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Relations between the land use and land capability classification in Küçük Menderes River Basin

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Abstract

The aim of this study was to analyze the relation between land use and land classes in Kucuk Menderes river basin in terms of sustainable utilization of natural resources. Landsat satellite images were used to determine the current land use, and remote sensing method was used for processing these images. Land capability classification reflects the natural environment potential of an area. The area occupied by agriculturally important lands depends on this classification. According to this, 34% were included in the 1st, 2nd, and 3rd class lands, 3% in the 4th class land, 7% in the 6th class land, 53% in the 7th class land, and 3% in the 8th class land. The most important land covers in the basin were; forest (21%), dry farming (21%), irrigated farming (17%), maquis – garrigue (11%), exposed surface (8%), settlements (3%) and water surface (2%).There was an inconsistency between the land capability classes and their usage. While the area occupied by 1st, 2nd, 3rd and 4th class lands, which should be used as agricultural lands covered 37%, the area occupied by the agricultural lands already covered 38%. This situation seemed consistent in terms of ratio, however, the fact was that 1st, 2nd, 3rd and 4th class lands were used for settlement (6%) and meadow-pasture (20%); while the 5th, 6th, 7th and 8th class lands were used for agriculture (32 %) and settlements (3%). This leads to some negative consequences. The massive erosion (60%) on the basin affects the lands that were inclined and lacking vegetation-cover. Basin lands became useless as a result of land degradation and erosion. To prevent this, a land use pattern suitable for the natural environment potentials of the region (land capability classes) should be used.

Key words

Land capability classes, Land use, GIS, Kucuk Menderes river basin, Remote sensing

Introduction

The use and classification of land is significant for development plans. All human activities are related to the environment and lands. Population growth and human activities put pressure on natural resources such as soil, vegetation and water. Land use and land classification involves the management and modification of natural environment or wilderness into built environment such as fields, pastures and settlements. It also has been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO, 2001b; FAO/UNEP, 1999).

Land use maps should be prepared, and land classes should be determined so as to decrease the negative effects of human activities on nature. Satellite images are important in these studies. Analyzing satellite images on computers with GIS program, and determining the condition of the land is important process for land classification (Panhalkar, 2011). Land classes, and locations of agricultural activities, settlement conditions, irrigation possibilities, industrial activities are chosen according to these land classes (Clawson and Stewart, 1965; Burley, 1961; Anderson, 1972; Jahantigh and Efe, 2010).

Soil quality is a major factor in division of land into categories according to the potential agricultural output. Drainage, elevation, gradient, susceptibility to soil erosion,

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temperatures, and rainfall also should be taken into account.

The Land Capability Classification System is one of many interpretative groupings made for agricultural purposes (Helms, 1977; Hockensmith and Steele, 1943; Neitsch *et al.,* 1997). The land capability classification generally begins with soil components of soil map units (Kellogg, 1951). Scientists are still improving land classification systems (Eswaran *et al.,* 2000; Fischer *et al.,* 2000).

Studies on land use started very late in Turkey. Although land classification began earlier, it was carried out only for agricultural purposes. Residential areas expanded towards agricultural lands due to migrations from rural areas to cities, which increased from 1950 onwards. Industrial facilities were established in fertile areas. As a result, use of first-grade agricultural lands for non-agricultural purposes increased. The most fertile agricultural lands of Turkey are located in Western Anatolia (Efe *et al.,* 2012). The most important among them is the Kucuk Menderes river basin. A considerable amount of agricultural land loss has occurred here, as no land planning was conducted. In the present study, land use in the Kucuk Menderes river basin was examined, and lands were classified based on their productivity.

Materials and Methods

Kucuk Menderes Basin, located in the Aegean Region on the west of Turkey, reaches through the Bozdağlar in the north and Aydın Mountains in the south, in the east-west direction. The basin covers an area of 3270 km². The important towns located in the basin are: Bayındır, Beydağ, Kiraz, Ödemiş, Selçuk, Tire, Torbalı, together with 260 villages. Kucuk Menderes river (175 km) is fed from the mountainous area in the east of the basin, and reaches the Aegean Sea (Fig. 1).

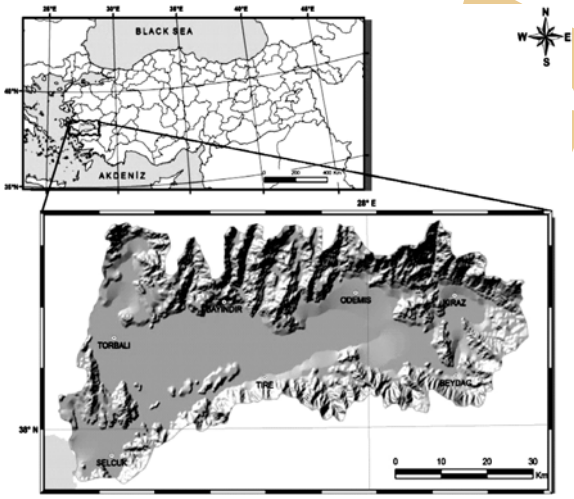


Fig. 1 : Location map of Kucuk Menderes Basin

Relation between land use and land capability classes in Kucuk Menderes river basin were noted in the related literature, followed by Landsat satellite images and remote sensing methods were used to process these, using GIS (Arcgis 10.x) software for mapping, field observations and maps, tables and configurations of the information and data obtained from the interviews with various institutions, foundations and people and the data were finally compiled.

