

*Full Length Research Paper*

# Monitoring land use changes in tourism centers with GIS: Uzungöl case study

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In Turkey, highlands have been used as venues for livestock and summer recreation for many years. Today, however, they are subject to alternative tourism and recreation activities, which dramatically change the nature in these regions. Because of natural beauties, "Touristic Centers" for eco-tourism have started rapidly in these places for the last three decades. Uzungöl, which belongs to Çaykara district of the Trabzon province, is one of the first of these tourism centers. In this study, temporal and spatial land use changes of the Uzungöl tourism center that has a national and international importance were analyzed using aerial photographs and GIS. For this purpose, aerial photographs of 1973 - 2002, and base map of 2008 were examined to determine the dimensions of the construction in the region. The results of the analysis have shown that, the region has undergone a heavy construction in the last 35 years. A very significant increase in the number of buildings (91%), which is especially concentrated in a particular watershed protection area around the lake, has been identified. Results indicate that, Uzungöl is under an unplanned development period, which is away from the scope of eco-tourism wonderland sustainability and/or intervention with the general plan of construction work.

**Key words:** Aerial photograph, ecotourism, GIS, land use change, Uzungöl.

## INTRODUCTION

Consumption of natural resources has accelerated with the industrial revolution in the world. Rapid population growth and consumption of these resources caused gradually was the expansion of urban and industry areas, while agricultural and forest areas were substantially diminished (Cruz, 1994). Industry and the growing level of urbanization have caused serious problems such as, concrete structuring, noise and environmental pollution especially in big cities. These problems affect adversely the lives of people living in urban environments (Soykan, 2000). Therefore, people living and working in this environment is in search of increasing the alternative tourism as well as the sea, sand and sun-based mass tourism (Marcouiller 1998; Bowe and Marcouiller, 2007).

Increased interest in the alternative tourism is greatly focused on the natural and cultural resources as well as lake tourism (Ceballos and Lascurain, 1991). The Northern European countries such as Finland, Iceland, Netherlands, Ireland and the United States are the leading countries in the development of lake tourism in the world (Akpınar et al., 2007). Among them is Finland,

also known as a country of thousand lakes that has a special place (Akpınar and Akbulut, 2007).

Turkey also shows a great diversity and wealth in terms of flora and fauna hosted in lakes and highlands (Çıkın et al., 2009). Especially, the evaluation of inland lakes and highland areas for recreation purposes has gained popularity in recent years (Atasoy and Bıyık, 2006). People are uncomfortable with the higher temperature of the Anatolian plateau in summers and they prefer to spend their weekend to cool off on the shores of the lakes and highlands, while having their picnic. In some lakes and highlands closer to the coast, besides internal tourism, external tourism activities are also frequently observed (Akpınar and Akbulut, 2007).

Eastern Black Sea Region, which constitutes part of Turkey of the Caucasus Eco-region, is one of the 200 important ecological regions in terms of biological diversity around the world. For this reason, the region has a higher highland and lake tourism potential. In the region, there are more than 200 highlands (20 of them are assigned as the tourism centers) and many lakes

