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Full Length Research Paper

National and regional landscape classification and mapping of Turkey: Konya closed basin, Suğla Lake and its surrounding area

Osman Uzun[1]*, Figen Dilek[2], Gülay Çetinkaya[3], Fusun Erduran[4], and Sebahat Açiksöz[5]

[1]Landscape Architecture Department, Forestry Faculty, Düzce University, Duzce, Turkey.
[2]Landscape Architecture Department, Agriculture Faculty, Ankara University, Ankara, Turkey.
[3]Landscape Architecture Department, Faculty of Agricultural Sciences and Technologies, Lefke European University, Turkey.
[4]Landscape Architecture Department, Agriculture Faculty, Çanakkale Onsekiz Mart University, Turkey.
[5]Landscape Architecture Department, Forestry Faculty, Bartin University, Bartin, Turkey.

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Each country ratifying the European landscape convention (ELC) is responsible for identifying their landscapes, integrating their approaches about landscape planning into the other sectoral plannings. Although the studies to classify landscapes at local scale in our country have been carried out for the last four decades, those at national and regional scales have gained importance along with the ELC in recent years. In this study a method was developed related to the classification of national and regional landscapes with the geographical information systems (GIS) and remote sensing (RS) techniques by using computerized data about climate, geomorphology, geology, land cover and great soil groups on an accessible level according to the conditions of our country. In the method proposed to create landscape classes for the first time in Turkey, the related data was overlaid by using GIS and mapped with a coding system specific to our country at national and regional scales in the Konya closed basin, which is one of the 25 big river basins determined by the General Directorate of State Hydraulic Works (GDSH). The map of landscape character types is used for the assesment of landscape characters, developing policies about landscape planning, landscape protection and management, the works about environmental impact assessment (EIA), strategic environmental assesments, and developing policies and making decisions regarding the sectors such as agriculture, forestry, and industry. The reason for selecting the Konya closed basin, Suğla Lake and its surrounding area as an area of research is that the Landscape Protection and Management project has been carried out in this area by the Ministry of Environment and Forestry and in this context; there is a database about the area. The research area has a significant biological diversity as well as climatic diversity. The Konya closed basin has an area of 53250 km^2 and 367 national landscape character types have been determined with the implementation of the method to the area. Suğla Lake and its surrounding area has an area of 740 km^2 and it has 54 national landscape character types at national scale. When the entire basin is considered, this amount increases the importance of the research area in terms of landscape diversity. Determination of 214 landscape character types in Suğla Lake and its surrounding area at regional level shows the importance of the landscape diversity of the area at regional level. As required by the ELC's commitment, it is suggested that the related method be implemented to the other 24 big river basins and subregions by using the data sets suggested.

Key words: Landscape classification, landscape planning, landscape character assesment, Konya.

INTRODUCTION

The countries signing ELC are responsible for classifying and protecting the landscapes of their countries, forming their management policies, and integrating the landscape into the other sectoral plans such as industry, forestry,

agriculture and settlement etc (Şahin, 2003). A landscape, in ELC, means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors. Landscape has been defined by different approaches as in the whole world. However, “landscape ecology” based definition comprises one of the most current definitions today. A landscape is a mosaic of land uses in similar forms on kilometres of large areas and local ecosystems. Some qualities seem to be similar and tend to reiterate across the entire area like geological land forms, soil types, vegetation types, regional animal existence, natural intervention regimes, land use, and patterns created by people in a landscape. Therefore, spatial element sets that characterize landscape are reiterated (Forman, 1995).

Major natural factors shaping landscape are climate, geology and geomorphology, relief, hydrology, soil and flora. Natural factors change as a result of the interaction of people due to a series of cultural factors. Major cultural factors are settlement areas, transport network, agriculture, forestry and industry (Wascher, 2005). Classification and identification of landscapes is the first problem to be faced by the responsible organizations and institutions for the development, protection and management of landscape. Because all the decisions related to the future of the landscapes should be in sufficient numbers or the change should be assessed during the process (Luginbühl, 2002). The interaction of natural and cultural resources, particularly with people, is more important for the identification of the landscape. In this context, during the classification studies, a balance should be struck between people and nature.

Landscape identification and assessment require the borders of similar or different types of landscape zones to be determined. Until recently this classification has been carried out by traditional geographical processes where homogenous qualifications have been analyzed. Besides, researches have been conducted for the last twenty years and new identifications and assessment criteria have been created. Researches have presented different meanings of the concept of landscape; thus, the necessisty to implement the other methods rather than this single meaning that identifes and characterizes landscape have emerged. ELC suggests that special cultures in Europe be realized and participation be needed for that part of the population (Luginbühl, 2002). Landscape character means “a set of elements that makes one landscape different from another”. Particularly the whole set of elements like geology, topography, soil, flora, land use and settlement areas formulate the landscape character.

Landscape character adds meaning to that area by making one area different from another, and understanding that one area is different from another will help us provide contributions to make better future plannings by considering envirnomental and socio-economic factors of that area. Landscape character is the distinct, recognisable and consistent pattern of elements in the landscape. They can make one landscape different from another with these characteristics (Swanwick, 2002). Landscape character assessment is used to define environmental and cultural characteristics representing a local scale, monitor environmental changes, understand and analyse the awareness of locals about changes and developments (Swanwick, 2002). Landscape character assessment (LCA) includes identification, classification and mapping of different landscape characters. Within the scope of this assessment, factors that cause change in each landscape character type are questioned. This approach is particularly useful to make decisions related to the future management of landscape character. While classifying the landscape, firstly, landscape character type and landscape character area should be determined (Julie et al., 2007).

