edilmiştir. Corine Sistemi baz alınmış ancak sınıflamada sadeleştirmeye gidilmiştir. Böylece arazideki değişim daha net ortaya konulmaya çalışılmıştır. Mersin ilinde arazi örtüsünde meydana gelen değişimler 1990, 2000 ve 2018 yılları dikkate alınarak 15 sınıf temelinde ortaya konulmaya çalışılmıştır. Çalışma kapsamında, bu dönemlerde meydana gelen değişimlerin

nedenleri ve sonuçları üzerinde durulmuştur. Sonuç olarak, 3 dönemde incelen arazi örtüsünde 28 yıllık süreç içerisinde meydana gelen değişiklikler görsel ve ölçüm değerleri çerçevesinde ortaya konmuştur. Mersin’de özellikle yerleşim alanlarının gittikçe büyüdüğü gözlemlenmiştir. Mersin’de geleceğe yönelik olarak yapılan planlamalar, arazi örtüsündeki bu değişimler göz önünde bulundurularak yapılmalıdır.

1. Introduction

Areas that survive on the earth without being affected by human activity are called natural environments. The general feature of these environments is that they are free from human influences in terms of climate, vegetation, and morphology. While these areas continue their existence with these features, on the other hand, they met the needs of people such as water, air, and food without any problems until a certain period. However, natural environments have been exposed to human influences in the last two hundred years, with an increasing population and especially industrialization and urbanization movements also increasing need for raw materials, food, and residential areas cause great changes in natural environments. However, in addition to the areas where people change according to their needs, they also need natural areas for a healthy life and sustainable progress. Firstly, he continued his life by making use of the resources and lands offered by his environment [1].

Today, more than half of the world's population lives in cities. This rate is increasing every year. However, urbanization, which we cannot define only with the demographic movement, also covers economic and social changes.

After the industrial revolution, urbanization, which emerged as a byproduct of his, after 1950 in Turkey are redesigned with migration from rural areas to cities continues today [2,3]. As a result of the population accumulation caused by excessive migration in the cities, the existing settlement in the cities cannot meet the need for shelter.

Also, as a result of the unplanned development of large cities, which spread over a large area in many developing countries, on the one hand, there are problems in the proper use of the land, and on the other hand, the opportunities of remote districts to benefit from public services, especially infrastructure, remain limited. Changes in urbanization and land cover/land use, improper land use, natural balance deteriorates with the destruction of natural vegetation, so the ability of the land falls from upper classes to lower classes. Not only affect global climate change, but also damage forests, negatively affect available water resources and cause vegetation to disappear. When urban growth does not occur in a planned way, it also causes a waste of energy resources and landscape degradation [4].

When these developments are not considered, increasing urbanization movements, despite the economic and social development provided, make it inevitable to face environmental and health problems. Also, especially the misuse of the existing land, it has reached the maximum level with urbanization and increasing population [5]. However, the main purpose of people is to live healthily and happily in the world. For all these reasons, it is important for people to be aware of the changes occurring in their environment, to monitor the changes and to direct the change for a healthy development when necessary. In this way, while maintaining healthy modern settlements, on the other hand, the protection of agricultural areas, forests, and water resources necessary for life will be ensured. Thus, land use and urban development plans will be more accurate and predictable. In this context, the area of this study covers the Mersin province (Figure 1). When Mersin province is examined, it is observed that there have been significant changes in land use in the last 30 years as a result of population growth, industrialization and urbanization activities. On the one hand, the population of the city increases with the intense migration movements from rural and other cities to Mersin, the existing housing stock and urban area are not sufficient for the incoming population, and there is a slum and an unplanned development.



Figure 1: Working Area Location Map

Especially in the Black Sea and the Mediterranean region, the altitude level that starts from the coast, which affects cities negatively, causes the cities to get stuck in the coastline [6]. Urban development and industrial areas create pressure on fertile agricultural lands and cause these areas to be lost in time. Besides, the opening of natural areas that are not suitable for agriculture due to economic reasons also leads to deterioration in land use. In recent years, the expansion of the spring grassland in the area between 700-1250 meters also contributes to the changes on the land. In this study, the change in the land cover of Mersin province since 1990 is examined based on the Corine System.

