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Land use changes of the Balcova-Guzelbahce shore line investigated using geographical information system (GIS) and remote sensing technique

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This study investigated and determined land use changes resulting from economic pressure to develop the land which means development pressures, more specifically anthropogenic stresses, originate urbanization on agricultural land such as dam, swamp, highway, settlement and recreation area. The study, based on aerial photographs and satellite images, geographical information system (GIS) and remote sensing (RS) images, was implemented on the Balcova–Guzelbahce shore line where the Izmir–Cesme Highway runs parallel to the west coast of the Aegean Region of Turkey. The changes in land use between the years 1957 and 2005 were determined by GIS and RS technique. Results showed that the area of 1st class agricultural land decreased from 1753.1 to 989.6 ha because of improper land use changes, with the area of olive groves decreasing from 95.3 to 28 ha, forests decreasing from 837.1 to 806.5 ha and scrub land decreasing from 4310.8 to 4145.8 ha. Furthermore, between 1957 and 1976, dry farming land decreased from 2452.3 to 836.7 ha. In the period after the year 1976, as a result of use out of purpose, all dry farming lands have eventually disappeared by being converted into different use of lands. While some use of lands have been converted into horticulture and irrigated farming, others have been converted into 49 ha highway and 739 ha settlement. It has been understood from the results of the study carried out with GIS and RS technique that most of the fertile agricultural lands have been lost due to land use out of purpose.

Key words: Coastal land, geographical information system (GIS), land use, remote sensing.

INTRODUCTION

Physical changes over a specific area, which are caused by the anthropogenic effects of economic and social factors, initially lead to deformation of the nature of that area. The environment and biological diversity is damaged rapidly by pollution resulting from industrialization, uncontrolled urbanization, changes in land use and improper land use (Kurucu and Chiristina, 2008; Dengiz et al., 2009; Kesgin and Nurlu, 2009; Pradhan et al., 2012). Turkey is considered by many, a rich country because of the diversity of its climate, topographic structure and other natural resources. Moreover, the nature, history and cultural values of the country increase this richness. Turkey is losing the natural structure of its 8300 km coastal land because of unplanned recreational touristic facilities, settlements, agricultural, industrial and touristic amenities, roads and highways built in close proximity to the coast.

Coastal lands constitute a vitally important environment because of their sensitive ecologic system and habitat. The coast line, which harbours 40% of the world’s population, is an ideal place for various kinds of
agricultural production due to its suitable climate. These lands are also ideal settlements for fishermen and those who use the sea for food and transport. On the other hand, since the ruins of ancient cities and areas of natural beauty are also situated along the shores, these are the most suitable places for the development of the tourism industry (Alkis, 1997). Therefore, coastal lands are places where human impact is felt so intensely and the controversy between usage and preservation of natural resources is most evident. More recently, demands for the use of these lands has constituted a serious threat which has also been observed and presented in this study.

Considering the importance of the study region, which encompasses the Çakalburnu Fishery and has fertile soil with a sensitive ecological system due to it being coastal land, it was considered crucial to determine the changes caused by anthropogenic influences in order to take relevant measures and make suggestions regarding the future of the area.

The study region has been an area of interest for years because of its growing economy. The land use has changed over time from citrus farms to independent residences for the wealthier residents. In addition, the construction of the Izmir-Cesme Highway and the opening of the southern part of the highway leading to dense urbanization with multiple buildings have had a further negative effect.

Agricultural lands are being used for other planned or unplanned purposes such as industry, tourism or settlement (Duran, 1998). Settlements have expanded enormously in an irregular pattern and at a great loss to agricultural lands (Weng, 2002; Sesli et al., 2009). As the settlement expands, the city is deprived of the forest and the city swamp land, which are critical ecological areas (Mundia and Aniya, 2005). The increase in settlement, industry, highway and airport areas results in a great transformation of the agricultural areas. In addition, road construction causes fragmentation of natural areas and degrades the surrounding area because of the hazardous gases released by motor vehicles (Turan et al., 2008). Specified emissions for the main traffic air pollutants are CO₂, NOₓ, particulate matter (PM₁₀) and SO₂ and the highest pollutants are by the highways (Bayram et al., 2009; Cetin et al., 2006).