Landscape character types are defined by unique relations between natural components such as geology, soil, morphology, land cover and human components such as settlement and field patterns, land use, building, and farming styles. Landscape types are generic in nature. They can occur in different areas or different geographical areas. For example, open fields and enclosed landscapes, rural landscapes, polderlands, moors, mountainsides etc. A landscape typology is a systematic classification of landscape types based on attributes that describe properties of interest, such as land use, scenic properties, or cultural characteristics or history. There will be different topologies depending on the classification purposes (Van and Antrop, 2007). Landscape character areas include areas with unique characteristics and reflect geographical characteristics of the region. Landscape character types are defined by the same names such as plateau, plain etc., even if they are in the different parts of the world, and they are usually given a proper name since they are unique of their kind (Swanwick, 2002).

According to Troll (1939), two methods exist for landscape classification: the holistic method and the parametric method. The principle of the holistic method is to start with a hierarchical subdivision of an area. This method is often based on detailed documents presenting synoptic views of the landscape as in a bird’s eye (Van and Antrop, 2007). At the same time, this method is based on the “Gestalt” theory with perceptual ability to a great extent (Van and Antrop, 2007). The parametric method starts with overlaid thematic maps; thus, the overlay polygons define the landscape units and the combined themes describe the landscape (Van and Antrop, 2007). The trend in recent years is to use the parametric methods for landscape classifications.

*Coressponding author. E-mail: osmanuzun@duzce.edu.tr. Tel: 00 90 (380) 542 11 37. Fax: 00 90 (380) 542 11 36.

There are three approaches in classifying the landscapes at global level (Wascher, 2005). First, the "world map of present-day landscapes" developed by Milanova et al. (1993) in Russia; second, the "anthropic landscapes map" prepared by the "American natural resources conservation service"-USDA; and third, the "European landscape map" developed by Meeus in 1990s. Meeus (1993) formed the foundations of the landscape map in the "European environmental report", the report of the "European environment agency". Landscape atlases can be produced at different scales (national, regional, and local). This structure based on the inventory allows for the necessary information for the objectives related to landscape development plans of the experts and landscape characteristics to be formulated (Luginbühl, 2002).

National landscape maps or atlases are instruments used for rural development, environmental assessment, to protect biodiversity and develop the related policies. For example, the atlas produced a result of the "European landscape character areas" is used to create scenarios belonging to the potential changes in land use at regional level and the changes in economical, social and environmental factors under landscape function (Wascher, 2005). In landscape classification, some European countries like England, Norway, Spain, Portugal, Slovenia works on a national scale, while some like France and Belgium work on regional and local scales. Identification and assesment of a landscape at national level does not prevent top-down inventory building (Luginbühl, 2002). Landscape atlases used in France allows the definition of landscape to be implemented in the areas they are formulated. Therefore, landscape atlases are the first thing to do before identifying landscape policies.

The relationship between landscape policies and landscape atlases enables the preparation of atlases depending on the administrative distributions/ separation of national lands. Landscape atlases in France are produced in three stages as identification landscape units, identification and characterization of landscapes and assessment of landscape dynamics. A landscape atlas is an information tool. Beginning from qualification of landscape units and identification of very special areas, it enables to define the priorities for the identification of landscape development phenomena, landscape protection, management and planning (Seguin, 2007). Some examples about the practical use of the atlases in France are as follows (Seguin, 2007):

Landscape atlases are reference tools for upper scaled planning projects; the suggestions proposed to overcome the problems about the landscapes in landscape atlases will provide support to national and local decision-makers; contributions will be provided to reduce social pressures and form landscape policies for the local needs and urban development with the analysis within the atlases; the data obtained will serve to redefine and redirect the tourism potential of the area; the works carried out during the preparation of the atlases will also enable the decisions about the land use and management to be tested in terms of compliance.

In Belgium, signed the ELC in 2005, 293 landscape units and 21 main landscape regions were defined for the Flanders region. In this study, visual properties were taken into consideration (Van and Antrop, 2007). Norway defined 45 landscape regions, 444 subregions and 276 distinct cultural landscapes. There is no preferred scale; the scale is selected according to the objectives (Luginbühl, 2002). Lioubimtseva and Defourny (1999), in their studies, developed their existing landscape classification systems in Russia by using GIS techniques. Landscape Character Classification of England was carried out by the Directorate of Nature Conservation and national character areas of the country were determined. England is divided into similar landscape character areas. These areas are called "National character areas" (NCA) (NE, 2009).

In England, 159 character areas were determined in eight regions and each area was classified into sub-scales. While forming character areas, twelve national databases were used including altitude, land form, ecological characteristics, land capability, surface geology, farming styles, settlement pattern, woodlands, field density and pattern, visible archeology, industrial history, and designed park areas (Swanwick, 2002). While classifying the landscape types, geology (limestone, sandstone, granite, alluvial etc.), land form (plain, valley, waterside, hill etc.), land cover (farm lands, wetlands, pasturelands etc.) and settlements (industry, cities, villages etc.) were taken as the basis. Landscape Character Assesment works were conducted under the project entitled "European landscape character initiative" (ELCAI), launched by Wascher (2005) in fourteen member countries.