2. Materials and Methods

In this study, CORINE (Coordination of Information on the Environment) land use data were used (Table 1). CORINE project is one of the important land management projects carried out within the scope of the European Union GMES (Global Monitoring for the Environment and Security) program. This project was started by the European Commission in 1985. An environmental information system was created until 1990, and the terminology and

methodology of the CORINE system were developed and the system was accepted at the European Union level. The main idea in this project is to create a standard database of the entire European land piece with common evaluation criteria. The purpose of the Corine project is to create land cover/use maps containing satellite images and geographic information systems, as well as location-related land information. The data obtained with this project is computer-aided land use data of satellite images according to the determined land use classification. The project also includes Turkey, where 39 countries (an area of 5.8 million square kilometers) covers [7,8].

CORINE system in our country in 1998 Turkey Statistical Institute, optimal use of land resources has been launched to be created using satellite images of the required land cover inventory for the work to be done on a geographic basis, such as the creation of a framework that will allow the field sampling in various studies [2]. There are essentially 3 levels in the CORINE system. There are 5 basic land cover classes at level 1, 15 classes with land cover/use at level 2, and 44 land use classes at level 3 [9].

In this study, to perceive the changes better between 1990 and 2018, it was decided that the merging of some classes in the Corine Land Use classification would be more accurate in terms of reality and interpretation as a result of the observations in the field. The level used in the study is usually the second level. However, a total of 15 classes were created by combining them with some classes at the third level (Table 2). To combine classes, ArcGIS 10.5 program and merge tool for polygon classes.

The changes occurring in the land cover in Mersin province were explained by taking into consideration the years 1990, 2000 and 2018. The amount of areal changes in this process has been revealed.

Table 1: CORINE Land Cover Classes

Level 1	Level 2	Level 3
1. Artificial Regions	1.1. City Structure	1.1.1. Continuous City Structure
		1.1.2. Discrete City Structure
	1.2. Industrial, Commercial and Transport Units	1.2.1. Industrial or Commercial Areas
		1.2.2. Road and Railway Related Areas
		1.2.3. Ports
		1.2.4. Airports
	1.3. Mining, Discharge and Construction Sites	1.3.1. Mine Extraction Areas
		1.3.2. Discharge Fields
		1.3.3. Construction Sites
	1.4. Artificial Non-Agricultural Green Areas	1.4.1. Green City Areas
1.4.2. Sports and Entertainment Areas		
2. Agricultural Areas	2.1. Arable Areas	2.1.1. Irrigable Arable Lands
		2.1.2. Continuously Irrigated Lands
		2.1.3. Rice Fields
	2.2. Continuous Products	2.2.1. Vineyards
		2.2.2. Fruit Gardens
		2.2.3. Olive Gardens
	2.3. Grasslands	2.3.1. Grasslands
	2.4. Heterogeneous Agricultural Areas	2.4.1. Annual Products with Continuous Products
		2.4.2. Mixed Agricultural Areas
		2.4.3. Agricultural Lands with Natural Vegetation
2.4.4. Forest Agriculture Lands		
3. Forest and Semi Natural Areas	3.1. Forests	3.1.1. Broad Leaved Forests
		3.1.2. Coniferous Forests
		3.1.3. Mixed Forests
	3.2. Maki or Herbaceous Plants	3.2.1. Natural Meadows
		3.2.2. Shrubberies
		3.2.3. Sclerophyll Vegetation
		3.2.4. Plant Change Areas
	3.3. Little or No Vegetation/ Flora Areas	3.3.1. Coast, Beach and Sandbox
		3.3.2. uncovered Cliffs
		3.3.3. Sparse Vegetable Areas
3.3.4. Burnt Out Areas		
3.3.5. Glaciers and Permanent Snow		
4. Wet Areas	4.1. Internal Wet Areas	4.1.1. Swamps
		4.1.2. Turfs
	4.2. Near Coastal Areas	4.2.1. Salt Marsh
		4.2.2. Salts
		4.2.3. Flats formed by the tide event
5. Water Communities	5.1. Inner Waters	5.1.1. Water Trails
		5.1.2. Water Bodies
	5.2. Sea Waters	5.2. 1. Coastal Lagoons
		5.2. 2. Golden Horn (River Mouths)
		5.2. 3. Seas and Oceans

Table 2. Land Use Classification Based on Corine System in Mersin

Ranking	Land Usage
1	Residential area
2	Transportation Area
3	Industrial and Commercial Area
4	Dry Field
5	Watery Field
6	Vineyards
7	Fruit Gardens
8	Olive Gardens
9	Grassland and Meadows
10	Other Agricultural Areas
11	Sand Dunes
12	Uncovered Cliffs
13	Forest Area
14	Swamps
15	Streams and Lakes

3. Results and Discussion

The changes occurring in the land cover in Mersin province were explained by taking into consideration the years 1990, 2000 and 2018. The amount of areal changes in this process has been revealed. Based on the results, forward-looking predictions were made.