Dense road networks divide an area into smaller pieces and make new borders in terms of wild life. Apart from the death of wildlife around the roads, highway noise is a repellent to wild animals. Moreover, the barrier effect caused by the roads divides the current wildlife population. In addition, the roads cause regional hydrologic deformations and increase erosion and chemical pollution effects. Based on the road influence area, 15 to 20% of the U.S. is affected by the roads whereas in Holland bridges and tunnels were built to increase the ecologic stream (Forman and Alexander, 1998; Kesgin and Nurlu, 2009).

Due to the construction of roads on the 1st and 2nd degree agricultural soils, loss of agricultural land is quite high. Therefore, roads need to be re-routed to less important agricultural soils (Sandal and Gurbuz, 2003).

The study area is considered very important because it encompasses 1st class agricultural land and the region is located on coastal land. The 1st class agricultural lands have a higher water retention capacity and their productivity is considerably high. They have substantial fertility and a wide range of plant options (KHGM, 2001).

The existence of 1st class agricultural lands is essential to establish ecological balance and to provide economic development.

Besides erosion, the misuse of this agricultural land for other purposes is the most important problem with regard to agricultural soils in Turkey. The overall annual income loss as a result of the misuse of agricultural land is estimated about US$ 2,5 million (Ozbek and Oztas, 2004; Dengiz et al., 2009).

The main consequence of urbanization is the highly increased population due to the industrial development and rise of domestic migration. Also, the environmental problems resulting from increased air, water and earth pollution are evident (Doygun and Alphan, 2006; Sowmya and Somashekar, 2010; Akgun et al., 2012).

The unplanned development of the 2nd settlement and the tourism sector emerging in the region of Narlidere have been posing problems that cannot be solved without setting long-terms goals set with the contribution of the residents, as this whole area is coastal land. Thus, the decisions concerning land use should be taken by a select committee of professionals from various affiliated disciplines. Program targets should be set after a long term planning process that ensures that public opinion is taken into account in any decision (Dikkaya, 1998).

Guzelbahce District was unable to benefit from its resources adequately and in order to deal with this problem some recommendations were put forward. While determining the appropriate land use in the past, the decisions were based on sustaining the natural balance and function whereas today they are based on profit rather than a consideration regarding the elements and cycles of the natural system (Tiril, 1998).

In Izmir, the area of 1st class agricultural area is 5,854.00 ha (KHGM, 2001). Some 30% of the 1st class agricultural area in Izmir is under investigation. 22.34% of the study area is a 1st class agricultural area. One of the largest sources of income in the region is horticulture. The region is known for its famous citrus fruit orchards, but because of the land use out of purpose, ecologic problems have started and the agricultural lands are in danger. This research aimed to demonstrate the changes in land use caused by urbanization along with anthropogenic stresses and changes in land cover due to use out of purpose. The area between Balcova to Guzelbahce districts was selected as the study area because it has great importance in terms of coastal and
agricultural implications.

MATERIALS AND METHODS

The study area comprises the coastal part of the Balcova, Narlidere and Guzelbahce districts where the Izmir-Cesme Highway lies on the western side of the metropolitan area.

On a larger scale, the study area lies on the western coast of Turkey, within the borders of Izmir province and is bordered by Balcova in the east, Guzelbahce in the west, the Aegean Sea to the north and Balcova Dam in the south. The part of the Izmir–Cesme Highway included in the study is 18 km long. The surface area of the study is 80 km² (Figure 1).

Balcova Dam was constructed on the Ilica Creek between 1970 and 1980 to supply water for public and industrial purposes. It has rock bisque filling with a volume of 1,011,000 m³. The height from the creek base is 63.40 m.

According to the meteorological data of the State Meteorology Service, the average temperature in Izmir is 17.84°C, and average annual precipitation is 688.3 mm (DMI, 2008).

There is an elevated area located just 500 m south of Balcova District centre and behind this area, there is a lowland gradually descending to the seaside. The Dede Mountain, around which Balcova District centre stands as a borderline, was split by several creeks, particularly by the Ilica Creek. Most of the ground surface is covered by forest. The extensive areas of Narlidere and the Sahilevleri Plains are alluvium. In addition, cretaceous flysh made up of sand and clay stones is located on the southern part of the plain. There are also some elevated areas such as hills and mountains over 500 m. The creeks follow the slopes to the sea irregularly and flow into the Sahilevleri shore (IZTO, 2004).

