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Investigation of Land Cover Change in Kahramanmaras Province (Turkey)

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Abstract: *Land cover changes directly affect biodiversity, contribute to global climate change, are a primary source of soil degeneration and alter ecosystem services. Therefore, it is necessary to have accurate information about land cover in order to ensure effective use of land. In this study, it is aimed to determine the changes in the land cover between 1990-2018 in Kahramanmaras according to the CORINE (Coordination of Information on the Environment) system. While a change was observed in all of the ten determined classes, it was determined that there was an increase in seven of them and a decrease in three of them. The classes with the highest increases were mine sites, urban open green areas, water bodies, and urban areas, respectively. The land covers with the highest decreases were dunes, maquis shrubland, and agricultural areas, respectively. As a result, possible causes and consequences of changes in land cover classes were discussed.*

Keywords: Land cover, CORINE, Kahramanmaras

1. INTRODUCTION

Humankind has constantly changed the environment in which it lives, and this has brought about large-scale land cover changes [1]. Land cover change is the direct and/or indirect result of human actions to control essential resources and is a general term that refers to human alteration of the earth [2]. Changes in ecosystems due to the changing process of land cover constitute the biggest environmental concern for humanity today. Therefore, monitoring and mitigating the negative consequences of land cover changes while maintaining the production of essential resources has become a top priority for researchers [3].

Land cover changes, which play an important role in today's global change events, are complex and dynamic processes related to natural and human systems and affect soil, water, and the atmosphere [4,5]. Land cover changes directly affect biodiversity, contribute to global climate change, are a primary source of soil degeneration and alter ecosystem services [6,7,8]. Information on land cover changes is important for policy decisions, planning and management of natural resources, modeling environmental variables, understanding the distribution of habitats and linking land use activities [9,10,11]. Therefore, it is necessary to have accurate information about land cover in order to ensure effective use of land, which is an important natural resource, and to create integrated plans for environmental processes.

Advances in RS (Remote Sensing) and GIS (Geographical Information Systems) techniques offer new opportunities to create detailed, fast land cover maps covering large areas over high resolution satellite images [12,13]. Since the 1970s, international scientific societies have developed various methods for the detection and monitoring of land cover characteristics [14]. The most widely used of these methods is the CORINE (Coordination of Information on the Environment) system [15]. CORINE is a program started in 1985 that aims to gather information for the European Union on priority environmental issues (air, water, soil, land cover, coastal erosion, biotopes). Since 1994, the EEA (European Environment Agency) has included the CORINE Project in its program. CORINE is a data source for determining land cover changes. It is implemented in all European Environment Agency member countries in line with the criteria and classification system determined by the European Environment Agency. It has been implemented in order to establish a standard database for the purposes of determining environmental changes in the land, rational management of natural resources, and formulating environmental policies [16].

In this study, it is aimed to determine the changes in the land cover between 1990-2018 in Kahramanmaras according to the CORINE system. As a result of the analysis, the land classes in the region, the areas they cover, and their spatial and temporal changes were determined, and the possible causes and consequences of the changes were discussed. With the study, results that can support studies such as city and regional planning, sustainable land management, sustainability of the ecological environment, and proper use of the land have been obtained, and thematic maps that can be used as a basis in different studies have been produced.

2. MATERIAL AND METHOD

Kahramanmaras was chosen as the study area (Fig. 1). CORINE 1990 and 2018 data were used as the main materials in determining the land cover of Kahramanmaras and analyzing its change. These are 100-meter-resolution raster data in GeoTiff format obtained from the CORINE project's website (Copernicus Land Monitoring Service) [17]. First of all, the part that includes Kahramanmaras city borders from these data was clipped using ArcGIS-ArcMap 10.3 software. Then, reclassification was made for the ten basic land covers (Agricultural Area, Bare Rock, Dune, Forest, Maquis Shrubland, Meadow and Pasture, Mine Site, Urban Area, Urban Open Green Area, Water Body) determined within the scope of CORINE land classes. After these processes were carried out for both periods,

the sizes of the land covers determined in ArcGIS-ArcMap 10.3 software were calculated as hectares and the ratios of these classes in the total surface area of Kahramanmaras province, their size and the amount of change were presented in a table.