For land use changes, regular and up-to-date data collection was followed and remote sensing methodology provided valuable help. Landsat TM satellite image was used, which consisted of 7 bands. To distinguish pasture areas, exposed surfaces and irrigated farming fields better, satellite images specifically taken in summer were selected. For this purpose Landsat TM satellite image of the study area dated June 23, 2011 was used. Controlled classification was made in Erdas Imagine software for the Landsat TM satellite image. The image was classified by applying "maximum similarity method". It was formed by 50 classes in the first stage. Then the recoded images were reduced to 8 classes and land use map of the Kucuk Menderes river basin in 2011 was produced. The map of land capability classes reflects relation between the natural environmental characteristics and socio-economic circumstances in the area. It was created by integrating the field observations and the maps for "Izmir Lands" provided by GDFRS (General Directorate for Rural Services).

Current situation of the land use was attempted to be reflected by the support of boards, graphics and maps as well as field observations. Relations between land classes and land use methods were questioned by using the overlay analysis of Arcgis 10.x programme, and by considering the results obtained, finally recommendations were made from a geographical perspective.

Geographical setting : The alluvial soil occurring in the plains and colluvial deposits were observed throughout the river valleys in the research area (Fig. 9, 10, 11). Different geological formations from Paleozoics to Quaternary occured in the study area (Akartuna, 1963).

Kucuk Menderes river basin, a part of "West Anatolia Graben system", can be divided into four main geomorphological sections. The study area experiences typical Mediterranean climate, with average annual temperature ranging between 16-18°C, average annual precipitation between 600-850 mms, and average annual relative humidity varying between 55-70% (Koçman, 1989). The basin has a subarid-subhumid climate, and under usual circumstances there is an arid period starting from June till of October end, therefore the agricultural irrigation was used during this period.

Alluvial soils occur in plain and river sides (Fig. 9, 10, 11); colluvial, noncalcareous brown forest soil and noncalcareous brown soil are common in the area. On the limestones at the west

of the basin terra-rosa (red Mediterranean) is observed (Topraksu, 1974; KHGM, 2001; Atalay, 2011).

Kucuk Menderes Basin is in the Mediterranean phytogeo graphical region in terms of vegetational characteristics. Red pines (*Pinus brutia*) and maquis occupy a large area in the basin (Fig. 17). Black Pine (*Pinus nigra*) can be seen in the Mediterranean-Mountainous vegetation zone (Efe, 2010; Atalay and Efe, 2010). The chestnut tree group lies on the northern slopes of Aydın Mountains facing Kucuk Menderes Plain (Atalay, 2008). Generally, the forests located at high areas were destroyed. On these areas where forest lands have changed into maquis and agricultural lands, one can frequently see the exposed surfaces (Ozturk, 1995, 1999; Feoli *et al.*, 2003; Ozturk *et al*., 2002, 2010).

The study area is relatively rich in terms of ground and surface waters. Kucuk Menderes river discharges 908 million m^3 of water in a year. Kucuk Menderes Basin cannot adequately meet the needs in terms of agricultural irrigation and ground water reserve. When considered that more than 10.000 wells were drilled in the basin, the severity of the situation could be understood well (DSI, 1973; Ozturk*et al.,* 2011). Kucuk Menderes Basin has been witnessing approximately 5000-6000 years of history from the Late Chalcolithic (Bronze) Age (Meric, 1988; Gozenç, 1978). The latest census reveals that, in 2012, the basin had 480.000 people, 67% of this population live in towns and 33% in villages (TUIK, 2012).

Agriculture is dominant, followed by industry, commerce, tourism and transport. The 2012 information depicts that the production of corn, potato, wheat, tomato, barley, watermelon, olive and fruits (fig, peach, and chestnut) is common. Domestic waste and sewage, along with industrial waste, reach Kucuk Menderes river by streams and gullies or are mixed up in ground water due to increase in settlements in the basin. An extreme use of fertilizers leads to soil and water pollution. All these factors are important in considering land degradation.

Results and Discussion

The land capability classes which reflected the natural environment potential were evaluated during this study.