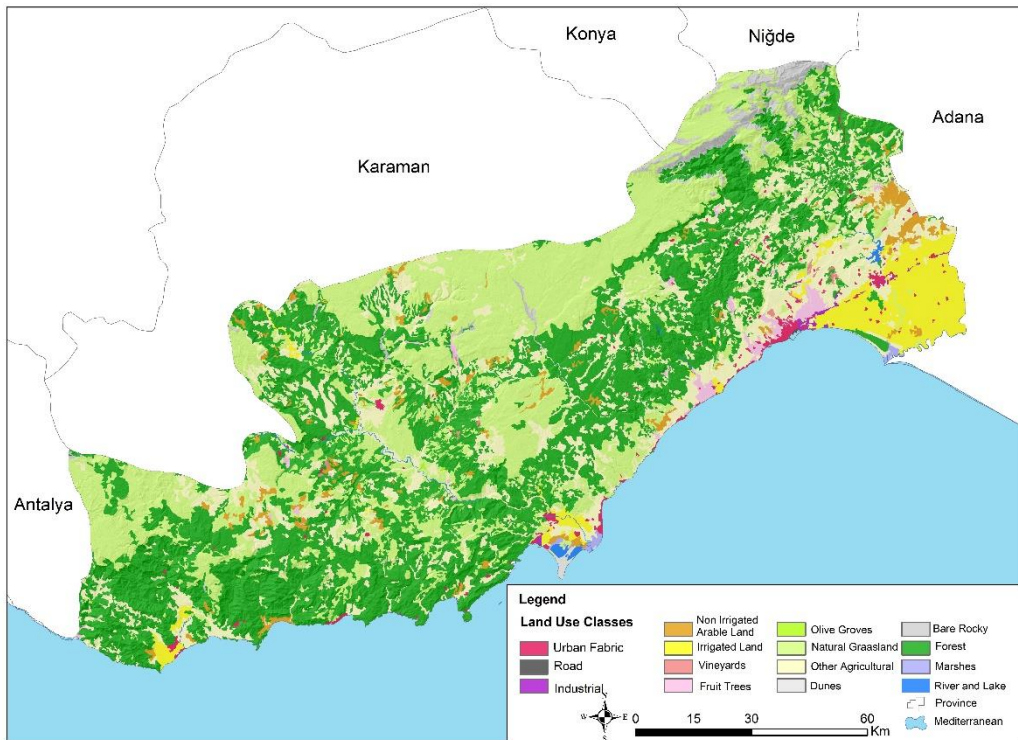
When the land use status of the study area with a surface area of 15908 km² in 1990 is examined, it is seen that most of this area consists of forests, grasslands, and meadows, followed by agricultural fields. While the forest area is 6566 km², grasslands and meadows are 4776 km² and agricultural areas are 3987 km² (Table 3-4). While dry field cultivation is 339 km² in agricultural areas, the irrigated field is 727 km², fruit gardens are 138 km², olive gardens are 4 km² and other agricultural areas are 2758 km². Other agricultural areas consist of forest areas, mixed agriculture areas, and areas where continuous crops and annual crops are planted and planted together. These agricultural areas mostly correspond to the belt with high slopes and natural forest cover (Figure 2). Settlement, industry, and transportation areas constitute a very low rate. While the area of the residential areas reaches 135 km², the areas where the industrial facilities spread are 21 km² and the transportation areas outside the residential areas are about 2 km².

Table 3. Land Use Status of Mersin Province Over the Years According to Corine System

Agricultural Area Usage	Years		
	1990 Km²	2000 Km²	2018 Km²
Dry Agriculture	339,7	338,4	316,6
Irrigated agriculture	727,0	726,4	643,3
Vineyards	20,0	19,9	40,7
Fruit Gardens	138,0	127,1	747,4
Olive Gardens	4,1	4,1	27,7
Grassland and Meadows	2758,7	6557,2	3215,0
Total	3987,5	7773,1	4990,6

Table 4. Agricultural Area Usage Status in Mersin Province by Year Based on Corine System