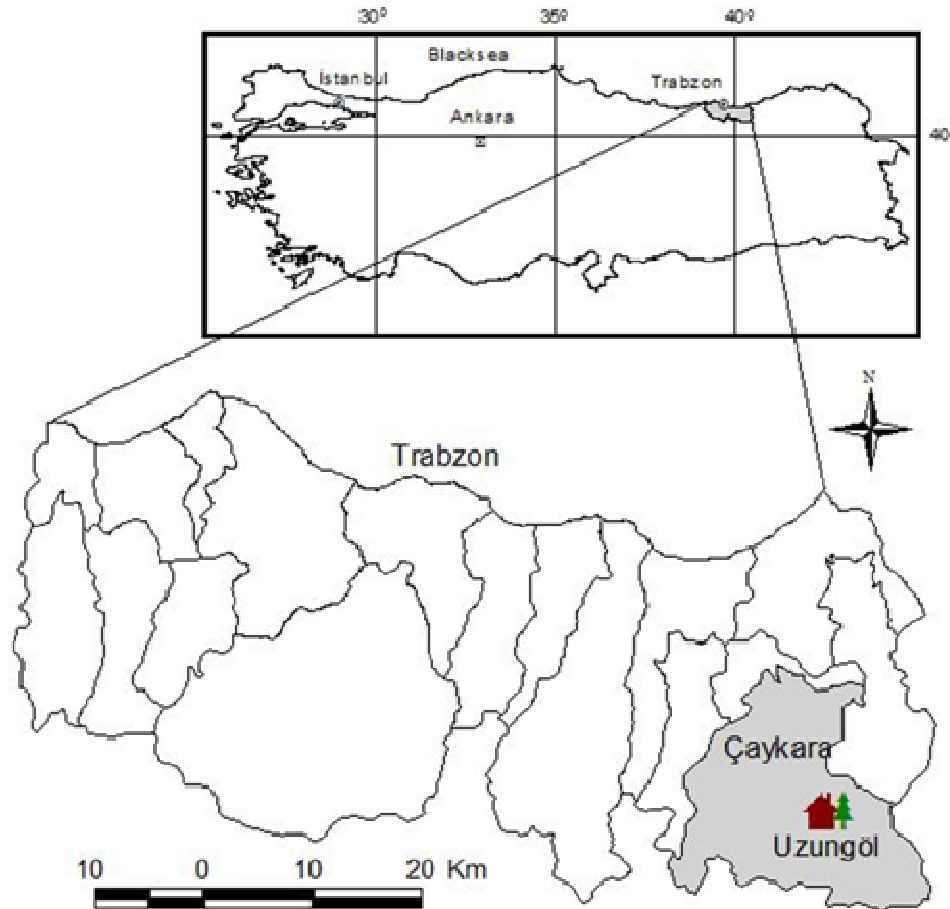


Figure 1. Location map of the study area.

(Atasoy, 2007). These highlands have a large tourist potential and many alternative tourism opportunities in terms of preserved highland culture, historic sites, natural beauties, flora, fauna, forests, lakes, streams, waterfalls, clear mountain air, water, etc. Therefore, in 1990, the Ministry of Tourism has initiated a "Highlands Tourism Project" in Turkey and out of declared 26 "Tourism Centers" for highlands 20 of them were in the Eastern Black Sea Region. A total of 5 tourism centers were in Trabzon province (Atasoy, 2007). While only 4 of these are for the use of highland tourism, Uzungöl tourism center is both for highland and lake use (Anonymous 2006).

Geographical Information Systems is an excellent tool for assessing the land use/land cover changes using different kinds of data such as satellite images, aerial photos and maps (Bender et al., 2005; Wu et al., 2006; Cetin et al., 2008). Geographical data can be collected, stored, analyzed and displayed in a wide variety of environments (Yomralioglu, 2000; Longley et al., 2001; Budic et al., 2004). Aerial Photogrammetric data, which is a useful source of information and provides high resolution and timely data, have proven to be useful in monitoring land use/land cover changes (Rembold et al.,

2000). In this study, the land use changes experienced in the Uzungöl Special Environmental Protection Area in the last thirty-five-year period were investigated using Geographic Information System and Aerial photographs.

## MATERIALS AND METHODS

Uzungöl is located in the Eastern Black Sea section of the Black Sea Region. It is a town belonging to a district of Trabzon province. The population of Uzungöl was 4190 in 2000 and it is 105 km distance away from Trabzon city center, while, it is only 25 km away from Çaykara district center. Uzungöl basin has very steep slopes and a long valley formed by Haldizen Stream. Location map of the study area are shown in Figure 1. This area has a very important potential for tourism.

Uzungöl, which has a landslide settled character, formed as a result of the closure of the stream bed by eroded slope mass. The formation of Uzungöl accumulation cone has a different character from the classic cone. The cone of lake was formed from the rocks that were carried by very short streams from the large quantities of weathering products which was deposited in the steep slopes in the south of the lake (Akkan et al., 1993). The lake basin is approximately 1250 m high from the sea level. Because of vegetation, wildlife and landscape beauty was declared as "Natural park" by the Ministry of Forestry in 1989 (Araz, 1996). Also, in 1990, it was declared as "Tourism center" and in 2004 it was declared as

“Special Environmental Protection Area (SPA)” with the decision of the Council of Ministers (Anonymous, 2010). Because of these characteristics, many domestic and foreign tourists visit the area.

The lake in the form of a natural dam was formed by closure of Haldizen stream valley bed as a result of landslides. The surrounding spruce forests together with the lake present an attractive landscape exhibition. The lake's water surface shows little difference in the amount of water depending on the season. Currently, wooden bungalows with a capacity of 52 beds and restaurants located near Haldizen stream in the South of the lake were operated by the private sector and they are provided with successful services during summer-winter period. Haldizen Stream Valley lying towards the South has a great natural wealth. 10 small lakes located at the height of mountains, which are approximately 10 - 20 km to Uzungöl increase the number of activities in the region (Anonymous, 2006).