Land capability classes provide ideal information on the use of natural environmental potential (Ozturk *et al*., 1994; Gulersoy, 2008). According to the land capability class system developed by "USA Land Protection Organization", 8 different capability classes were determined in the basin (KHGM, 2001). The land classes I, II, III were agriculturally important, and were located on the floor of the basin, occupying 33% of the area (Fig. 9, 10, 14). These lands were irrigated and generally used as farming areas (43%) and partly as pasture (21%). Class IV land (Fig. 19) was generally located on the colluvial deposits on the sides of the basin and constituted3% of the area. These lands were generally used for growing olive, as dry and irrigated farming fields (44%) and partly as pastures (18%). Class V lands occupied 0.3% of the area. These lands were commonly found on the Neogene lacustrine deposits and were used for growing olive, as dry and irrigated farming fields (40%) and as pasture (20%). Class VI lands occupied 7% of the area and were generally used as dry-irrigated farming fields (35%). Forest-maquis-garrigues areas occupied 35% of the land. Due to excessive grazing on these lands (19% of the area was used as pasture), there was high level degradation (Ozturk *et al.,* 2012). Class VII

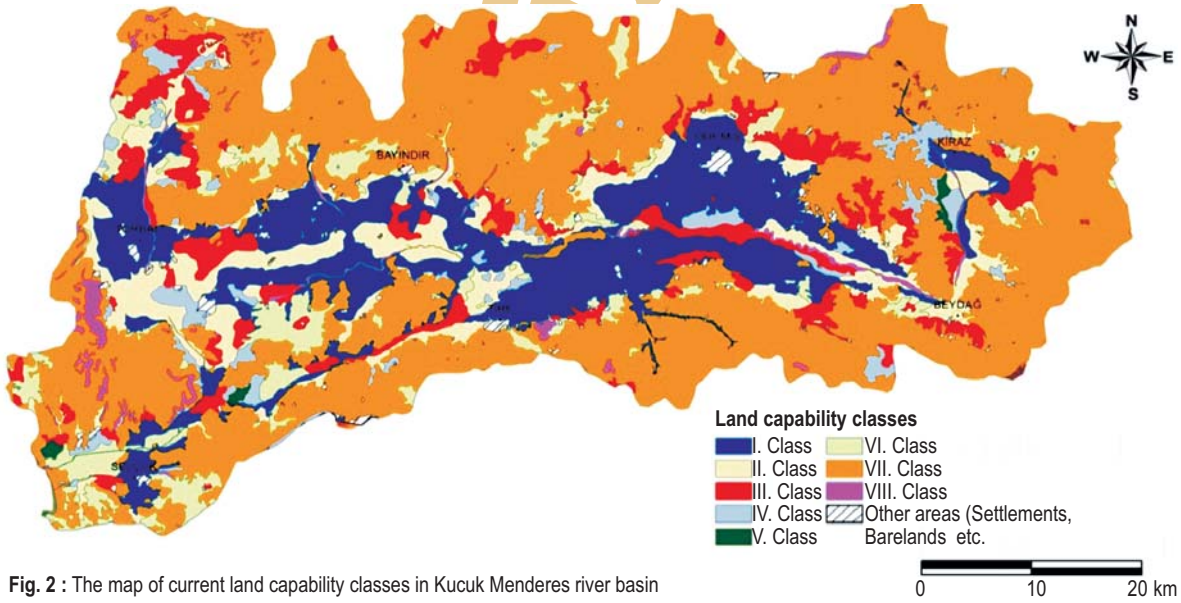


Fig. 2 : The map of current land capability classes in Kucuk Menderes river basin

lands occupied 53% of the basin and were mostly located on metamorphics and partly volcanic rocks. These were under huge pressure of excessive use. It is a perturbative factor that on 36% of these lands dry and irrigated farming activities were taking place. Class VIII lands occupied 3% of the area. These lands generally consisted of stony, rocky, sandy areas and water surfaces. The fact that 19% of these lands were being used for farming shows the effect of humans on natural environment (Fig. 2, 3).

A good proportion of Kucuk Menderes Basin was formed by agricultural fields (38%), and forest-maquis-garrigue (forest, 21%; maquis-garrigue, 11%), fields (32%). Due to traditional stockbreeding in the area, the pasture fields constituted 17% of the field. 8% of the field was in the form of exposed surfaces (stony-rocky-sandy areas, roads, degraded areas). Settlements, tourism, industry and mining covered 3% of the basin and 2% was occupied by water surfaces (Fig. 4, 7).

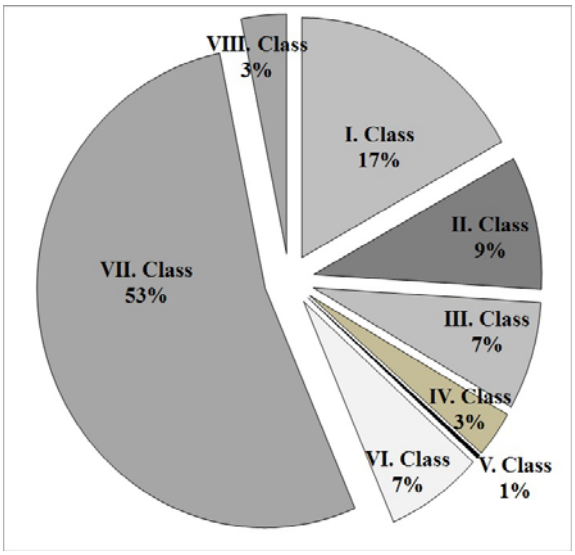


Fig. 3 : Current land capability classes and land use case of Kucuk Menderes river basin (%)