Land Usage	Years		
	1990 Km ²	2000 Km ²	2018 Km ²
Residential	135,8	162,8	217,9
Transportation	1,9	38,1	66,1
Industrial	21,1	15,7	36,6
Dry Agriculture	339,7	338,4	316,7
Irrigated agriculture	727,0	726,4	643,3
Vineyards	20,0	19,9	40,7
Fruit Gardens	138,0	127,1	747,4
Olive Gardens	4,1	4,1	27,7
Grassland and Meadows	4776,0	2729,1	2327,8
Other Agricultural Areas	2758,7	6557,2	3215,0
Sand Dunes	25,7	25,4	30,4
Uncovered Cliffs	314,7	314,7	678,5
Forest Area	6566,0	4768,0	7479,4
swamps	25,2	25,2	20,0
Streams and Lakes	54,1	55,9	61,0
Total Area	15908,0	15908,0	15908,0

**Figure 2.** Land Use Status of Mersin Province (1990)

When the land use status in 2000 is analyzed, it is seen that the agricultural lands rose to the first rank, followed by forests, grasslands, and meadows. Compared to 1990, while the forest areas were 4768 km² with a decrease of 1798

km², grasslands and meadows decreased to 2729 km² with a decrease of 2046 km². Agricultural fields expanded by 3785 km² and reached 7773 km². The largest expansion among the agricultural lands took place in the category of other agricultural lands. There was also an expansion of 10 km² in the fruit gardens category. There was a large expansion in favor of agricultural areas adjacent to or mixed with forests, grasslands, and meadows in the belt where the slope is high and natural forest cover is located. While there is a significant expansion in settlement and transportation areas, there is a contraction in the industrial area. The area of the residential areas has increased from 135 km² to 162 km², and the transportation areas outside the residential area have increased from 2 km² to 38 km². The areas of industrial facilities spread from 21 km² to 15 km². The decrease in the industrial areas is because many industrial areas remain within the settlements as a result of the expansion of the settlement areas. This situation is mostly seen in the east of Mersin city center (Figure 3). In areas covered by rivers and lakes, there was an expansion of about 2 km² and the surface area of these areas exceeded 55 km².

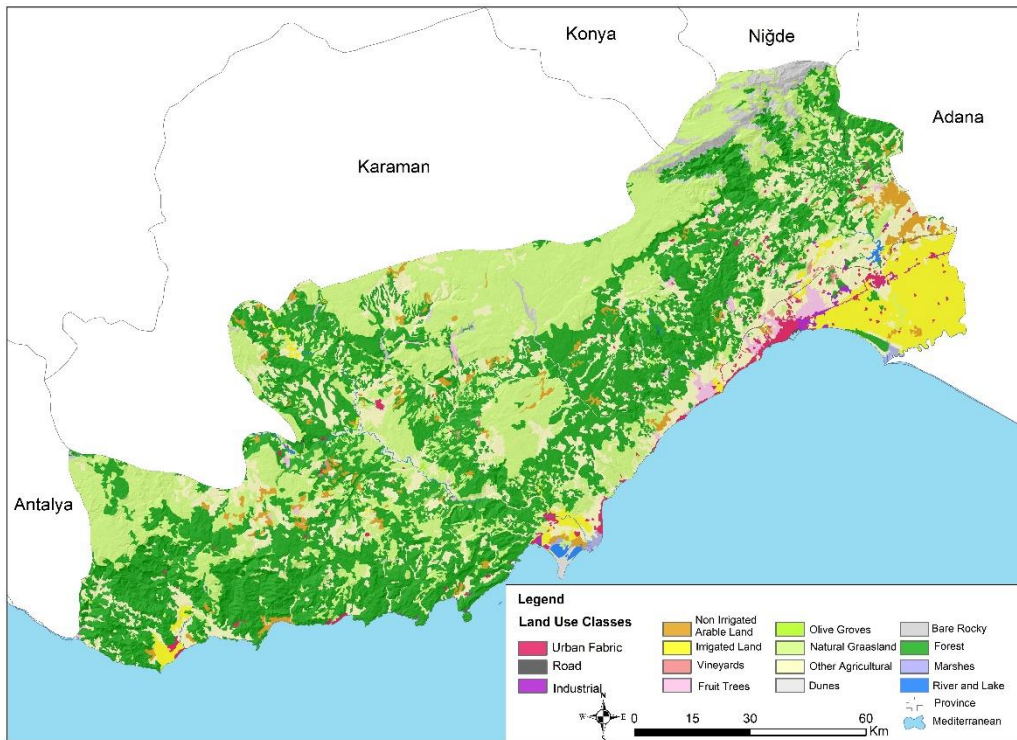


Figure 3. Mersin Province Land Use Status (2000)