The Balcova segment is the place where movement of the Izmir fault line can be best monitored geologically and geomorphologically. The Balcova segment of the Izmir fault is linked with this tectonic sediment and it is possibly connected to the active faults on its western end (Emre et al., 2005).

The land use changes caused by anthropogenic stress on the Balcova-Guzelbahce coastal line were determined by observations of both Land Use Types (LUT) and Other Land Use Types (OLUT) carried out at different time periods.

In the present study, the following cartographic materials were used: 1:1,000 scale photogrammetric settlement maps prepared by the Izmir Metropolitan Municipality in 2001, 1:35,000 scale stereoscopic aerial photographs taken by the General Command of Mapping in 1957, 1976 and 1995, IKONOS satellite image with 1 m ground resolution taken in June 2005 and 1:25,000 scale soil map revised by the Directorate of Rural Services in 1985.

The following were used in the flow process of the research: Intergraph-Geomedia Professional 5.1, as Geographical Information System software; Intergraph-Image Analyst 7.0, as satellite images processing software; Bentley-MicroStation SE, as CAD software; Microsoft-Access 2003 as database software. During the interpretation of the aerial photographs, a mirror stereoscope was used.

For land use types being employed in the research, the following criteria were used: Turkish soil potentials survey and planning of land use for the purposes other than the agriculture project prepared by the soil survey and mapping office directorship.
Brief explanations of the classes of land use types used in the research are shown below (Toprakus, 1982):

- **Irrigated Farming (S):** Lands used for irrigated farming.
- **Dry Farming (K):** Lands used for farming.
- **Scrub (F):** A natural floral cover consisting of scrub.
- **Forest (O):** Lands covered by forest flora.
- **Olive Groves (Ze):** Lands used for olive farming.
- **Horticulture (B):** Orchards.

Other land use type classes used in the research are dam, swamp, highway, settlement, and Cakalburnu fishery, under the heading of "recreation area". In order to determine the land use change from 1957 to 2005, the research was implemented in 9 steps:

1. 1:25,000 scale soil maps of the study area in paper format were scanned and as file *.tiff extension were transformed into raster form. These were given geographical coordinates by means of GIS software with help of topographic map corner coordinates and were saved as GeoTIFF. Next, the borders belonging to the soil groups were digitized manually and their symbol and legend information were entered into the database as attribution data. The soil group borders were digitized by being threaded through the middle points on the map, and the same lines were used on the neighbouring borders jointly. The data here was employed in the calculation of soil specifications digitally within the boundaries of the study.

2. IKONOS satellite images (2005) with 1 m resolution were rectified with current photogrammetric settlement maps with 1/1000 scale. From the satellite images, the external borders of the settlement areas, highway and land use types were drawn. The distribution areas of land use types in 2005 were determined.

While data was being collected from the satellite images, visual classification methods were not used because green fields in the city could be confused with floral coverage of the natural areas. In this context, the borders of the settlement areas were determined more precisely by means of the visual interpretation (Turk, 2003).

3. Aerial photographs (1957, 1976 and 1995) were interpreted in accordance with element analysis method by means of mirror stereoscope. On aerial photographs, rapier alignments were drawn perpendicular to the flight direction and elements on the photographs were examined. Then, the photographs were analyzed in accordance with element analysis methods and classified. After covering the photographs with acetate, the classified elements were drawn on the acetates (Tansoy, 1981). The interpreted photographs were scanned and transferred into digital form. Rectifications were completed using 1/1000 scale settlement maps. The elements interpreted from the aerial photographs on the CAD platform were digitized and their qualitative and quantitative distributions were presented.

4. Data extracted from the satellite images by means of GIS software and data digitized from the aerial photographs was transferred into the database ready for interpretation and questioning.

5. The digitized data was compared to the field observation in its own place. Observed differences were noted and adjusted.

6. The Spatial Difference Analysis was implemented by overlaying the area selected from satellite images from 2005 and data acquired from aerial photographs taken in 1957, 1976 and 1995 by means of Geomedia software. The amount of settlement development was determined digitally.

7. Geometric analysis of land use type classes produced by the interpretation of satellite images and aerial pictures was performed and general distribution quantities of other land use types were presented.

8. Urban sprawl through years was determined by Spatial Difference and Spatial Intersection Analysis of overlaid maps of settlement areas, other land use types and thematic soil specifications.