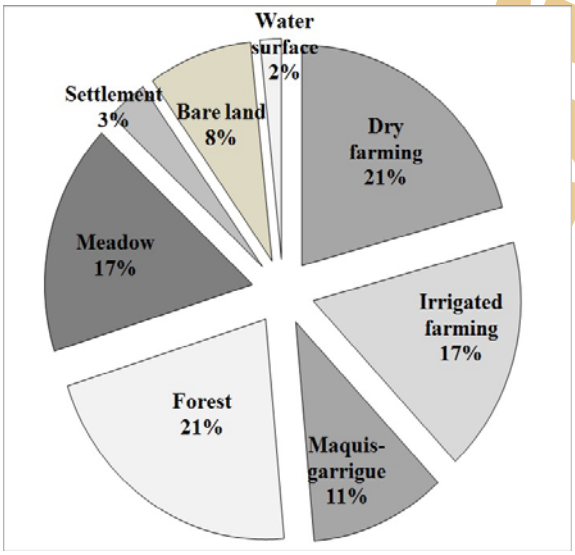


Fig. 4 : Current land use in Kucuk Menderes Basin (%)

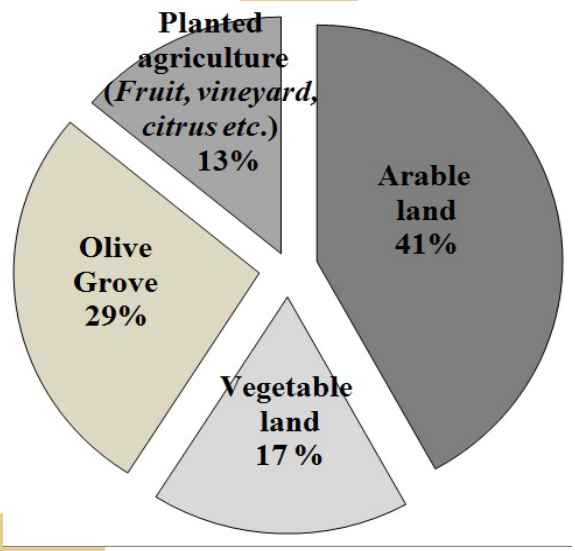


Fig. 5 : Agricultural land use in the Kucuk Menderes river basin in 2012 (%)

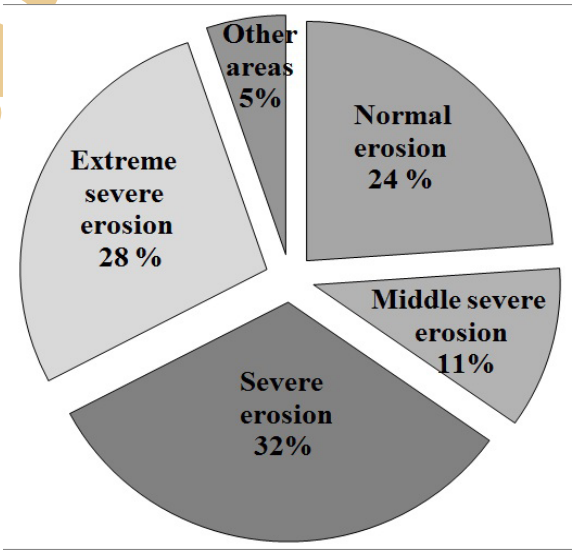


Fig. 6 : Erosion degree in Kucuk Menderes Basin (%)