In this study, the size of construction and its stages for Uzungöl tourism center were examined by using 1973 - 2002 aerial photographs with a scale of 1/23000 and 1/16000, respectively, and the base map of 2008. The temporal and spatial changes occurred in the region have been determined using aerial photographs took on different dates and base maps in the Geographical Information System (GIS) environment. ERDAS 9.2 software was used in the orientation process of aerial photographs and the temporal changes experienced in the highland were analyzed in the ArcGIS 9.2 software. The coordinate system of aerial photographs was converted to Datum ED-50 by UTM coordinate system of the base maps.

## RESULTS AND DISCUSSION

It is extensively recognized that urbanization can have serious implications for the long-term sustainability and health of human dominated stream systems causing problems, such as urban flooding, stream bank erosion, habitat degradation, and downstream pollutant loading when watershed development exceeds a certain impervious surface threshold (Randolph, 2004; Konard and Booth, 2005; Dougherty et al., 2006; Sheng and Wilson, 2009).

This work supplied important information about environmental changes and socio-economic results observed in Uzungöl tourism center. With development of highland and lake tourism in recent years there is an increased demand for parts of the world with natural beauties. The countries and rural areas having natural beauties were both negatively and positively affected from this increased demand. These effects were seen generally in the form of land use changes. Change of land use of an uncontrolled way does not only have local effects, but it is also triggering global change in a way. In particular, the natural features is small but highly demanding and important tourism regions such as the Uzungöl can quickly become distorted as concrete stack if the construction are not planned and controlled in a right way. Therefore, such areas should be monitored and taking into account of the characteristics in the past and structures should be constructed in a planned way while preserving the original features.

According to data obtained from the Uzungöl Municipality for 2009, the total number of touristic accommo-

dations (Hotels, Motels and Pensions) in the region was 41, and the total bed capacity of these enterprises was 1191. When the last five-year data was taken into consideration, it was shown that, the region was subject to intense tourism activities (Figure 2). In 2005, 92,348 domestic and 1,790 foreign tourists stopped by the region, while approximately 60,000 people visited daily. In 2009, these figures were 156,000, 7,000 and 110,000, respectively. When the last five-year values were compared, the increase in the number of domestic tourists that spent the night was 69%, while the number of foreign tourists staying was observed in a significant increase with 290%. A total of 1,142,907 domestic and foreign tourists that clearly shows the region's tourism that potentially visited the region in the last five years.

The temporal land use changes in the Uzungöl Special Environmental Protection Area (SEPA) were identified for settlement, forest, pasture, buildings and lake areas for the periods of 1973, 2002 and 2008 (Table 1). In this study, since tourism properties of the region were not yet known and there were not initially change in land use, aerial photographs belonging to the 1973 were taken as the base. Thus, the basic data were comparable to today's land use could be obtained.

### Changes in the settlement area

In the Eastern Black Sea region, depending on topography, rural settlements are very scattered to a greater extent (Anonymous, 2000). This structure rarely appears in Uzungöl (Figure 3). Because of adverse terrain of the region and lack of suitable land for habitation, a collective settlement is almost observed. Analysis results showed that the total settlement area was 194.66 ha in 1973, while, in 2002, it was increased to 195.25 ha (Table 1). Approximately, 0.6 ha that observed increase was due to the decrease in the river bed area as a result of improvement works conducted by the XXII Regional Directorate of the State Hydraulic Works (DSI) in 1998. It was known that, significant disasters such as floods and landslides often experienced in the region have cause loss of life and property. Therefore, the negative effects of construction on stream bed are taking place from time to time in the region.

On the other hand, changes experienced between 1973 - 2008 in road network and construction in Uzungöl SEPA are shown in Table 1 and Figures 3 and 4. According to Table 1, there were 299 houses in the area in 1973 with a total area of 37.8 ha. In 2002, there were 560 houses (an increase of 87%) with an area of 59.5 ha. Between 2002 - 2008, a small increase in the number of houses (571) was observed with an area of 6.08 ha. In 2004, the area was covered by the SEPA and illegal construction has decreased significantly through strict measurement. Overall, a significant increase in the number of houses (91%) has been observed for the last 35-years. This significant increase in the housing in Uzungöl