9. Present Land Use (PLU) and Land Use Capability (LUC) analysis of occupied lands were implemented. With the PLU and LUC analyses, in order to determine classes of land use capability borders and types of use, criteria of the classes specified on the existing soil maps were compared with the other acquired data. PLU and LUC classes of occupied lands were determined and their surface area was calculated.

The method employed in the study is given in Figure 2 as a flow chart.

**RESULTS**

In the study area, 2852.5 ha Red Brownish Mediterranean, 2824.8 ha Limeless Brownish and 1916.3 ha Colluvial Large Soil groups can be commonly seen. According to land use capability classification, there are 1753.1 ha 1st, 38.9 ha 3rd, 163.2 ha 4th, 143.2 ha 5th, 131.8 ha 6th, 5564.8 ha 7th, and 53.8 ha 8th class agricultural lands in the region.

From 1957 to 2005, 3.8% of the scrub area, 28.8% of the irrigated farming area, the whole of the dry farming area, 3.7% of the forest and 70.6% of the olive farming area were used out of purpose, since they were unable to resist development pressures and were also converted to different land use types. In this process, despite the losses in other types of agricultural land use, horticultural usage gained a 7.0% improvement (Table 1).

According to the research, even though all of the agricultural activities changed every year, their existence continued. However, extensive dry farming lands covering a large surface area in 1957 was converted into irrigated farming, horticulture and other land use types. During this 48-year period, although a development has been observed in land use, in general, there has been a great deal of loss in land use types because of conversion to other land use (Table 2).

New settlements and the highway construction were most responsible for the losses in land use types. Significant effects of urbanization and tourism have been observed from 1957 to 2005 in the coastal area of the study. Because of insufficient building bylaws, construction of summer or regular houses accelerated and consequently the lands in the study area passed into other hands. Within the last 48-year period, the area covered by settlements increased by almost 1500% (Table 3). The areas of olive groves have shrunk by 7.70 ha during this 48-year term because of settlements.

The Izmir-Cesme highway built in 1995 covers an area of 145.8 ha. This construction area displaced 3.9 ha of settlement and 7.1 ha of swamp area as classified in 1976. Overall, the highway construction removed 53.5 ha horticultural area and 49 ha dry farming area from agricultural purposes. The famous symbols of the region, the citrus fruit orchards are under serious threat because of land loss and a rise in boron in the underground water.

The Balcova Dam which did not exist in 1957 has become an important source of water for Izmir since 2005. The dam was built on a 25 ha scrub and forest
Figure 2. Flow chart of method followed in the study.

Table 1. Distribution of land use types in specific years.

<table>
<thead>
<tr>
<th>Land use types</th>
<th>1957 (ha)</th>
<th>1976 (ha)</th>
<th>1995 (ha)</th>
<th>2005 (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry farming</td>
<td>2452.3</td>
<td>836.7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Irrigated farming</td>
<td>-</td>
<td>-</td>
<td>40.0</td>
<td>28.5</td>
</tr>
<tr>
<td>Horticulture</td>
<td>-</td>
<td>923.0</td>
<td>959.3</td>
<td>992.8</td>
</tr>
<tr>
<td>Olive farming</td>
<td>95.3</td>
<td>52.9</td>
<td>51.2</td>
<td>28.0</td>
</tr>
<tr>
<td>Forest</td>
<td>837.1</td>
<td>869.2</td>
<td>833.2</td>
<td>806.5</td>
</tr>
<tr>
<td>Scrub</td>
<td>4310.8</td>
<td>4552.7</td>
<td>4494.8</td>
<td>4145.8</td>
</tr>
</tbody>
</table>
area (Figure 3).

When the study area was investigated for the 1957 to 2005 period, while the settlement area on 1st class agricultural land was 36.5 ha in 1957, it was found that this figure had reached 716.5 ha in 2005. The rise in the settlement area caused a loss of 680 ha in 1st class agricultural land because the land was used out of purpose. From 1995 to 2005, 56.5% of the highway was constructed on 1st class agricultural land, which removed 83.5 ha of 1st class agricultural land from its designated purpose (Figure 4).

From 1957 to 2005, the Cakalburnu Fishery expanded by 67.1 ha and became an important recreational area. However, the thousands of tons of earth added to the wetland area have seriously jeopardized the fishery, which should have been preserved. During this expansion, the coastal land was filled and the 46.9 ha swamp area behind it was also drained.

Table 2. Losses in land use types as a result of stress and other land use types from 1957 to 2005.