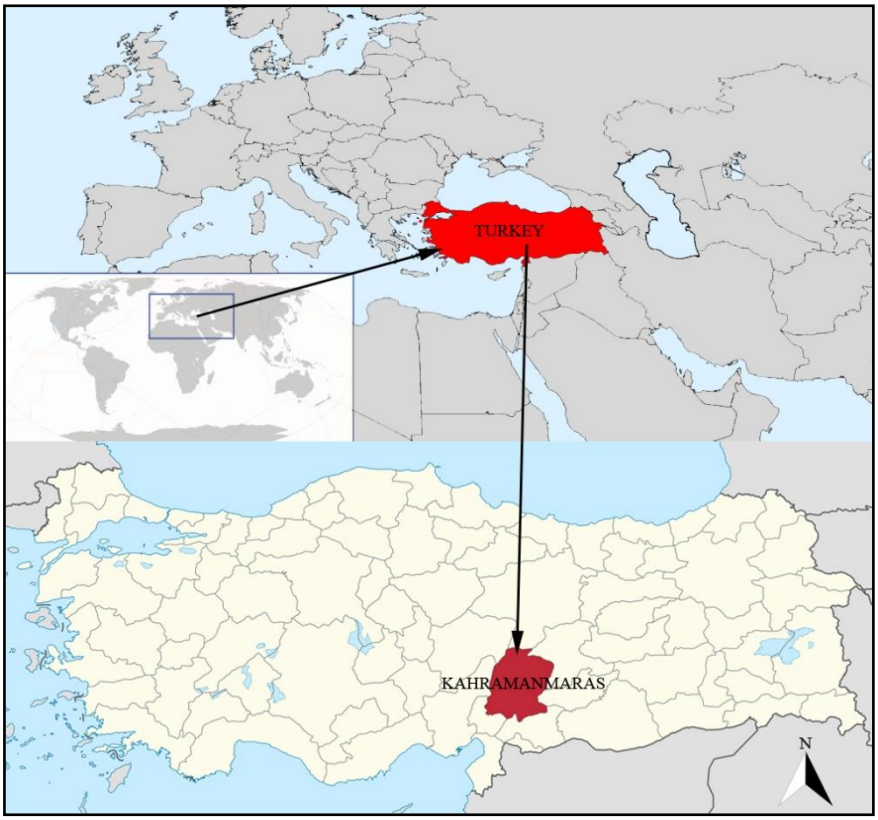

Fig 1. Location of the study area

3. RESULTS

The land cover map of Kahramanmaras province in 1990 is given in Figure 2. In Table 1, the area covered by the ten basic land covers determined within the scope of CORINE land classes in 1990 and the proportions of these classes in the total surface area of Kahramanmaras province are given. Accordingly, while the land cover covering the most area within the provincial borders was agricultural areas (42.04%), this class was followed by meadows and pastures (24.61%), maquis shrubland (18.40%), and forests (11.67%). The land covers with the least area were urban open green areas (0.003%), mine sites (0.12%), dunes (0.21%) and water bodies (0.42%).