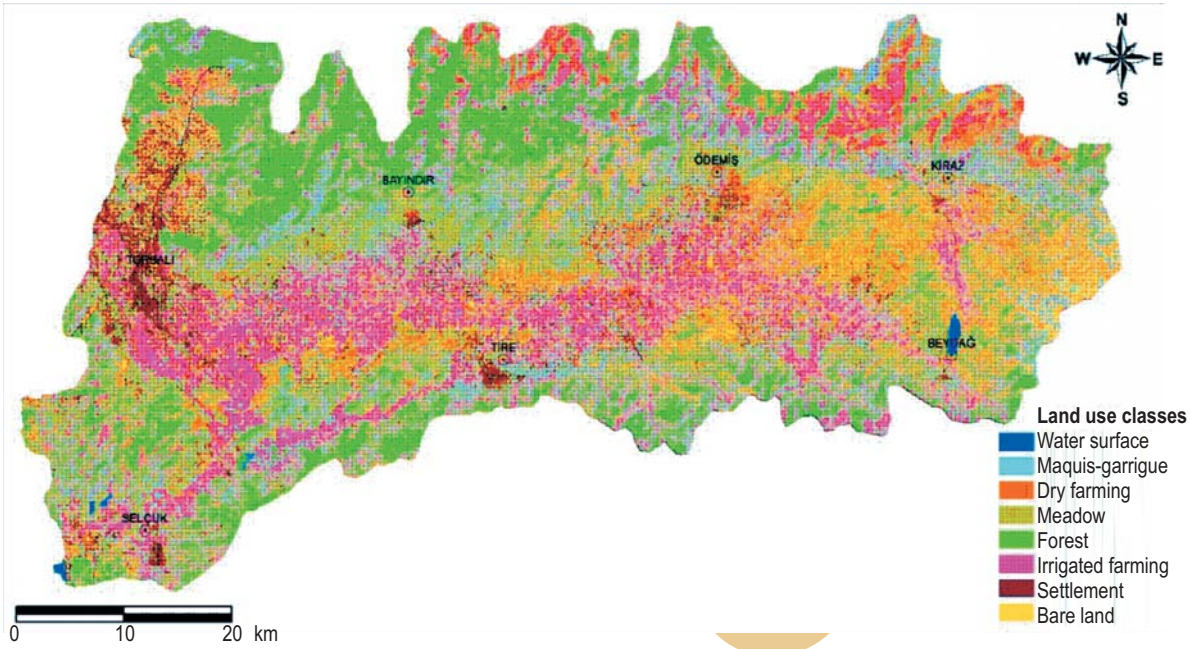


Fig. 7 : The map of current land use

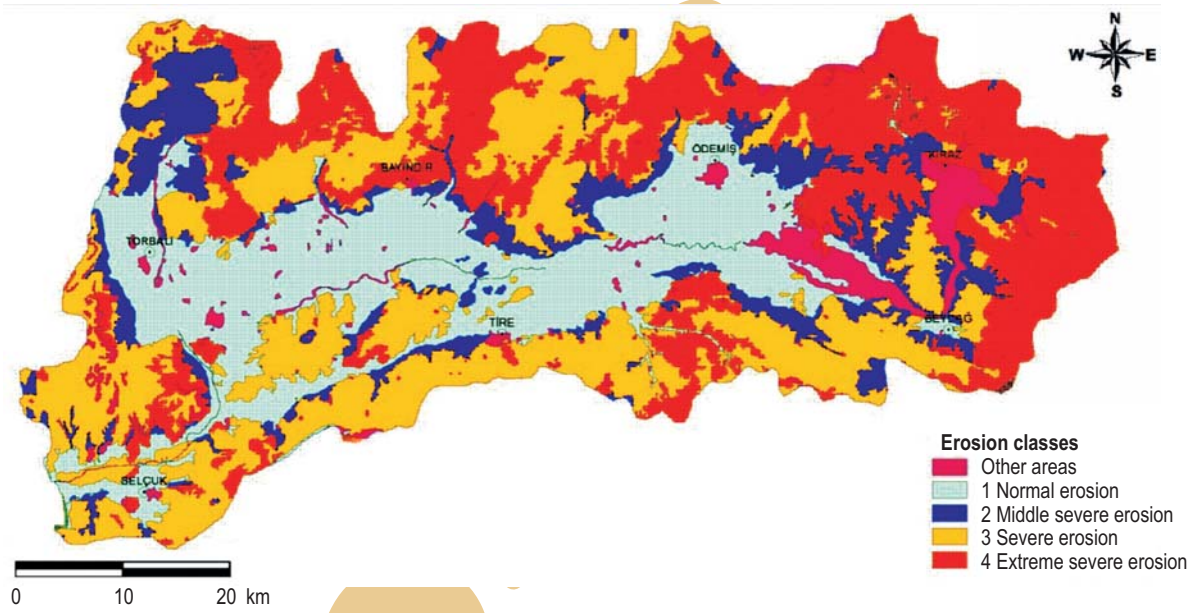


Fig. 8 : The erosion map of study area

55% of the agricultural fields were used for dry farming (50-60% cereals (wheat, barley); 40-50% of the area was used for growing olive, viniculture and fallow lands (Fig. 10, 12). Dry farming fields were common on class VII (51%), class I (21%), class II (9%), and class III (8%) lands, basin sides and in the East of the basin (Odemis, Kiraz, Beydağ triangle) and around Tire. Irrigated farming areas in the basin (45%) were increasing. Irrigated farming activities on class I (21%), class II (11%), class III (8%), and class VI (7%) lands were carried out on the areas, where inclination was 0-5% on the floor of the basin and in the valleys. The irrigated farming activities on class VII lands (48%) need special attention. Irrigated farming activities, hugely depend

on the irrigation, potentially lead to an excessive use of the plain in the basin. 53% of the agricultural fields have already been irrigated by the cooperatives. Olive growing (29% of agricultural fields) is widespread on colluvial deposits in the basin, sides and basin floor. Maquis also occured on the destroyed forest lands (Fig. 4, 7). In the basin, there were more than 8 million fructiferous olive trees (Efe *et al.,* 2013).

Considering the use of agricultural field in Kucuk Menderes basin (data obtained in 2012), farming fields were the most commonly used ones (41%), followed by the olive groves (29%), vegetable fields (17%) and planted fields (13%) (Fig. 5). The dominant products in the farming fields were corn (fodder) (303 km^2), potato (132 km^2), wheat (103 km^2), corn (grains) (76 km^2), barley (75 km^2), cotton (36 km^2), clover (29 km^2), fodder turnip (28 km^2), *Vicia sativa* (25 km^2) and tobacco (19 km^2). In the vegetable fields, most common products were tomato (88 km^2), watermelon (45 km^2), pepper (37 km^2), cucumber (39 km^2), bean (23 km^2), okra (9 km^2) and green pea (8 km^2). In the planted fields, cultivation of fruits, vineyards, and citrus were dominant (Izmir Provincial Directorate of Agriculture, 2012). Cultivation of fig, peach, chestnut, grape, mandarin, cherry, pomegranate, apple and plum are becoming more valuable and their fields are getting wider and wider day by day. There is a great increase in the planting of pomegranate around Selçuk delta plain and the planting of fig on the slopes facing North of Aydın Mountains (Fig. 8, 9, 11, 12). Cultivation of ornamental plants in the basin reveals that 676 families cultivate on 46.6 ha in Bayındır; 158 families on 15.4 ha in Odemis, 24 families on 45.3 ha in Torbalı. Floriculture has been another significant activity, carried out for last decade. Outdoor floriculture and arboriculture is rapidly increasing in the settlements around Bayındır (Fig. 11).