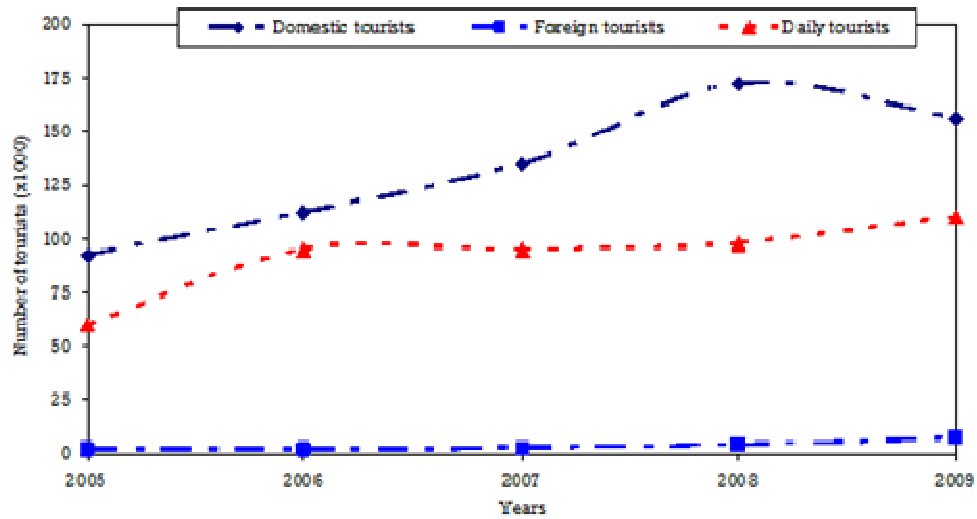


Figure 2. Distribution of number of tourists visited Uzungöl in the last five years.

Table 1. Temporal land use changes in the Uzungöl SEPA.

Year	Settlement (ha)	Forest (ha)	Pasture (ha)	No of Buildings	Buildings (ha)	Lake (ha)
1973	194.66	746.14	43.84	299	3.78	8.71
2002	195.25	744.40	43.84	560	5.95	10.39
2008	195.25	-	-	571	6.08	14.58
Change (%)	0.30	0.2	-	91	61	67