According to the definition of the "Eurpoean landscpae map project" (LANMAP2), functional hierarchy was taken into account among biotic, abiotic and cultural facts. When arranged consequentially; the data such as climate, geology, geomorphology and topography, hydrology, soil, natural flora, fauna, land use and landscape patterns has to be reconsidered. These observations were taken as a basis for the method formed to determine the national landscape typologies (Wascher, 2005). For a European landscape classification the following core data sets have been selected (Wascher, 2005):

1. Climate based on the stratification of Europe in environmental zones.
2. Topography in form of the digital elevation model GTOPO30 with 1 km resolution of the USGS.
3. Parent material as a subset of the "European soil

database" on the scale 1:1 million of the "European soil bureau", re-sampled to 1 km resolution.
4. Land use of the Corine land cover database on the scale 1:100000, re-sampled to 1 km resolution.

Ecognition software (Definiens Imaging GmbH Munich, Germany) was used for the drawings of the European landscapes. This software is used to classify the objects as images (Wascher, 2005). At the European level, the "European landscape map" was created by overlaying these maps. There are 375 "European landscape types" in eight environmental zones in the "European landscape map". Some data that can be used in parallel with the landscape classification approach of Washer (2005) in our country are as follows:

There are climate maps for our country created by different researches related to the climate (Akman, 1999; Özyuvaci, 1999; Şensoy and Ulupinar, 2010). However, the "Climate map of Turkey" prepared by Şensoy and Ulupinar (2010) according to Thornthwaite's climate classification is the most uptodate and correct map. The reliability of Thornthwaite's method related to climate is apparent for the landscape planning works at local and regional scales in our country (Başal, 1981; Uzun, 2003). Şensoy and Ulupinar (2010) analysed the data belonging to nearly a hundred and twenty stations having data for the climate period of 1971 to 2000 in Turkey by using excel program. The indices obtained from these point results were mapped by using GIS and climate classification map of Turkey was obtained.

In our country, geological maps at the scales of 1/500 000 and 1/25 000 are produced by the mineral research and exploration institute (MREI). Geomorphological maps are usually produced at regional and local scales under special projects. The geomorphological map by Erol (1991) on behalf of MREI provides details about geographical formations and rock types affecting geological formations at a scale of 1:1.000.000. In our country, land cover maps are created and interpreted at different scale planning works. However, the land cover maps covering the entire country and belonging to the same date are the standard Corine land classification (CLC) maps that include 44 land cover classes as in Europe.

They are classified at three hiyerarchial levels. Five main categories (Level 1) include artifical lands, agricultural lands, forests and semi-natural lands, wetlands, and water structures. In order to collect detailed land cover information for CLC mapping and strike a balance among the project expenditures, the scale of the map was selected as 1:100.000, the smallest mapping area was 25 ha, and minimum width of the linear elements was 100 m. The smallest change unit was determined as 5 ha. Accordingly, the changes smaller than 5 ha and areas smaller than the total width of 25 ha were not taken into account (EFM, 2009).

The "soil and water resources national information centre" working at national level related to the soil maps in our country, works under the "ministry of agriculture and rural works". The institution has all the soil maps of Turkey. It is possible from these maps to get information about inclination groups, great soil groups, land capability classes, land use and etc. (TKB, 2008). In our country, the "general command of mapping" is responsible for the topographic maps. Topographic maps at the scales of 1:250.000, 1:100.000/ 1:25.000 are produced and used for different purposes in our country. Since the data sets that are used for landscape classification are similar to each other, it will enable the countries that do not take place in the project launched by Washer (2005) to compare their landscape classes with those of the other countries.

The aim of this study is to determine a method for the landscape classification at national, regional and local scales in Turkey, and to prove the applicability of the method in the sample of the "Konya closed basin" with the selection of the data sets to be used in the method. Since, in our country, there is no official legal status about landscape planning and no method to identify the landscapes of the countries, there is a need to set a course for producing policies about the identification, protection and management of landscapes. One of the aims of the research is to commence make up for shortcomings. The reason for selecting the research area is that "Landscape management, protection and planning project for Konya province, Bozkir-Seydişehir-Ahirli-Yalihüyük Districts and Suğla lake" being conducted by the "Landscape protection branch" of the "Nature conservation office" of the General Directorate of Nature Conservation and National Parks under the Ministry of Environment and Forestry has been continuing within the borders of the "Konya closed basin", Suğla Lake and its surrounding area.

Continuing a project about forming policies related to landscape identification, landscape planning, landscape management and protection by a government agency for the first time in Turkey and, in this context, creating a GIS database for the area have provided significant contributions to the research.

MATERIALS AND METHODS

The research area covers the "Konya closed basin", one of the 25 main river basins determined countrywide by the Directorate of State Hydraulic Works (GDSH) and Suğla Lake and its surrounding area, which is located within the borders of the basin (Figure 1). The "Konya closed basin" covers an area of 53.850 km^2, which is equal to approximately 7% of the total area in Turkey. The basin, comprising the main part of the Central Anatolian Plateau, has mainly a plain morphology with differing altitudes of 900 to 1050 m. The basin includes thirty-nine districts in the provinces Konya, Aksaray, Karaman, Isparta, Niğde, and Ankara. In this area, nearly three million people live, 45% in the rual areas and 55% in the urban areas (JMO, 2010).