Forest lands (21%) were spread on the inclined areas (inclination 10-15%), on class VI and VII lands, on the South slopes of Bozdağlar, on the northern slopes of Aydın mountains and on the western part of basin (Fig. 12, 13, 17, 20). The red pine (*Pinus brutia*) groups occupied the slopes facing north and west of mountainous areas, depending on the optimum humidity conditions. Sandy soil, formed by weathering of metamorphics, caused crooked trunks on these pines. In Bozdağlar, red pines formed mixed forests of Valonia oaks (*Quercusithaburensis ssp. Macrolepis*), and the maquis species under these trees were sporadic. The red pines could be seen up to 800-900 m and were mixed with oak species and chestnuts in the valleys (*Castanea sativa*). Beyond this altitude, there were Black pines (*Pinus nigra*). The red pine forests were widespread on Aydın mountains (around Odemis and Tire), but were largely destroyed and replaced by economically valuable trees like chestnut (*Castanea sativa*), walnut (*Juglans regia*) and especially fig (*Ficus carica*) (Cukur, 1998). The red pines were found on high planes, far offfrom the effects of humans, at about 1000 m altitudes. On the slopes facing north of Aydın Mountains, there were chestnut, alder (*Alnus glutinosa*) and under these were ferns, all ranging between 400-450 m to 950-1000 m (Fig. 14). At places, chestnut groups were dispersed with plane trees and other oak species. The bush layer of these chestnut groups consisted of maquis and deciduous species like wild pear and mayflower. Black pine (*Pinus nigra*) groups started at 850-900 m and could be seen up to high altitudes, where mountain steppes were located. In the basin,forest lands were generally located on class VII (78%), class VI (8%) and class III (5%) lands.

Maquis-garrigue areas (11%) were spread in patches in the basin (Fig. 4, 7, 17). On the northern slopes of Bozdağlar olive groves were formed up to 400-500 m On the non-destructed lands one could see ryegrass, sandalwood, nettletree, cermes oak, phyllyrea, prickly juniper, strawberry tree, cistus, sage and broad-leaved cistus. From the inner sections of valleys, to 700-800 m altitudes, hygrophilous maquis species such as daphne, myrtle, oleander could be seen. Xerophilous maquis species, on the other hand, were common around Odemiş, Birgi, Kiraz and Beydağ. Around the graben, the maquis species went up from 100-150 m to 500-700 m. On the northern slopes of Aydın mountains, one could see cyprus oak (*Quercus infectoria*), hackberry (*Pistacia terebinthus*), besom (*Spartium junceum*), and kermes oak (*Quercus coccifera*) groups, all starting from 300-400 m. The spread of garrigues is generally related to the destruction of red pine forests and maquis. It could be seen that they were mixed with maquis up to 500 m around Bülbül mountain in Selçuk. Maquis-garrigue groups generally occured on class VII (51%), class I (19%), class II (10%), class III (8%), and class VI (7%) lands. The fact that the maquis-garrigues are common on class VII lands, which could be forest lands provided a striking example to show that the level of land degradation in the basin (Fig. 18).

Pasture areas occupied 17% of the basin (Fig. 4, 7, 15, 16). Pasture areas were common on class VII (46%), class VI (8%) lands which lacked trees and underbrush, and on class I (21%), class II (12%), and class III (9%) lands which could be used as agricultural fields. Pasture areas, which reflect the traditional stock breeding in the basin, also faced destruction. Excessive and early grazing on the inclination greater than 10% specifically gets exposed and causes exacerbation of erosion. The cattle should graze on 3 ha, sheep or goats should graze on 1.3 ha of pasture (Atalay, 2011; Ozturk *et al.,* 2012). In Turkey however, a bovine animal has 1.6 ha, and an ovine animal has 0.5 ha of pasture to use. There was no consistency between the current animal existence and the pasture areas. Insufficiency of pasture areas caused the forests, maquis and olive groves to be used as pastures and this speeded up the process of land degradation (Fig. 18). During land observations, sheep yards and sheep eating tree saplings were frequently seen. In the study area, corn (fodder), barley, clover, rye, triticale and oat were planted in the plantations.