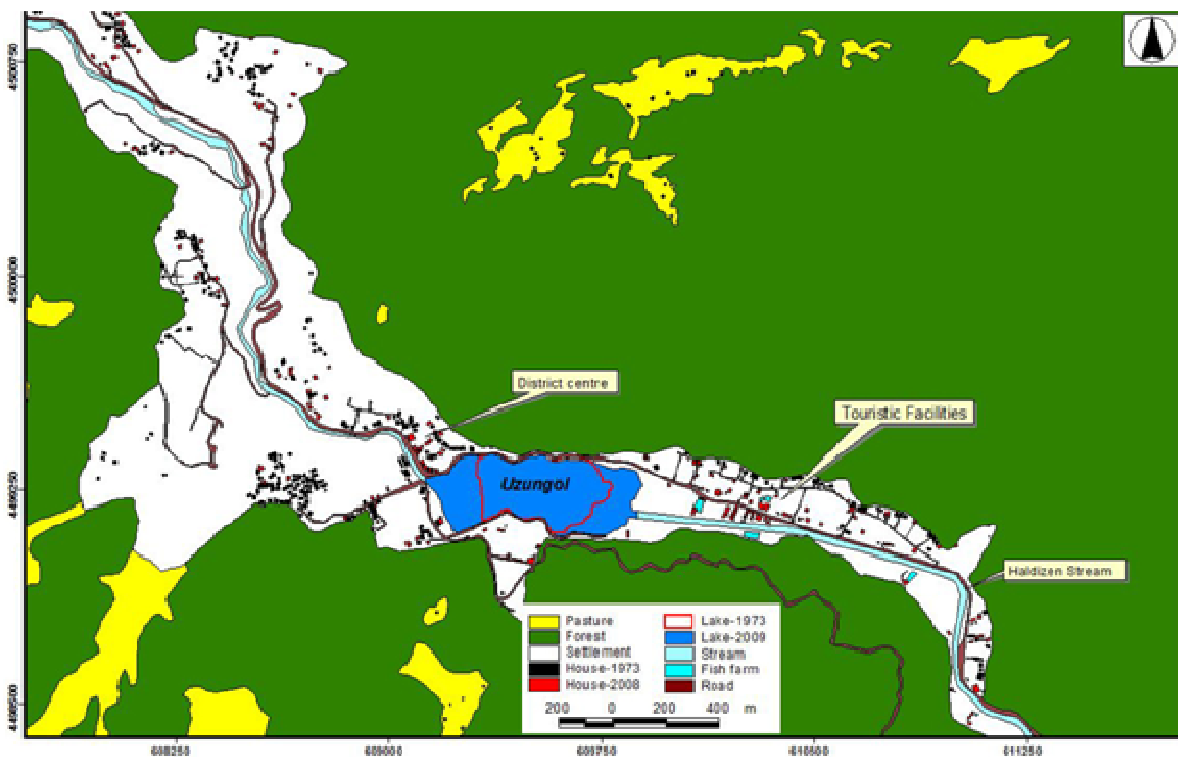
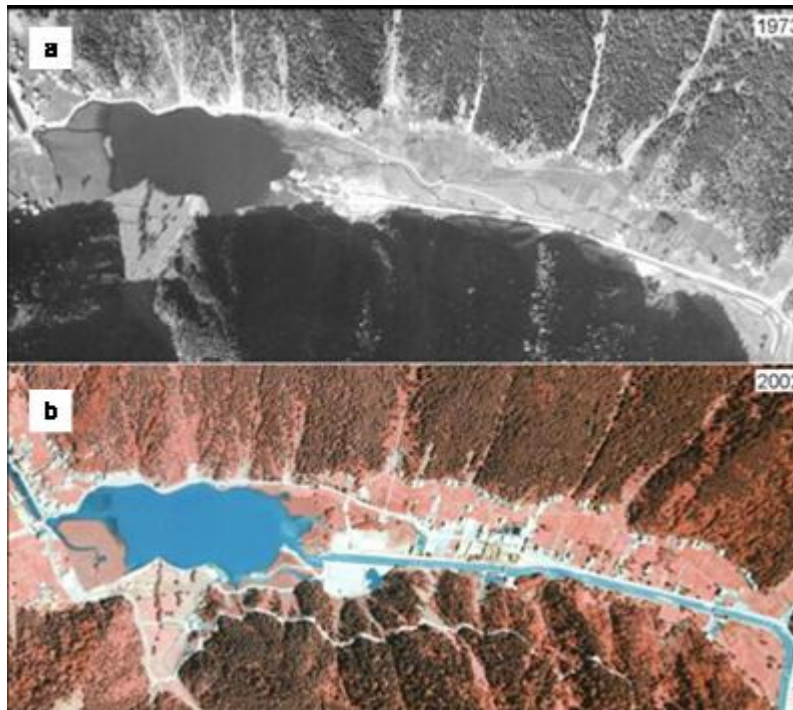


Figure 3. Temporal land use changes in Uzungöl between 1973 and 2008.



**Figure 4.** Temporal changes observed in Uzungöl between 1973 and 2002.

was gained by speed after 1980 when it has been the subject of tourism activities. In addition, an area of 0.90 ha of road works has been constructed to ensure that there was access to additional houses constructed in the region.