The "Konya closed basin" is one of the 200 important areas



Figure 1. Boundaries of 25 Major River Basins in Turkey and Konya Closed Basin (GDSH, 2010) and Suğla Lake and its surrounding area.

determined worldwide by the world wild federation (WWF) in terms of its rich biodiversity. In the basin, there are 15 important areas for birds that provide breeding area for 8 out of 13 bird species which breed in Europe and are at the risk of extinction in the whole world, and an important flora covering an area of hundreds of thousands hectares (WWF, 2010). The basin is one of the important production areas in Turkey in terms of agriculture (WWF, 2010). The basin, having an important share of crops, pulses, and sugar beet production, provide 9.2% of the total income Turkey gets from crops, 6.2% from pulses and 8.5% of the industrial products including sugar beet (JMO, 2010). At the same time 60% of the total salt production in Turkey comes from this region (JMO, 2010). There are numerous lakes, reed fields and other wetlands within the "Konya closed basin". The wetlands within the Konya basin can be summarized as Samsam, Kozanli, Kulu, Beyşehir, Suğla, Bolluk, Tersakan and Tuz Lakes, and Hotamiş, Eşmekaya and Ereğli Reeds (JMO, 2010).

In the study, following the determination of the landscape classes at national level, a landscape classification was carried out at regional level in Suğla Lake and its surroundings. Below can be seen the borders belonging to Suğla Lake and its surrounding area. The research area includes Konya province, Bozkir-Seydişehir-Ahirli-Yalihüyük districts and Suğla Lake and its surroundings; the borders of the Suğla lake basin were taken as basis in terms of the functional structure of the landscape for drawing the borders of the area. The border drawn as ecologically-based is 74.152 ha (Figure 2). The basic maps used within the framework of the research are as follows: topographic maps produced by the "General command of mapping" at a scale of 1:100.000 and 1:25.000, map of main river basins of Turkey produced by the "State hydraulic works (GDSH, 2010), climate map of Turkey produced by Şensoy and Ulupinar (2010), "geological and geomorphological map of Turkey" created by Erol (1991), "great soil groups map" created by the Ministry of Agriculture and Rural Works (TKB, 2008), Corine 2006 maps produced by the Ministry of Environment and Forestry (EFM, 2009).

The method used for classifying the landscapes of Turkey is carried out in two stages as selection of data sets and determination and mapping of the landscape character types. Firstly, to form the method related to the determination of the "landscape classification in Turkey", some preliminary approvals were carried out using the studies of Başal et al. (1983), Swanwick (2002), Mücher et al. (2003), Uzun (2003), Wascher (2005), Van and Antrop (2007), Uzun (2009).

i) While identifying the landscapes, it was seen suitable for the landscapes of our country to be identified at basin level due to the "European union water directive" and the planning approaches at basin scale during the physical planning process; hence, identifying the landscapes of the country with the names of 25 main river basins at upper scale (Konya closed basin landscape, Western Blacksea Basin Landscape etc.),
ii) Using "parametric" methods in identifying landscape classes and forming a hierarchy at "national, regional and local" levels to identify landscape character types and areas,
iii) Using data sets accessible at national and regional levels to be used in landscape classification,
iv) Land patterns created by people are also accepted to be used in the classification together with the natural data to form landscape character types considering the definition of an area created as perceived by people as a result of the action and interaction of natural and/or human factors, as stated in ELC.

Selecting data sets

During the first stage, the data sets to be used to classify the landscapes in our country were selected. In this context, the studies of Swanwick (2002), Mücher et al. (2003), Uzun (2003), Wascher (2005), Van and Antrop (2007) were used. In the landscape classification study to be carried out for our country, the data about climate (Şensoy and Ulupinar, 2010), geology (Erol, 1991), geomorphology (Erol, 1991) and land cover (EFM, 2009) was selected at national scale, and besides all these data "great land groups" (TKB, 2008) at regional scale. After deciding about the related data sets, it was determined on which details the data would be used at national and regional levels.

Determination and mapping of landscape character types

Within the framework of the approach related to the landscape classification at national level, climate, geomorphological,