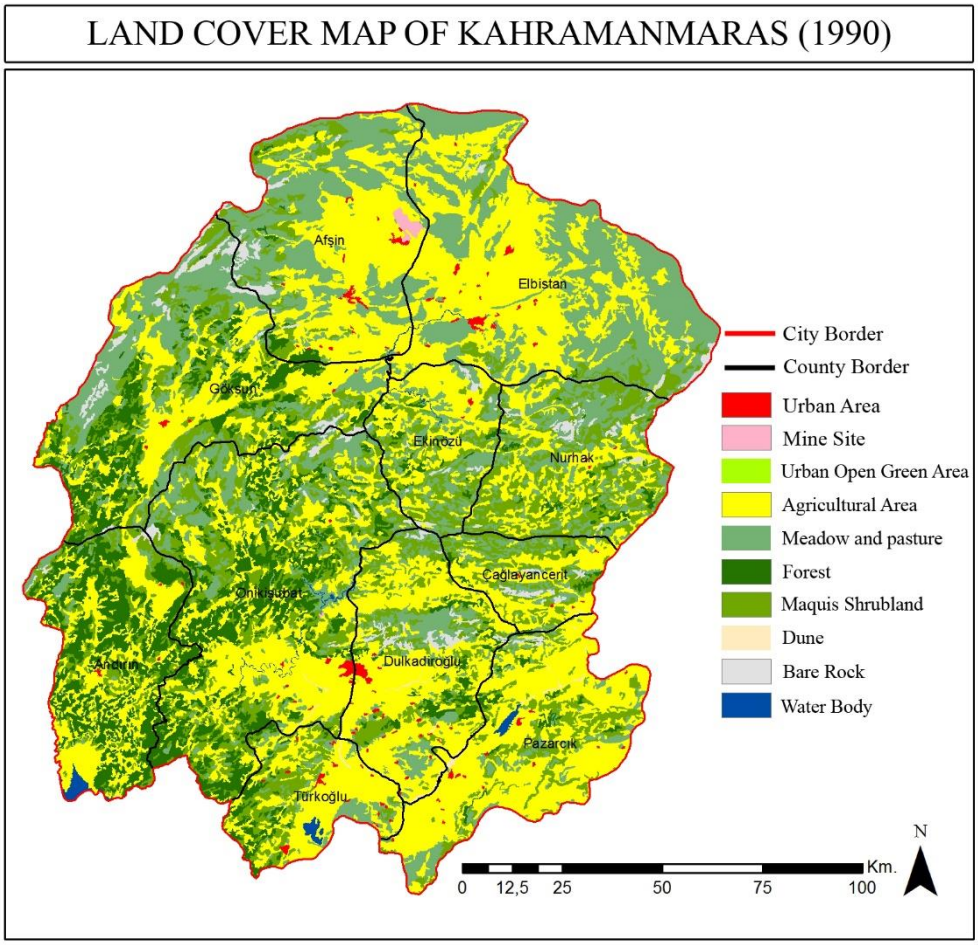

Fig 2. Land cover map of Kahramanmaras (1990)

Table 1. The area covered by the land covers in 1990 and the ratios of these classes to the total surface area of the province

Land cover	**Area size (ha.) 1990**	**Ratio in the total surface**
Agricultural Area	610.544	42.04%
Bare Rock	27.778	1.91%
Dune	3.155	0.21%
Forest	169.612	11.67%
Maquis Shrubland	267.266	18.40%
Meadow and pasture	357.443	24.61%
Mine Site	1.858	0.12%
Urban Area	8.345	0.57%
Urban Open Green Area	46	0.003%
Water Body	6.125	0.42%

The land cover map of Kahramanmaras province in 2018 is given in Figure 3. In Table 2, the area covered by the ten basic land covers determined within the scope of CORINE land classes in 2018 and the proportions of these classes in the total surface area of Kahramanmaras province are given. Accordingly, while the land cover covering the most area within the provincial borders was agricultural areas (34.63%), this class was followed by meadows and pastures (31.91%), maquis shrubland (14.10%), and forests (12.71%). The land covers with the least area were urban open green areas (0.01%), dunes (0.16%) and mine sites (0.45%).