<table>
<thead>
<tr>
<th>Other land use types</th>
<th>Scrubs (ha)</th>
<th>Forest (ha)</th>
<th>Horticulture (ha)</th>
<th>Dry farming (ha)</th>
<th>Irrigated farming (ha)</th>
<th>Olive farming (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dam</td>
<td>20.1</td>
<td>4.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Highway</td>
<td>32.3</td>
<td>-</td>
<td>53.5</td>
<td>49.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Settlement</td>
<td>606.2</td>
<td>9.4</td>
<td>198.3</td>
<td>739.0</td>
<td>11.6</td>
<td>7.7</td>
</tr>
<tr>
<td>Recreation Area</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Swamp</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 3. Changes in other land use types in specific years.

<table>
<thead>
<tr>
<th>Other land use types</th>
<th>1957 (ha)</th>
<th>1976 (ha)</th>
<th>1995 (ha)</th>
<th>2005 (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreation area</td>
<td>7.7</td>
<td>8.0</td>
<td>43.9</td>
<td>74.8</td>
</tr>
<tr>
<td>Swamp</td>
<td>53.3</td>
<td>60.7</td>
<td>8.6</td>
<td>6.4</td>
</tr>
<tr>
<td>Dam</td>
<td>-</td>
<td>17.9</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Highway</td>
<td>-</td>
<td>-</td>
<td>118.0</td>
<td>145.8</td>
</tr>
<tr>
<td>Settlement</td>
<td>104.7</td>
<td>535.2</td>
<td>1304.6</td>
<td>1694.5</td>
</tr>
</tbody>
</table>

DISCUSSION

During the 48-year period, the study area has experienced a rapid urbanization process. Since urbanization has been resorted to be conveyed fast and unplanned with the aim of providing opportunities for the increasing population caused by migration from rural to urban areas, the effects of this uncontrolled urbanization can also be seen within the study area. In this study, land use changes resulting from economic pressure to develop the land have been researched and determined. When the physical structure and the geographical location are taken into consideration, the importance of the research area in terms of agricultural activities and its contribution to economy prove to be highly significant.

In the southern part of Balcova District, species comprising scrub and pseudo-scrub are common on the slopes at 150 to 350 m. Fairly dense calabrian pine (Pinus brutia) forest is present on the higher places of the ridges and hills behind. The flora of Narlidere and Guzelbahce counties can be defined as calabrian pine on the elevated areas and scrub on the descending slopes (IZTO, 2004).

The area is unique for daily tourism attractions, both domestic and international. The cable car in Balcova, Lake of Cengiz Saran, Balcova Dam and the Cakalburnu Fishery can all be considered among the important daily recreation places and they improve domestic tourism. Balcova Thermal Amenities and other thermal hotels in the region attract foreign tourists in particular and thereby consequently improve international tourism. Moreover, the hotels are the only ones out of the 1300 thermal hotels in Turkey which have a treatment centre with international links. Furthermore, the five-star hotel in Narlidere makes a great contribution to domestic and international tourism with its hot springs and health spas with availability for private events such as weddings and conferences, etc. (IZTO, 2004).

Access to the study area became easier following the connection of the Izmir-Cesme Highway, which opened in 1995, to the Izmir-Aydin Highway in 2000. A significant improvement has also been observed in the tourism sector after this link up.

Floriculture and citrus farming are the most important sources of income in the Narlidere part of the study area. Although Balcova’s economy mostly relies on tourism,
Figure 3. Land Use Types (LUT) and Other Land Use Types (OLUT) in 1957-1976-1995-2005.
Figure 4. Land Use Capability Classes (LUCC) and Other Land Use Types (OLUT) for 1957-1976-1995-2005.

Agamemnon hot springs and the surrounding tourist hotels also supply a considerable amount of income to the region. In addition, recreational parks and the only marina in Izmir are in this district, contributing to the economy of the region with a considerable amount of income. Citrus, olive and grape farming can be found in
Guzelbahce.

It has been determined that the study area has been affected negatively in spite of the aforementioned benefits with additions to the unplanned constructions such as the filling of the coastal land and the drain of swamp. As a result of the draining, the creeks coming down from the hills were closed. This also caused an increase in salt content. Furthermore, drills made for thermal water sources caused boron contamination of the underground waters. This contamination has affected agricultural land and wild life in the Cakalburnu Fishery, an area which must be preserved. The lack of strict laws governing the conservation of nature, the land and its biological diversity, together with misuse of current laws, are causing irreparable damage to the eco-system.