When the land use situation in 2018 is analyzed, it is seen that the forest areas rose to the first rank and this was followed by agricultural fields, grasslands, and meadows. Compared to 2000, forest areas increased by 2711 km² and reached from 7468 km² to 7479 km². Agricultural areas decreased by 2782 km² from 7773 km² to 4990 km². A 3342 km² contraction has occurred in areas adjacent to forest areas within the agricultural areas and mixed with natural vegetation or where long-term and annual agricultural plants are intertwined. The contraction in agricultural areas in this category has exceeded 50% compared to 2000. Fruit gardens increased by 620 km² and reached from 127 km² to 747 km². Olive gardens increased from 4 km² to 27 km² and the vineyards increased from 19 km² to 40 km². On the other hand, there has been a decrease of 83 km² in areas where irrigated farming has been done. Grasslands and meadows decreased from 2729 km² to 2327 km² with a decrease of 401 km². On the other hand, there have been significant expansions in the areas of settlement, transportation, and industry. The residential area has increased from 162 km² to 217 km², transportation area from 38 km² to 66 km² and industrial areas from 15 km² to 32 km². Expansions in the field of industry and transportation mostly originated from highways and industrial facilities built in the east of the study area (Figure 4).

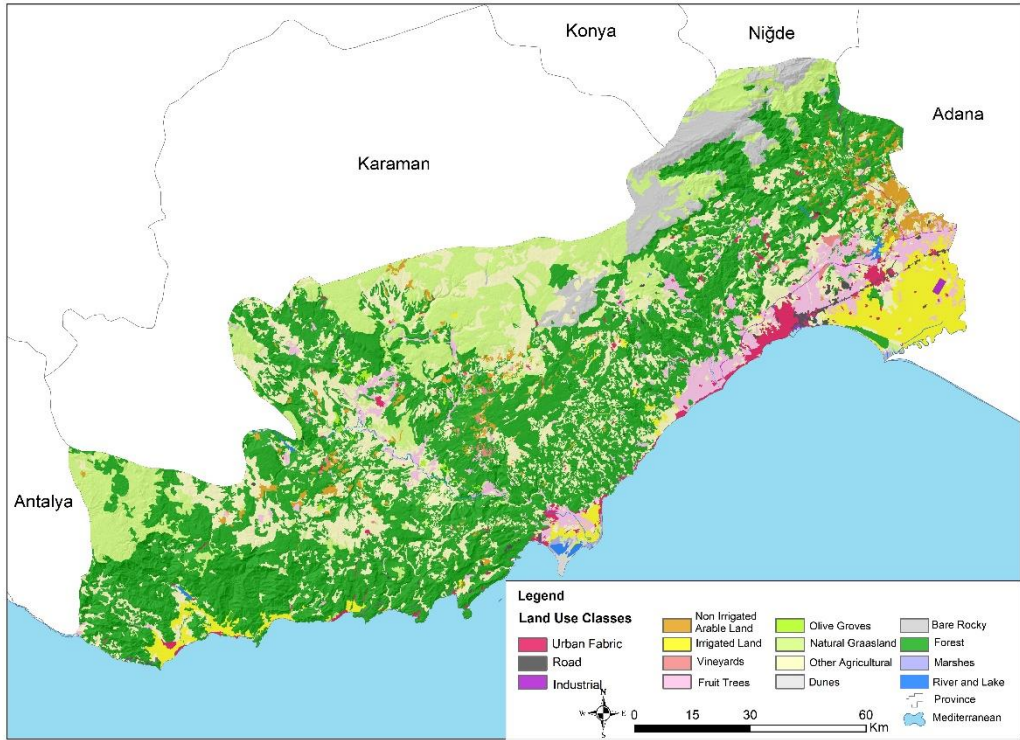


Figure 4. Land Use Status of Mersin Province (2018)

According to the calculations made based on the Corine System in 2018, the total agricultural area in the study area is around 4990 km². Its ratio to the total area is 31%. In the study area, irrigated farming mostly takes place in the south of Mersin-Adana highway and the Göksu Delta, whereas dry farming areas are concentrated especially in the northeast of Tarsus district.

The vineyards, on the other hand, are common in a hilly area of 10-15 km in the north of Tarsus and Mersin settlements and in the southeast part of Mut district.