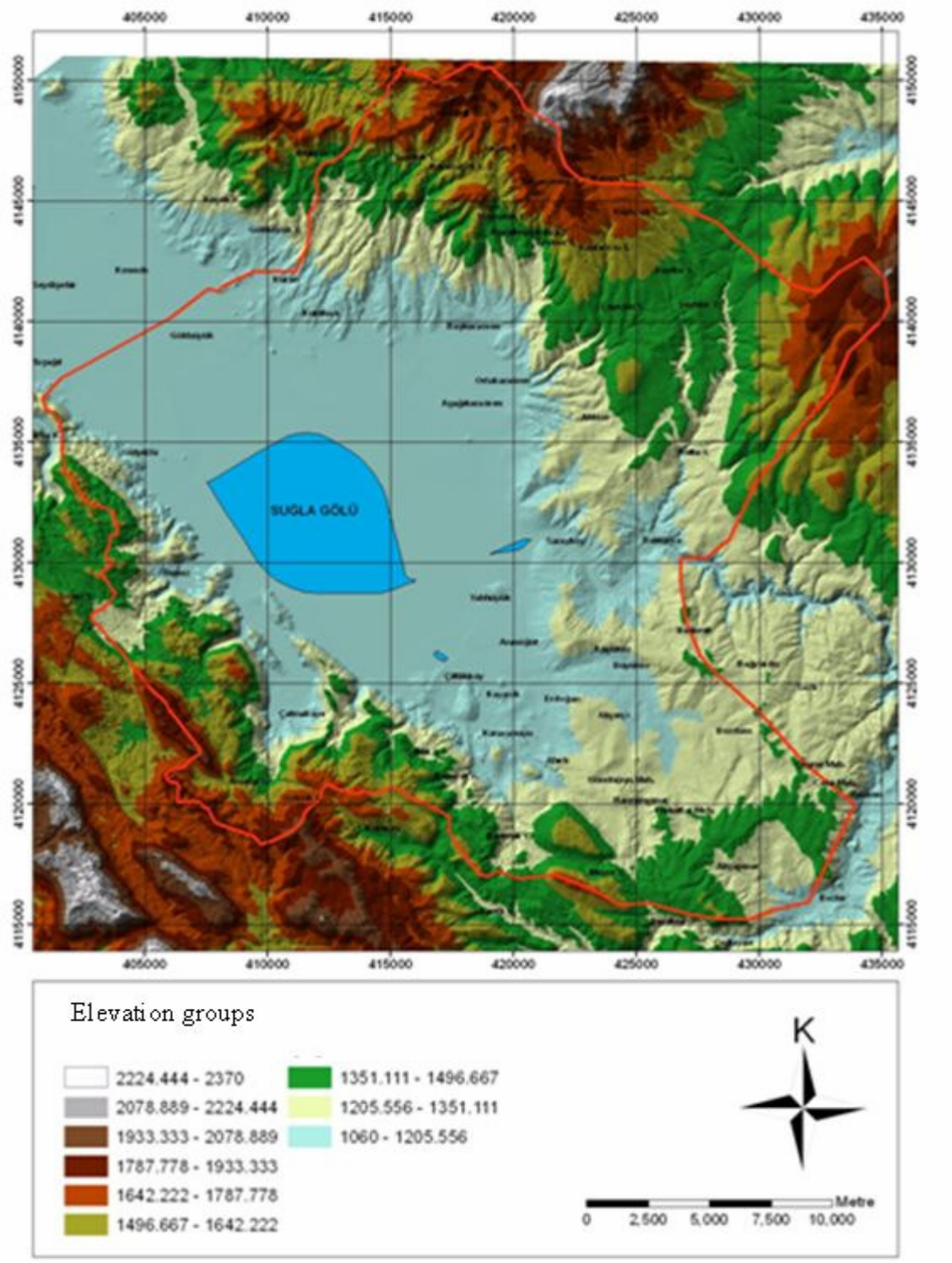


Figure 2. Study area.

geological, and land cover maps, each data as a polygon, were subjected to overlay analysis by using "ArcGIS9.3", GIS software. Determination of the "landscape character types" at regional level was only conducted within the borders of Suğla Lake and its surrounding area. In addition to the landscape character classification at national level, the map of great soil groups was overlaid with the other four maps. While forming "landscape character types" at regional scale, the polygons smaller than 25 ha

Table 1. Data sets and their areas of use that are used while determining national, regional and local landscape character types.

Levels	Criteria	Level	Scale	Implementation
National	Climate	1. Level	1:1.000.000 1:250.000	Planning of national, geographical region, basin, development plan, strategical plan etc.
	Geomorphology	1. Level		
	Geology	1. Level		
	Corine Land cover	2. Level		
Regional	Climate	2. Level	1:100.000 1:50.000 1:25.000	Sub region, province or more province planning, Enviromental plans.
	Geomorphology	2. Level		
	Geology	1. Level		
	Corine land cover	3. Level		
	Large soils groups	1. Level		
Local Some data may used according to study areas	Land cover, Geology (local), Geomorphology (local), Land use potencial, Slope, Aspect Microclimate, Elevetion groups.		1:25.000 1:10.000 1:5.000 1:1.000	City, County, Village planning.

were reconsidered. Additionally, the errors occurring during the polygon overlays were dissolved by using the related commands (dissolve, select, merge etc.) of "ArcGIS 9.3" program.

As a result of the inventory work carried out in the research area, border corrections were made that would be reflected from subscale to upperscale in the borders of the landscape character types at regional level by using the maps such as geomorphological, geological ones etc. A coding system was formed as to how the data to be used at national and regional scales would explain a landscape character type. Accordingly, the legend information describing the overlaid maps was used in the coding system respectively. The landscape character types with the same names which were overlaid and coded by using ArcGIS 9.3 were grouped amd mapped using GIS. As a result of all these procedures, maps of landscape character types were obtained for the Konya closed basin and Suğla Lake and its surroundings.