The Izmir-Cesme Highway and the Balcova Dam prevented the water from flowing to the region and consequently caused ecological changes. The excessive water requirement led the resident use of the ground water. This enormous increase in ground water consumption led to the level of ground water falling, which led to an increase of boron in the water as well as its salinization (Keles et al., 2008; Cakir et al., 2008). In addition, the heavy base of the Izmir-Cesme Highway blocked the soil’s natural drainage and this resulted in disruptive effects on the underground streams. It has been determined that hot spring waters discharge into creeks and excessive ground water usage must be prevented, while high quality irrigation water must be supplied in the study area (Napier et al., 2009). Besides the loss of area caused by the highway, it also damages agricultural lands and surrounding flora with its ecologically negative impact. Hazardous chemical compounds in exhaust gases are transported to the earth surface by means of rain and wind. As a result, the heavy metal content and lead in particular, negatively affect soil quality. Traffic in the study area causes lead and cadmium deposits in agricultural land especially around the Izmir-Cesme Highway.

The major emissions from motor vehicles are NO₂, CO, HC, SO₂, particulate matter (PM) and lead in the PM. Although PM emissions arising from exhaust gases are not high, they need to be studied carefully because they threaten human health and nature with their lead content.

The acidification which may be caused by these emissions is also important with regard to the possible effects on soil and water resources. In order to assess this, calculations for amount of precipitation and volumetric flow rate must be implemented. In addition, measurements should also be taken for surface concentrations resulting from the NO₂, CO, HC, SO₂, PM and lead content of the PM released by motor vehicle exhausts on this road, and PM resulting from erosion of tires. Also, the total precipitation consisting of both wet and dry precipitation mechanisms should not be ignored. These emissions are being acidified by factors such as humidity in the air and temperature, which then cause changes in the characteristics of soil and water causing pH alterations. These negative changes affect the food chain and air quality for all creatures in the region. The damaging changes in the ecologic system thus produce an uninhabitable environment (Dulgeroglu, 2002).

Highways constructed without considering their ecologic effects also damage natural wild life. Alexander and Waters (2000) investigated the mobility of wild life in the Alberta, Banff National Park which the Trans Canada Highway (TCH) (14,000 annual average daily traffic) and 1A Highway (3,000 annual average daily traffic) pass through. The effects of highways on trails used by wolves, pumas, lynx, weasels, deer, sheep, wild rabbits and red squirrels were monitored. The fragmental effect of roads on the land is affected the living conditions of wild life on the Rocky Mountains and the neighbouring conservation area. It was shown that roads inhibit the mobility of wild life, pose problems for the movement of animal groups and cause demographic effects, such as a decrease in biologic diversity and increase in the threat of extinction. With the interpolation of point data, the access points were shown where high frequency of transition is being observed and these regions are about 250 to 2000 m in diameter. The researcher stated that the previous movement patterns can only be recovered by removal of the highway and/or by enclosing it in places where frequent transition is being seen. In the long term, the most efficient way to preserve regular wild life mobility is by dividing the adjacent habitats without splitting them apart. In order to allow wild animals to move freely between locations in the study area, ecological corridors should be provided for crossing the Izmir-Cesme Highway.

The Law of Soil Protection and Land Use No. 5403, Section 4, Article 10 states that “Agricultural Lands, apart from conditions specified by laws, cannot be used for any other reason” (Anonymous, 2005). Article 13 of the same Law regarding the usage of agricultural lands for reasons other than their designated purpose states that “the absolute agricultural lands, special produce lands, cultivated lands and irrigated farming lands cannot be used for reasons other than agricultural production. However, if there is no alternative option, and with the approval of the committee, strategic needs for national defence, need for temporary settlement places in case of a natural disaster, oil and natural gas discovery and production activities, mining activities determined by the relevant ministry for public benefit, plans and investments determined by ministries for public benefit, and demands for the usage of these mentioned lands out of their designated purposes can be permitted by the ministry provided that they comply with the soil protection projects”. Even though it has been bluntly stated in the related law that there should not be constructions in 1st class agricultural lands, it has been observed that between the years 1957 and 2005 the settlements have expanded over the 1st class agricultural lands within the.
study area.
Agricultural land can easily be acquired for other purposes due to the manipulations of real estate speculators. This happens because the required land planning permission is not given in accordance with the direction of expansion of city settlements and because it is not determined before the land demand decisions are made. The uncontrolled expansion of settlement areas in the study area has had a negative effect on the economy of urban-rural environment causing water supply, sanitary sewerage and public services to be unavailable to many of the residents of this area. New developments on very fertile agricultural land cause unnecessary loss of soil. In the future, assuming that this process continues unchecked, it is apparent that agricultural land use will continue to shrink and eventually disappear. The causes of soil erosion and degradation in the study area should be prevented and 1st class agricultural land should be excluded from settlement areas.