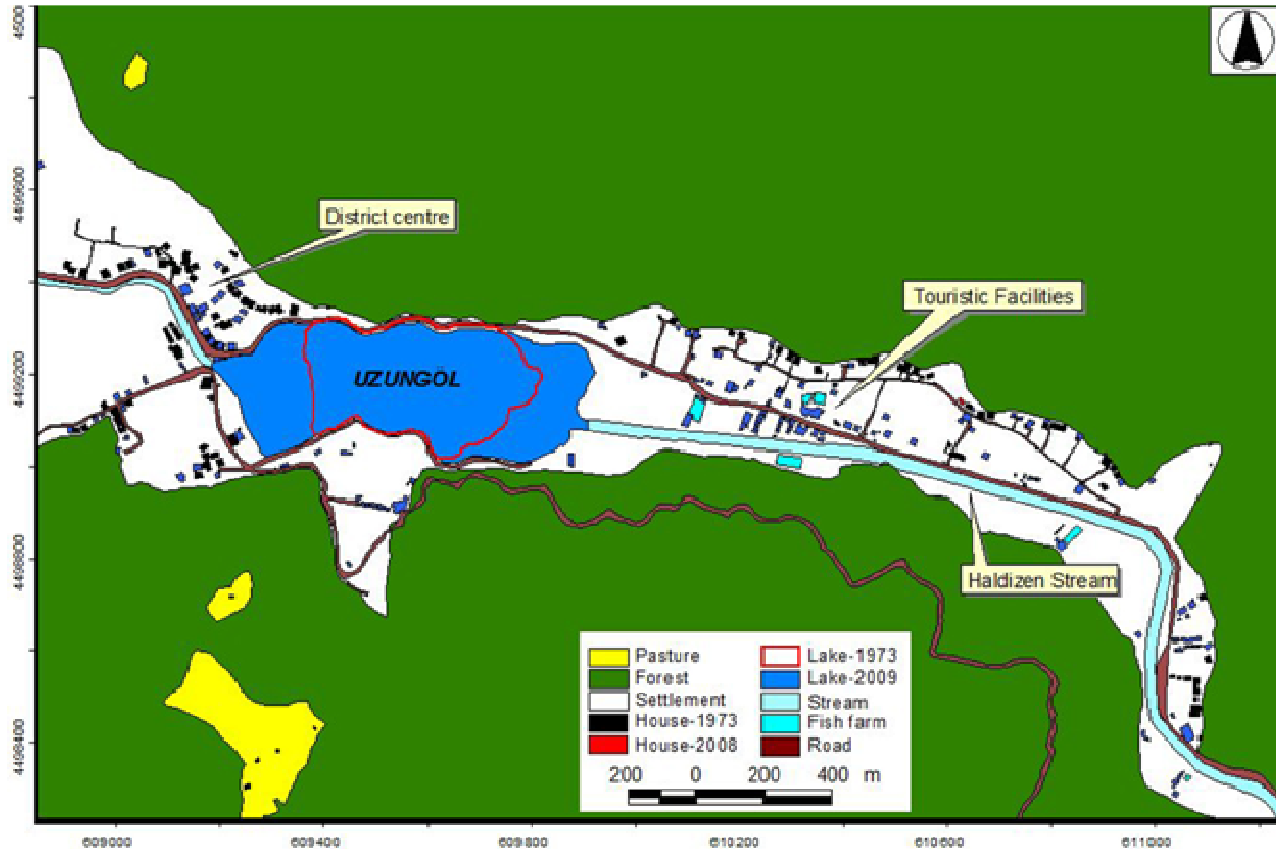
Due to region's rugged land morphology, there is a collection of settlements on hill foots (Figure 6). Houses in the region are constructed according to traditional architecture of the region and they are attractive buildings in aesthetic view. Section of buildings used as a stable was constructed from stone, but parts are used as housing was entirely made of wood (Figure 5). For the construction of old houses, the necessary materials have been provided from the surrounding forest. The houses are generally two-storey, but three-storey ones are also common. In the majority of dwellings, the lower parts excavated in the slope were being used as the stable, where the upper portions were being used as the residence. In these type of houses, sub-floor used as a stable is made of stone, while the second floor is entirely made of wood.

A dense concrete structure was observed in the natural lake park of Uzungöl (Figures 4 and 5). There were 97 houses in the vicinity of the lake in 1973 with a total area of 1.33 ha, while the average area of the houses was 137 m<sup>2</sup>. It can be seen that almost all were built on private property on the edge of the forest away from the lake and river basin (Figure 4a). Since landslides and flooding were frequently occurred in the lake and river basin as a result of the rugged terrain of the region, this is an

important explanation why it has forced human to be more careful in the selection of suitable settlement area.

On the other hand, in 2002, while there were 293 houses, the residential area of these houses covered 2.98 ha in total and the average area of houses was found as 102 m<sup>2</sup>. In 2008, the number of houses was 295, the total residential area was 2.99 ha, and the average was 101 m<sup>2</sup>. In addition, six fish farms are located in the lake basin with a total area of 3,108 m<sup>2</sup>. Some of the houses around the lake were built according to actual restoration of old houses in 1973 and most of them were being used for tourism purposes, while some have been completely reconstructed. Almost all the additional houses consist of accommodation and catering facilities (Figure 5).

The completion of the road initiated in 1990 to connect Çaykara to Uzungöl has become the starting point for the tourism in the region. After that, local people having real estate in the lake basin were accelerated for construction facilities for tourism. Increased tourism activities were also resulted in private sector investment in the Uzungöl. Especially, a sudden increase in the construction of touristic accommodations and restaurant facilities was observed in the region. 8 hotels were constructed by the private sector with a total area 250 m<sup>2</sup>. Some of the private sector houses consist of home-style wooden bungalows. Almost all the facilities are situated in the lake basin. 125% increase in the amount of construction within the lake basin has been determined for the last 35 year period (Figures 5 and 6b, c). Rather than being built in the traditional architectural style new houses are mostly



**Figure 5.** Temporal land use changes in Uzungöl lake basin between 1973 and 2008.

built for pension and hotel-style accommodation purposes. It can also be seen in Figures 4 and 5 that most of new houses are built within the lake basin.