RESEARCH FINDINGS

Data sets and codes to be used for the landscape classification of Turkey at national and regional scales

While determining the landscape character types in Turkey, the data in Table 1 was used at national, regional and local levels (Başal et al., 1983; Swanwick, 2002; Mücher et al., 2003; Uzun, 2003; Wascher, 2005; Van and Antrop, 2007; Uzun, 2009). The levels of landscape classification for climate, geomorphology, geology, and Corine land cover data were explained in Table 1. The levels 1, 2, and 3 are related to the detailed information belonging to each data set to be used. For example, while the data at level 1 covers rough information, the data at levels 2 and 3 includes more detailed information. It was not defined clearly which data would be used for classification works at local level because some data might stand in the forefront depending on the area worked. For example, the data to be assessed related to an area where climatic changes vary will differ from the data belonging to an area where geomorphology stands in the forefront.

Initials of the Turkish words were taken as basis for all the coding of the landscape classifications (Tables 2, 5, 6, and 7). Data sets used for landscape classification, their details and coding systems are explained as follows:

Table 2 indicates at which level the data about climate is used for landscape classification. Accordingly, the prefixes Mega, Mezo, Micro, Tundra and Don were suggested to be used for the classification at national level, and at the 2nd level the letters Thornthwaite used for identifying climate were suggested to be used. Tables 3 and 4 shows at which level the data about geomorphology and geology are used for landscape classification. Accordingly, the 1st level codes will be used at national level and the 2nd level codes will be used at regional level in the geomorphological map, and the data on the geological map will be used at the 1st level. The codes to be used for the landscape classification of the data belonging to Corine land classification are given in Table 5. As seen in Table 5, the second level of Corine land cover data was used for the classification at national level, the third level of Corine land data was used in numbers at regional level.

While coding at the second level, the initials of the first level classes in the Corine classification and then the initials of the second level classes were taken as basis. For example, YSY: it was formed by taking the initials of the related definitions describing urban structure in artifical regions. YSU: it expresses the industry and

Table 2. Use of the data about climate at different levels for landscape classification and codes (Şensoy and Ulupinar, 2010).

1. Level		2. Level	
Code	**Climate**	**Code**	**Climate**
Mega	Megatermal (High temperature climates)	A	Very humid
Mezo	Mezotermal (Average temperature climates)	B4	Humid
		B3	Humid
		B2	Humid
		B1	Humid
Mikro	Mikrotermal (Low temperature climates)	C2	Semi-humid
		C1	Dry – Az nemli
Tundra	Tundra (Very low temperature climates)	D	Semi-dry
Don	Don (Very low temperature climates)	E	Dry (desert)

Table 3. (Relief classes) Use of geographical formations for landscape classification (Erol, 1991).

2. Level relief classes		1. Level code relief classes	2. Level relief classes	
Code	**Round crested forms**		**Code**	**Sharp crested forms**
0	0. Alluvial plains	*O: Basin's	1	1. Basins with terraces
2	2. Subsequent depressions	*V: Valleys and depressions	3	3. Large valleys
4	4. Low Plateus (D III) on Neogene (Pliocene) formations	*Y: Plateous	5	5. High plateaus (D II) on older formations
6	6. Flat topped with D I D II surfaces)	*T: Hills	7	7. Sharp crested, moderate high
8	8. Flat topped with D I, D II surfaces	*D: Mountains	9	9. Sharp crested, high

*Abbreviations are in Turkish.

Table 4. Use of main material (Lithology influencing the landforms) for the landscape classification (Erol, 1991).

1. Level		1. Level	
Lithology influencing the landforms		**Lithology influencing the landforms**	
Code	Causing round, low relief	Causing sharp, high relief	Code
0	0.Aluvium	1.Sandstone, conglomera, flysch formations	1
2	2. Alternating clay, marl, limestone	3. Limestone, marmer	3
4	4. Schist, gneiss	5. Alternating schist, gneiss, marmer, quarsite	5
6	6. Volcanic tuffs, ignimbrit)	7. Volcanic lava, agglomerate	7
8	8. Ofiolit, serpentine	9.Plutonic rocks	9

transport unit of the artificial region. Similarly, for the codings at level 2, initials of the related definitions were used. For level 3, the related numbers were used directly. Under these main categories, in addition to the European classification criteria, twelve level 3 classes were added for our country (Anonymous, 2009): Artificial surfaces: 1121 Discontinuous urban fabric, 1122 Discontinuous rural fabric ,Agricultural areas : 2111 Non-irrigated arable land, 2112 Non-irrigated arable land (Greenhouse), 2121 Permanently irrigated land, 2122 Permanently irrigated land (Greenhouse), 2221 Fruit trees and berry plantations without irrigated, 2222 Fruit trees and berry plantations with irrigated, 2421 Complex cultivation without irrigated, 2422 Complex cultivation with irrigated, Forests and

Table 5. Codes for landscape classification (adapted by Corine, 2006).