Olive gardens are concentrated in the Göksu basin and especially north of Mut district center. Olive gardens are also common in hilly areas north of Tarsus district.

Fruit gardens, on the other hand, are dense in an area about 10 km wide, starting from the surroundings of the Erdemli district where the irrigation facilities are sufficient and the Mersin-Tarsus highway. It is also spreading increasingly in the Göksu basin, around Silifke and Mut district centers.

Other agricultural areas are concentrated especially in Göksu basin, plateau area in the north of Silifke and Erdemli districts, in hilly areas in the north of Çukurova. The fields included in this classification include areas with annual products mixed with continuous crops and areas where natural vegetation is mixed with agricultural areas, forest agricultural areas, and areas where mixed crops are grown.

While the grasslands are common in the plateau area in the north of the province, the bare areas occupy a large area in the north of Tarsus, Çamliyayla and Toroslar districts, where the slope and elevation are very high.

The forests extend from east to west of Mersin and reach an average depth of 50 km. The forests go down to the sea in the section from Antalya province border to Erdemli district.

Dunes and swamps are located at the mouth of Göksu, Seyhan and Tarsus Stream.

Industrial areas are mostly concentrated around Mersin-Adana highway in the east of Mersin city. There are also some industrial facilities to the west of Silifke district.

Although the settlement areas are spread throughout the province, it covers a large area between Mersin and Tarsus.

4. Conclusion and Suggestions

In the study area covering Mersin province and 15908 km², the changes in the land cover were examined according to the Corine system in 15 categories and based on 3 separate years.

As a result of this review, an increasing trend was observed in settlements, transportation, industrial areas and vineyards between 1990 and 2018, while a decrease was observed in dry and irrigated agricultural areas, grasslands and meadows. In this process, while bare areas doubled, a fluctuating course was observed in forest and fruit areas. Due to the increasing population in the expansion of the settlement areas and the economic development, the expansion of the settlements and the effect of the development plans made are in question. Likewise, as a reflection of the population and economic developments, the construction of new transportation networks, highways, the establishment of new industrial facilities and the expansion in the Organized Industrial Zones have led to the expansion of transportation and industrial areas. These enlargements in residential, transportation and industrial areas have caused some other areas of use to contract. While there is a decrease in dry and irrigated farming fields around the densely populated areas, as well as in fruit gardens and vineyards, fruit gardens, vineyards, and olive gardens have expanded away from the shore and in places where the altitude is increased. The places where this expansion has occurred were mostly realized in areas bordering forests and grasslands. The increase in river and lake areas in this process is due to newly built dams and ponds. Rises and decreases in other agricultural areas are mostly related to the situation in forest areas. Here, the decrease in one was reflected in the other as an increase. While the surface area of other agricultural lands increased by more than two times in 2000 compared to 1990, it can be said that the economic process and population movements were effective in decreasing to 3215 km² in 2018. In recent years, especially in places where the altitude is over 1000 meters, despite the increasing agricultural cost, the relative decline in sales prices has made it impossible for people to cultivate in these low-yield areas. For this reason, people who could not make a living generally stopped cultivating in this area and migrated to the city center. In this case, a large part of these areas started to look like a forest again.

When the changes in the land cover over the years taken into consideration, it can be predicted that there will be an expansion in settlement, transportation, industrial areas, fruit gardens, olive gardens and vineyards. However, it should be noted that the areas mentioned above should not be against each other. Because settlement, transportation, industrial areas, and fruit gardens, olive gardens and vineyards are largely adjacent to each other and mostly concentrated in the southeast of the study area. For this reason, especially settlement, transportation, industrial areas; away from fruit gardens and olive gardens; grassland or slope rate is high; low agricultural productivity; It would be more appropriate to direct it to the areas with dry farming areas that are not 1st and 2nd class. In addition, the forest areas around the rural settlements are under the pressure of a large population and settlements due to the developments in the spring land. The forests must lose their quality due to the fires that have been cut or intentionally removed, and consequently, these areas should not be allowed to settle for the sake of rent. In this context, water resources in these areas are also under threat. The awareness that a modern residential fabric that is compatible with nature and a healthy life away from environmental problems is indispensable for our future should be expanded in the society. Planning at different scales (regional, urban, tourism, recreation, etc.) should be done correctly by considering the past process and considering future generations.

Competing Interest / Conflict of Interest

The authors declare that they no conflict of interest. The none of the authors have any competing interests in the manuscript.

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