A large part of these houses was built in concrete construction techniques and they were re-arranged using wood veneer in fronts in order to simulate regional architecture (Figures 6b, c). In addition, newly constructed houses are made of wood with a larger floor area and multi-storey (3 or 3.5) like apartments (Figure 6c). Therefore, protection barriers of urban planning can be prevented by building new houses instead of the former traditional wooden houses (Figure 6a). Because of special importance of the region, Protection of Natural Heritage Committee in 1998 was declared Uzungöl Municipality and surrounding villages as I and III Degree Natural Protected Area. Due to the increase in profit, it was difficult to prevent illegal construction. As a result, the traditional architecture and character of local structures were moved away towards new applications to meet the daily requirements. New construction adversely affects texture and silhouette of traditional houses and it causes visual pollution. Rather than to meet the accommodation needs of those living in the area, houses built in the last 35 years were mostly constructed to respond touristic accommodation facilities. This indicates that construction in Uzungöl now comes to the fore as the

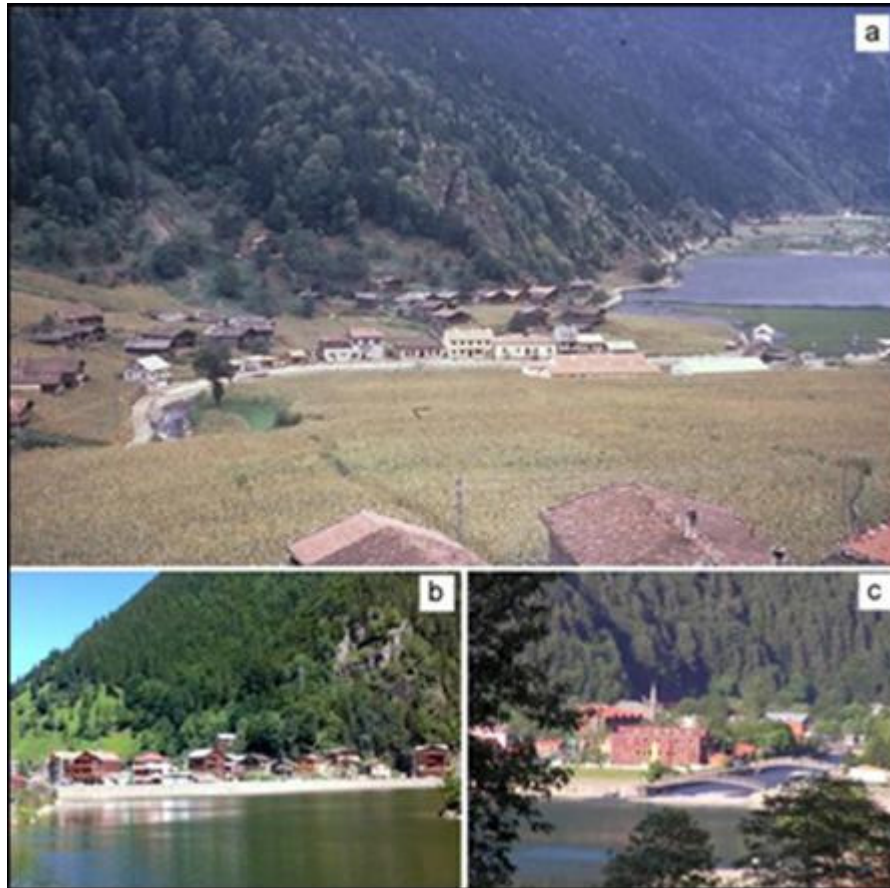
tourism and recreation purposes.

### Changes in the lake area

Depending on the season, changes in water level of Haldizen stream can be observed. The region's climatic conditions and high level of ground water constantly provides water to be found in the river bed even in the period of the lowest water precipitation in the region. The flow of Haldizen stream increases to maximum level during the months of April - May due to melting of snow and abundant rainfall. The high slope of the river bed basin leads to the occurrence of floods immediately after the intense rainfall (Ulu et al., 1999).