2. Level code	3. Level code	Land cover	2. Level code	3. Level code	Land cover	2. Level code	3. Level code	Land cover	2. Level code	3. Level code	Land cover	2. Level code	3. Level code	Land cover
	1	Artificial surfaces		2	Agricultural areas		3	Forests and semi-natural areas		4	Wetlands		5	Water bodies
*YSY	1.1	Urban fabric	*TEA	2.1	Arable land	*DOR	3.1	Forests	*IKB	4.1	Inland wetlands	*SKS	5.1	Inland waters
	111	Continuous urban fabric		211	Non-irrigated arable land		311	Broad-leaved forest		411	Inland marshes		511	Water courses
	112	Discontinuous urban fabric		212	Permanently irrigated land		312	Coniferous forest		412	Peatbogs		512	Water bodies
YSU	1.2	Industrial, commercial and transport units		213	Rice fields		313	Mixed forest	IDI	4.2	Coastal wetlands	SDS	5.2	Marine waters
	121	Industrial or commercial units	TSÜ	2.2	Permanent crops	DMO	3.2	Shrub and/or herbaceous vegetation association		421	Salt marshes		521	Coastal lagoons
	122	Road and rail networks and associated land		221	Vineyards		321	Natural grassland		422	Salines		522	Estuaries
	123	Port areas		222	Fruit trees and berry plantations		322	Moors and heathland		423	Intertidal flats		523	Sea and ocean
	124	Airports		223	Olive groves		323	Sclerophyllous vegetation						
YMI	1.3	Mine, dumpand construction sites	TME	2.3	Pastures		324	Transitional woodland shrub						
	131	Mineral extraction sites		231	Pastures	DBO	3.3	Open spaces with little or no vegetation						

Table 5. Contd.

	132	Dump sites	TKT	2.4	Heterogeneous agricultural areas	331	Beaches, dunes, and sand plains
	133	Construction sites		241	Annual crops associated with permanent crops	332	Bare rock
YYA	1.4	Artificial non-agricultural vegetated areas		242	Complex cultivation	333	Sparsely vegetated areas
	141	Green urban areas		243	Land principally occupied by agriculture, with significant areas of natural vegetation	334	Burnt areas
	142	Sport and leisure facilities		244	Agro-forestry areas		

semi-natural areas: 3321 Bare rock, 3322 Bare rock (Salty).

Determination of landscape character types of Turkey at national scale

In the naming of landscape character types at national scale, the data about climate, geographical formations, rock types and land cover, respectively, was coded by putting dots between them. For example, the landscape character type coded as “Konya closed basin Mezo.D.8.DOR” stands for the landscape character type in the Konya closed basin with mesothermal climate, mountainous geological formation, ophiolite, serpentinite rock types, and forest land cover. Coding information can be found in Table 6. Within the framework of the approach related to the landscape classification at national level, climate, geomorphological, geological, land cover maps, each data as a polygon, were subjected to overlay analysis by using “ArcGIS9.3”, GIS software. In this context, 10 988 polygons were obtained in the “Konya closed basin”.

The polygons with same characteristics were grouped to reach the common “landscape character types” from them. As a result, 367 different landscpe character types were obtained in the basin (Figure 3).

Determination of landscape character types of Turkey at regional scale

Codings to be formed at regional level can also be performed at provincial level as well as basin level. Since a more detailed scale is used at regional level, the coding system will be more detailed when compared to those used at national level. In this context, the map of great soil groups was integrated with the detailed data in the other four maps in addition to the types of data at national level. The key to the landscape classification at regional level and related codes are given in Table 7 in detail. In the Tables the landscape character type coded as “MezoB4.D8.7. N. DOR312” is explained as follows: “Konya closed basin, mesothermic, humid climate, mountainous round crested forms, DI, DII erosion surface, volcanic lava, agglomerate rock, non-calcareous brown forest soil and coniferous forest”.

The number of the landscape character types at regional scale was determined to be 214. The map of landscape character types at regional scale and its legend can be seen Figure 4.

RESULTS

Since it is the first study to identify the landscapes at national and regional scales for our country, this raises the importance of the study. At local scale there are similar studies which this study has been based on by Başal (1974), Başal (1981), Başal et al. (1983), Uzun (2003, 2009). Landscape classification is carried out at national scale in some European countries such as England, Norway, Spain, Portugal, and Slovenia, whereas it is carried out at regional and local scales in some countries such as France and Belgium (Luginbühl, 2002). In this study, a suggestion was made for a method for landscape

Table 6. Key to Landscape Classification at national level.

Climate (1. Level)	**Lithology influencing the landforms (1. Level)**
	0 Aluvium
	1 Sandstone, conglomera, flysch formations
	2 Alternating clay, marl, limestone
Mega(termal)	3 Limestone, marmer
Mezo(termal)	4 Schist, gneiss
Mikro(termal)	5 Alternating schist, gneiss, marmer, quarsite
Tundra	6 Volcanic tuffs, ignimbrit
	7 Volcanic lava, agglomerate
	8 Ofiolit, serpentine
	9. Plutonic rocks

Landscape character type: Climate + Relief classes + Lithology influencing the landforms + Land cover		
Mezo.D.8.DOR		
	Climate Lith. İnf. L.,	Land cover (2. Level)
		1. Artificial surfaces
		*YSY: Urban fabric
		YSU: Industrial, commercial and transport units
		YMI: Mine, dumpand construction sites
	Mezo.D.8.DOR	YYA: Artificial non-agricultural vegetated areas
		2. Agricultural areas
		TEA: Arable land
	Land cover	TSÜ: Permanent crops
Relief classes (1. Level)		TME: Pastures
*D: Mountains		TKT: Heterogeneous agricultural areas
T: Hills		
Y: Plateous		
V:Valleys and depressions	Relief classes	3. Forests and semi-natural areas
		DOR: Forests
O: Basin's		DMO: Shrub and/or herbaceous vegetation association
		DBO: Open spaces with little or no vegetation
		4. Wetlands
		IKB: Inland wetlands
		IDI: Coastal wetlands
		5. Water bodies
		SKS: Inland waters
		SDS: Marine waters

*Abbreviations are in Turkish.

classification of Turkey at national, regional and local levels. The method covers a classification system from a national scale to subscales. It was revealed that the data could also be used to form landscape character types and areas at local level (Figure 5).