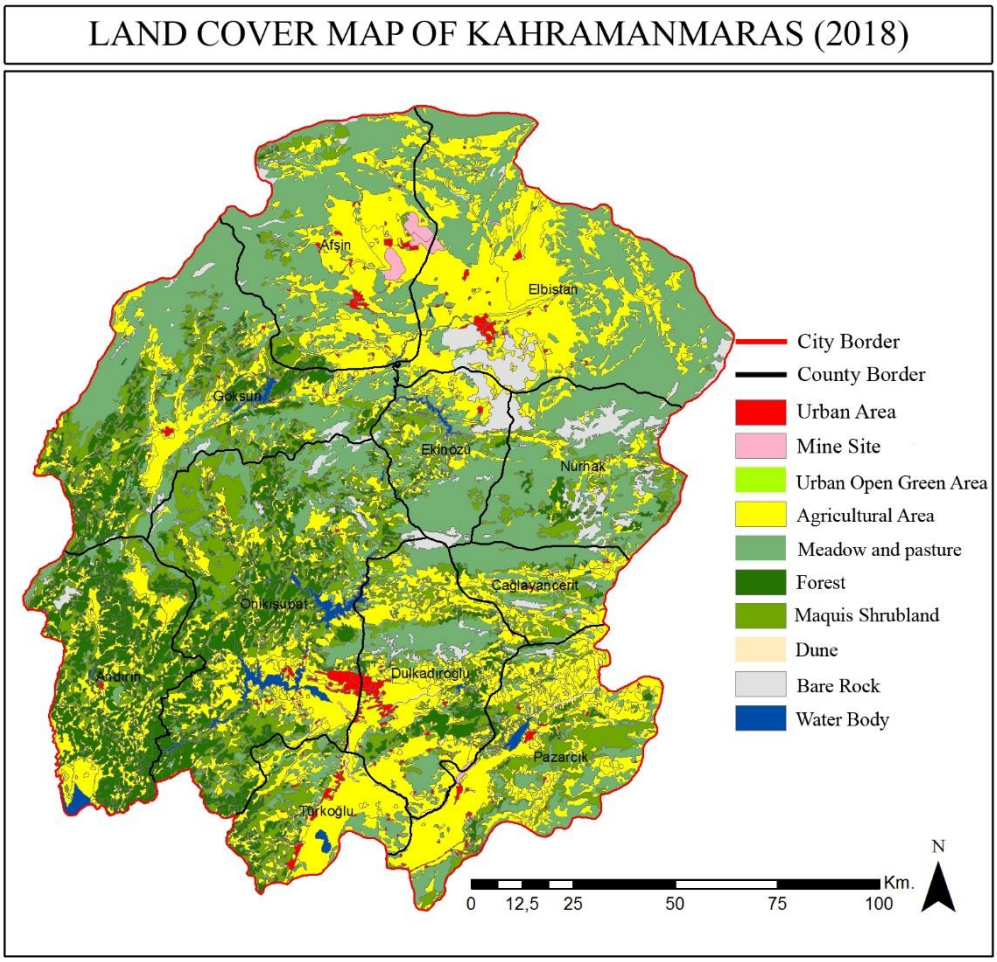

Fig 3. Land cover map of Kahramanmaras (2018)

Table 2. The area covered by the land covers in 2018 and the ratios of these classes to the total surface area of the province

Land cover	**Area size (ha.) 2018**	**Ratio in the total surface**
Agricultural Area	502.948	34.63%
Bare Rock	54.268	3.73%
Dune	2.382	0.16%
Forest	184.676	12.71%
Maquis Shrubland	204.834	14.10%
Meadow and pasture	463.526	31.91%
Mine Site	6.655	0.45%
Urban Area	16.321	1.12%
Urban Open Green Area	159	0.01%
Water Body	16.402	1.12%

The rates of land cover change between 1990 and 2018 were given in Table 3. According to this, while a change was observed in all ten classes, it was determined that there was an increase in seven of them and a decrease in three of them. The classes with the highest increases were mine sites (258.18%), urban open green areas (245.65%), water bodies (167.79%), urban areas (95.58%), and bare rocks (95.36%), respectively. The land covers with the highest decreases were dunes (24.50%), maquis shrubland (23.36%) and agricultural areas (17.62%), respectively.

Table 3. Land cover change between 1990 and 2018

Land cover	Area size (ha.) 1990	Area size (ha.) 2018	Rate of change
Agricultural Area	610.544	502.948	-17.62%
Bare Rock	27.778	54.268	+95.36%
Dune	3.155	2.382	-24.50%
Forest	169.612	184.676	+8.88%
Maquis Shrubland	267.266	204.834	-23.36%
Meadow and Pasture	357.443	463.526	+29.68%
Mine Site	1.858	6.655	+258.18%
Urban Area	8.345	16.321	+95.58%
Urban Open Green Area	46	159	+245.65%
Water Body	6.125	16.402	+167.79%

4. DISCUSSION

It was determined that the most common land cover in Kahramanmaras was agricultural areas in both 1990 and 2018. However, when the change in agricultural areas during this period was examined, it was seen that it decreased by 17.62%. It can be said that the reason for this decrease is largely the pressure of urbanization. Especially with the unplanned growth of urban areas, valuable agricultural lands are lost and improper land uses are realized.

Another data that supports the pressure of urbanization in Kahramanmaras is that the urban areas increased by 95.58% from 1990 to 2018. Urbanization brings with it many environmental problems. So much so that one of the most important causes of floods and overflows in the province in recent years is the increasing impermeable surfaces with urbanization. In order to prevent this situation, ecological-based planning approaches are needed in cities.

The rich hydrological structure of Kahramanmaras has enabled the construction of many dams and thus dam lakes. It is possible to explain the change of 167.79% in water bodies in this way. These dams and dam lakes have effects on the natural characteristics of the region, such as climate, vegetation, and wildlife, due to the volumes of water they contain.

The highest increase in land cover classes was observed in mine sites. Rehabilitation of these areas is very important after the mining operations in the mining areas are completed. It is extremely important to carry out comprehensive planning studies that include all stakeholders in the rehabilitation processes, especially in terms of supporting the sustainable development goals of rural areas.

The second highest increase in land cover classes was seen in urban open green areas. The most important reason for this is that, as a result of the uncontrolled spread of urban areas, the green areas in the immediate vicinity of the city remain within the city limits and turn into urban open green areas that are used extensively by the city dwellers. However, despite this increase, it can be said that open and green areas in the city are insufficient.

The 8.88% increase in forest areas in the province can be considered as a positive development. However, these forest areas are fragmented. Ensuring the integrity of these areas with green corridors will be beneficial in terms of ecosystem services as well as increasing ecological diversity.

5. CONCLUSION

In this study, changes in the land cover between 1990-2018 in Kahramanmaras province were determined according to the CORINE system. Possible causes and consequences of these changes were discussed. As a result, in this study, data that can support studies such as city and regional planning, sustainable land management, sustainability of the ecological environment, and proper use of the land were obtained. This study will serve as a base for further detailed and/or longer-term studies.

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