Results of photogrammetric analysis show that lake area in 1973 was seen as largely filled (Figures 4 - 6). Indeed, water covered lake area was found to be 8.71 ha. In 2002, this figure is measured as 10.39 ha. Two sedimentation preventative bents were constructed by DSI in 1991 and in 1993, in order to prevent the rapid filling of Uzungöl. In a study of hydrology, erosion and sedimentation of this basin has also shown that the filling of the lake was largely caused by soil erosion (Önsoy et al., 1995). Artificial lakes were formed behind these two bents. Areas of these lakes are not large enough to





**Figure 6.** Experienced dense construction in Uzungöl SEPA.



**Figure 7.** Size of construction in Uzungöl basin in 2008.

ensure the deposition of the suspended solid matter (that is, sand, dust and clay in the water). Therefore, the lake still continues to fill with smaller amount of these materials (Verep, 1999).

To clean accumulated deposits in the lake basin, a

comprehensive lake cleaning work was conducted in 2004 by DSI. The amount of material removed was approximately 250,000 m<sup>3</sup> (Altundağ, 2008). In 2008, a result of the cleaning operation of water-covered by area of lake to reached 14.59 ha (Figure 7a, b) and it corres-

ponds to 67% increase in the lake area compared to 1973. The bathymetric measurements conducted in Uzungöl lake showed that the deepest part of lake was 9 m in 1969 and it fell under 8 m in 1994 (Alkan, 1996). After the cleaning work, the deepest part of lake was 25 m and the shallowest part was measured as 7 m.

The cleaning work in the lake was a physical process. How microorganisms living in the lake were affected as a result of this removal constitutes of separate study. It was expressed that 200 mammals and 157 plant species including 151 bird species live in the lake basin. In addition, access to 400 green-headed mallards (*Anas platyrhynchos*) chooses Uzungöl as permanent living environment including incubation period as well (Araz, 1996).

Another danger caused by the crooked construction and lack of infrastructure for waste-water in Uzungöl is the eutrophic pollution of the lake. Besides natural contaminants (COD, nitrogen, phosphorus, suspended solids, etc.), in Uzungöl lake is also polluted by discharged household waste-water with high nitrogen and phosphorus content. If no measures are taken for the effect of eutrophication in the lake, its use for recreational and touristic purposes will be adversely affected after a while (Anonymous, 2006).

### Changes in the forest and pasture

Total forest area was 746.14 ha while, it was determined as 744.4 ha in 2002. 1.73 ha decrease in the forest area is a result of roads opened for field trips in the forest by the Forest Administration Directorate (Figure 4). Between 2002-2008, no change was detected for the forest lands. The road construction works undertaken in the foot slope of the valley completely disturbed the balance in Uzungöl basin and new artificial landslides were observed subsequently. In addition, it caused an enormous increase in the amount of sediments in the stream. During road expanding works at the southern section of slope by road vehicles, the southern banks of the river were filled with excavated material. As a result, the flow rate of the river was increased due to narrowing of the river bed. This situation caused by severely eroding of land at the northern slope and the new landslides were recorded (Altundağ, 2008). Pasture area between 1973, 2002 and 2008 was 43.84 ha without any change. Pasture lands are generally used for livestock grazing in the region.

### CONCLUSIONS

Results of the analysis done by using aerial photographs and base maps of Uzungöl, which was declared as the Special Environmental Protection Area and Tourism Center, showed a very significant increase in the number of houses (91%) in the region within the last 35 years. Also, the physical removal of 67% of the sediment in the

lake was accomplished from the lake area. While, the traditional architecture of the old settlement pattern was found compatible with nature, the new houses were built entirely of reinforced concrete construction techniques on the character away from the traditional construction with an unplanned manner.

The melting of snow and plenty of rainfall in April and May increase the flow of Haldizen Stream in Uzungöl valley to the maximum level. The high slope of the river bed of the basin leads to the occurrence of floods in this basin immediately after the intense rainfall. Landslide disasters in the region are also often experienced. Therefore, many hotels and pensions in the basin are under risk. Construction should not be allowed within the basin anymore, and tourism infrastructure should be provided in appropriate areas under control.

If it is not wanted to lose the beauties of Uzungöl Special Environmental Protection Area in the future, the natural balance in the region should not be disturbed. In addition, it is essential to maintain/improve the style of indigenous and traditional construction techniques in a controlled manner and it is of great importance for not disturbing the ecological balance. Therefore, Type housing projects and settlement tissues compatible with the natural structure of the highlands should be prepared immediately to prevent unplanned approaches leading irregular construction.

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