Fig. 9 : Potato agriculture on the sandy soil in the basin (Ödemiş)

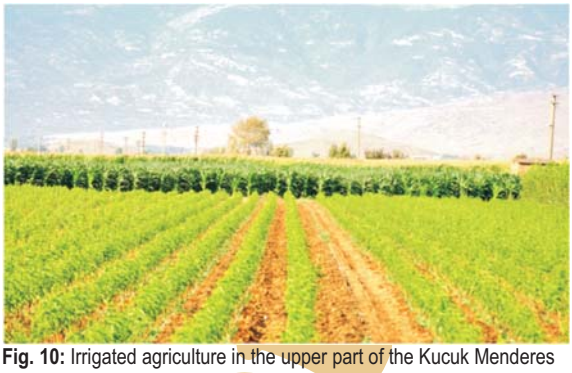


Fig. 10: Irrigated agriculture in the upper part of the Kucuk Menderes Basin around Gökçen-Beydağ



Fig. 11 : Horticulture and arboriculture are practiced around Bayındır



Fig. 12 : Plantation of olive and especially fig is primary agricultural activity around Aydin



Fig. 13 : Hilly area which is converted into an olive grove by terracing



Fig. 14 : Orchard (plum) established on the alluvial soil around Ödemiş



Fig. 15 : Dairy farms located near Derebaşı village (between Bayındır–Ödemiş)



Fig. 16: Stock breeding in the east of Bayındır



Fig. 17: Olive groves are formed in near forest consisting *Pinus brutia* which is climax tree of Mediterranean climate

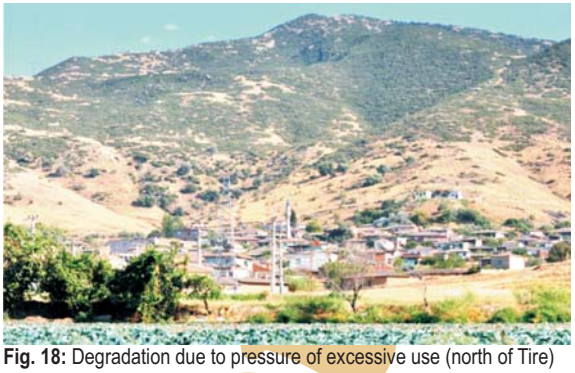


Fig. 18: Degradation due to pressure of excessive use (north of Tire)



Fig. 19 : Kucuk Menderes plain and Tire town



Fig. 20 : Beydağ and surroundings located in the upper region of the Kucuk Menderes Basin

Exposed surfaces, stony-rocky-sandy areas, roads occupied 8% of the basin and were degraded lands (Fig. 4, 7). The class VII lands (45%) could be located under the forest vegetation, and it is a perturbative fact that class VI lands (7%), which could be used as pasture areas, lacked vegetation (Fig. 16, 18). Lack of vegetation in class I (21%), II (11%), III (11%) and class IV (4%) lands was set to be used as agricultural fields which revealed that these lands could be reformed and changed into arable lands again.

On 3% of the basin settlement, tourism, industry and mining activities take place (Fig. 4, 7, 18, 19, 20). The percentage of settlements on class I (21%), class VII (45%), class II (11%), class III (11%), class VI (7%), and class IV (4%) lands varied. Kucuk Menderes Basin has approximately witnessed settlement for last 5000-6000 years. It was inhabited by 480.000 people in 2012. Important centers in the basin were Torbalı (127.101 inhabitants), Odemis (75.577 inhabitants), Tire (53.692 inhabitants), Selçuk (28.213 inhabitants), Bayındır(21.785 inhabitants), Kiraz (8720 inhabitants) and Beydağ (5612 inhabitants).

Settlements in the basin started from the basin floor and went up to 1250 m (Fig. 7). In the study area, half of the settlements (50%, 131 settlements) were on the basin floor, 30% (77 settlements) were on the side plains and 20% (52 settlements) were on the mountain slopes. Approximately, 70% of the settlements occupied class I, II, III and IV lands, which could actually be used as agricultural fields. This situation indicated inconsistency between land use and land capability classes.

The mines extracted in the basin and their locations are as follows: Arsenic (Ödemiş, Tire), dolomite (Torbalı, Selçuk, Tire), marble (Tire, Torbalı, Selçuk), titanium (Selçuk, Ödemiş, Tire, Kiraz, Beydağ, Bayındır), gold (Ödemiş), antimony (Ödemiş), copper-lead-zinc (Bayındır), mercury (Ödemiş, Torbalı, Tire production stopped), iron (Torbalı), emery rock (Tire), lignite (Tire). The natural vegetation in the mining areas was trimmed, the excavated material brought to surface, randomly stocked up material, and drilled holes were not closed. All these areas need reclamation, as early as possible.