Since 1909, there have been several earthquakes with a seismic impulse of more than 5 on the Richter Scale in the district where the study area is also included. As a result, death, injury, public damage and financial loss occurred. Therefore, one of the main aims of municipal policies must be to reduce the impact of earthquakes. Some types of ground are especially susceptible to the effects of the earthquakes. Filled in ground, in particular, increases their effect (Celep and Kumbasar, 2000).

Izmir City is situated in a 1st degree earthquake zone according to the 1996 data from the R.T. Ministry of Public Works and Settlement. Due to the several fault lines located in the region, multilevel buildings are unsuitable as building structures. In spite of this fact, the municipal authority subsidized and permitted the building of large shopping malls and multilevel buildings. When we consider the geologic structure of the region, new settlements must be constructed according to the law concerning "Regulation of buildings in earthquake zones", serial No: 26100 for concrete, steel and masonry buildings. Buildings which have already been constructed should be checked in accordance with this law (Anonymous, 2007).

The biggest problem of the forest lands located in the study area is that there is no real physical border line between the forest and private lands. However, there have been some improvements in the region lately, such as the accelerated reforestation activities for climate, social, cultural, and aesthetic purposes and also to increase wood production. Furthermore, the current policy of planting of super fine sapling and seeds in reforestation are signs of positive progress in the study area. This recent work has shown positive responses lately so that forest lands in the study area have resisted development pressures with the help of artificial support. Such reforestation activities should be continued.

The region, as a unique recreational area of Izmir, is an important source of oxygen with great forests. When we consider the importance of the study area for ecosystem preservation in the future, coastal lands must be prioritized for conservation during the planning process in order to sustain economic development. Urbanization expansion should be targeted towards the hillsides and mountainous areas that have little or no wild life and are not valuable agricultural land (Kurucu and Chiristina, 2008).

By conserving important natural and cultural resources in the study area more effectively, and encouraging the local people to choose conventional environmental resource land usage types, this will provide an economic resource and at the same time will protect the natural environment. For long term coastal land management, realistic planning is necessary in which all data is considered and proper implementation of plans are carried out and have regular follow-up checks.

Since protection of agricultural potential in the study area is of public benefit, the public must fully support land owners who help to preserve this natural land and wildlife by curbing the expansion of urbanization. Besides giving tax discounts to these land owners, the potential in the area should be increased through urban transformation projects, and by relocating inappropriate land use of areas with high agricultural potential to areas where there is little to no agricultural potential. Skilled specialists can be brought in to ensure the public’s involvement.

Conclusions

GIS and RS technique play an important role in establishing connections and analyzing data, calculating size of area, determining and examining changes, assessing results, and planning for recommendations. The usage of remotely sensed data is an effective choice in determining changes in land use.

This study places emphasis on the importance of GIS system usage to reach the correct results efficiently by integrating all data and requisite probations in land use changes.

Because of economic development, urbanization and internal migration, the expanding population has increasingly developed in the coastal regions, which has intensified the land conversion process over time. As a result, the drain on the natural resources and the overuse of agricultural lands has been intensified. During the research, the effects of the planning decisions were made without any consideration to ecological impacts.

The rise in the settlement area caused a loss of 680 ha in 1st class agricultural land as a consequence of land use out of purpose. Furthermore, highway construction has caused 83.5 ha of 1st class agricultural land to be used for purposes other than designated. During the past 48 years, the expansion of urban settlement has been influenced by geographical elements. As a result of our investigations, changes in land use have been revealed.
and a database which can be regularly updated has been constructed. These findings based on the aforementioned inappropriate decisions such as the highway and dam constructions, dense settlements and the land filling of Cakalburnu Fishery lands, show how disturbing the changes in land use are, including both a decrease of and a degradation in both agricultural and natural land areas.

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