There was an inconsistency between land capability classes and land use in the basin. While the area occupied the class I, II, III and IV land, which could be used as agricultural fields, was 37%, area occupied by agricultural lands was already 38%. This situation seemed consistent in terms of ratio, however the fact is that these classes of lands were used for settlement (6%) and meadow-pasture (20%); while land classes V, VI, VII and VIII were used for agriculture (32%) and settlements (3%) (Fig. 2, 3, 4, 7). Using these lands as settlement and pasture areas, and exposed surfaces showed the obvious misuse of

natural potential (for class I lands, 7% as settlement, 21% as pasture, and 10% exposed surface; for class II lands, 6% as settlement, 22% as pasture, and 10% exposed surface; for class III lands 4% as settlement, 20% as pasture, and 12% exposed surface). Whereas in class IV lands, which could be used as pasture, only 19% of the area was used for pasture and 35% of the area was used for agriculture. These areas were turning into degraded lands due to excessive grazing. As a matter of fact, areas in the basin described as "exposed surfaces" have emerged due to excessive-early grazing in the areas where vegetation was destroyed. 42% of class VII lands were covered by forest-maquis-garrigue, which means 58% of these lands were misused. The sandy, stony, rocky areas and water surfaces form class VIII lands (19%) were used for agriculture, depicting the effect of humans on natural environment.

Other factors showing inconsistency between land use and natural environment potential are as follows: 51% of dry farming areas on class VII lands, 48% of irrigated farming areas on class VII lands, 46% of the pasture fields on class VII lands and 45% of these on classes I, II, II, and IV lands revealed 45% of the exposed surfaces on the inclined class VII lands.

All these activities led to some negative consequences. The massive erosion (60%) on the basin affected the lands that were inclined and lacked vegetation-cover (Fig. 6, 8, 16, 18). In 11% of basin, the level of erosion was moderate, and in 24% it was geological. Severe erosion occured on the degraded areas with 10% inclination or more, the dry farming areas, around the settlements, mining sites. The rate of erosion was 59% on the maquis-garrigue areas, 57% of dry farming areas, 53% of pasture fields, 87% of the forest lands, 54% of the irrigated farming fields, 26% of the settled areas. In other words, 87% of class VI lands, and almost all of the class VII lands faced severe erosion. Rocky terrain had risen to the surface due the soil erosion on the areas consisting of metamorphic rocks, such as gneiss and mica schist in Bozdağlar and Aydın mountains (Koçman, 1989). Degradation of the areas as a result of misuse led to loss of biomass in the basin (Goudie, 2006). Extensive construction activity of secondary homes on coastal areas (Pamucak coastal area) added to the degradational activities. Secondary and touristic facilities, on the Aegean sea coast in the Kucuk Menderes Basin, was another example of land misuse. These areas were exposed to the risk of earthquake and probable sea level changes.

Other examples of land misuse in the basin were occasional floods, risk of ground liquefaction, problem of salinisation and alkalisation, drainage and chemical pollution (the domestic wastes and excessive-unconscious use of fertilizers-pesticides, especially due to the industrial facilities around Torbalı and Tire).

As a result of land misuse in the study area, there was an inconsistency in the type of land use. There is an emerging destruction which is unfavorable for the olive groves and agricultural fields on the coast and basin floor and for the natural vegetation on the high and steep areas. As a result of these destructions, the balance between soil-plant-water systems is broken and the production of biomass has declined (KHGM, 2001; Ozturk *et al.*, 2002, 2011, 2012).

Kucuk Menderes river basin has been intensely used for centuries. Today, nearly 53% of the area (1733 km^2) is misused, 60% of the areas are exposed to severe and extremely severe erosion, the soil is losing its productivity and the biomass is declining day by day. There is no consistency between the land use and land capability classes in the basin. The socio-economic activities, without considering the natural environment potential of the basin, have ended up with irreversible results (KHGM, 2001; Ozturk *et al.*, 2002, 2011, 2012).

It was found that 22% (717 km^2) of agricultural activities were practiced on non-arable land classes VI, VII, and VIII. The arable lands from classes I, II, III, and IV were used as residential areas (3%, 73 km^2). 8% of the basin (265 km^2) lacked tree-bush vegetation. In large portion of the area, there was great destruction of vegetation. The vegetation of forest, oak and maquis lands were destroyed due to grazing and other factors. Forest lands turned into degraded lands (closure rate is between 0-10%). Grazing was practised in the improper areas (except for class VI) (16%, 513 km^2). Another prominent factor was that there were forest-maquis-garrigue areas on class I, II, III and IV lands, which could be used only as agricultural fields (7%, 222 km^2). Such situation may be considered as positive concerning the vegetational characteristics of forest lands. However, the same situation did not seem to be applicable to maquis, especially garrigue areas (4%, 137 km^2). The ground water and basin soil were severely polluted by the factories established along the Fertek stream in the north and south of Torbalı, and by the Tire-Kutsan paper mill. Along with the agricultural enterprises in the basin, other industrial facilities, domestic wastes, pesticides and fertilizer residues added to this grave situation resulting in severe pollution of Kucuk Menderes river. The black water added from the olive squeezing practices during fall and winter was another factor of pollution. Municipalities in the basin (especially Odemiş and Tire) deposited solid wastes in the basin but the sewages polluted the Kucuk Menderes, as well as all ground water.

The balance between soil-plant-water was broken and the production of biomass declined due to land degradation in almost one quarter of study area. Therefore, the lands should be used according to their land capability classes in terms of their sustainability, and the agriculture of less water consuming, xeromorphic species should be considered. For the development of the basin, "Kucuk Menderes Basin Development Center" should be developed.

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