The accessibility of data is important to carry out landscape classification works at country-scale (Swanwick, 2002; Mücher et al., 2005; Wascher, 2005). In this context, in this study, all the data related to geomorphology, geology, climate and land cover used for the classification of the landscapes can be accessible at country scale. The related data could be accessed from the databases of the Ministry of Agriculture and Rural Works and the Ministry of Environment and Forestry. The landscape classification works could be used as basis for the studies such as landscape planning, EIA, Strategical

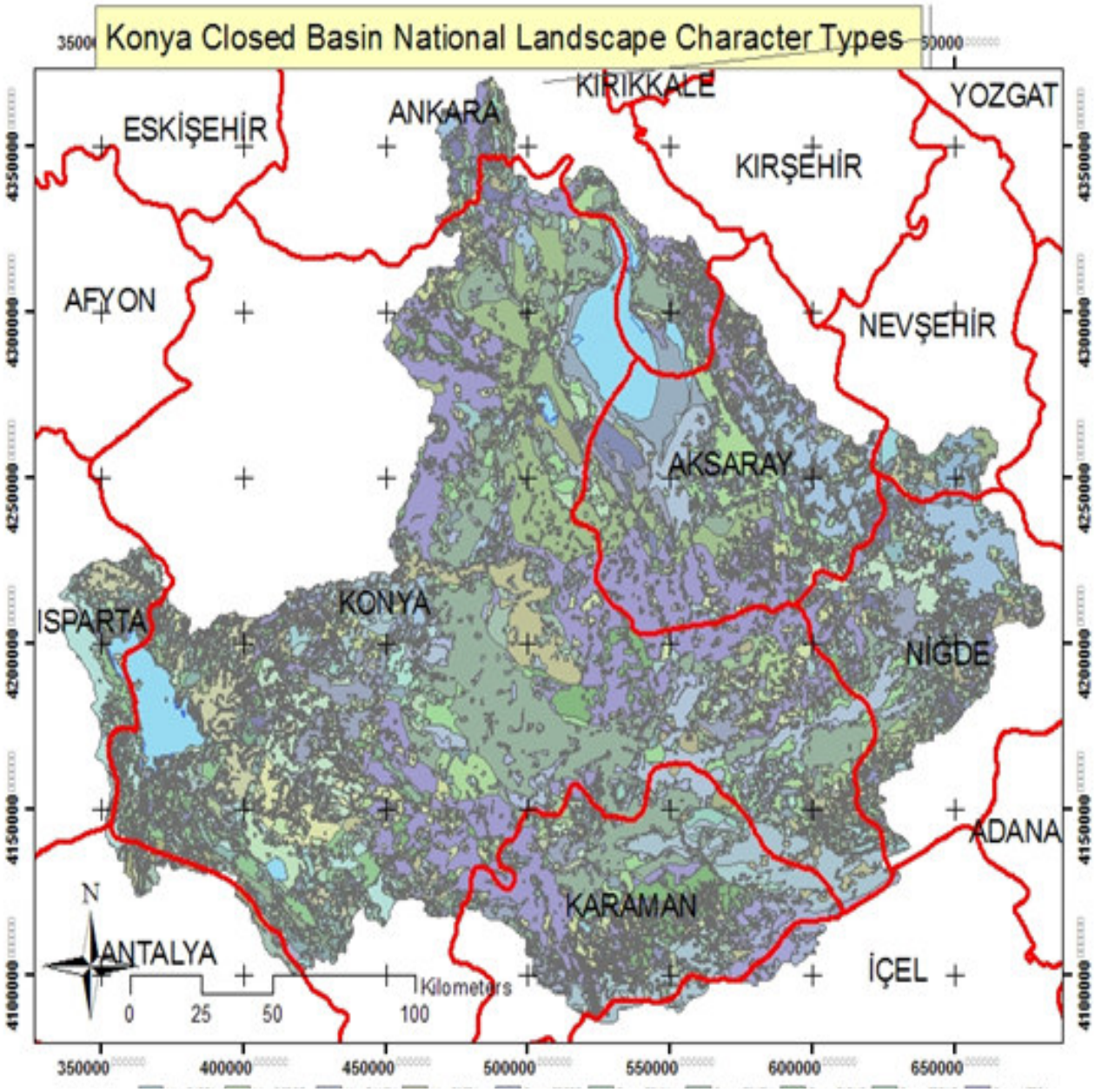


Figure 3. Konya closed basin national landscape character types.

EIA for any part of the country.

DISCUSSION

The data used for the method shows parallelism with those used by Swanwick (2002), Mücher et al. *(*2005), Wascher (2005). In this context, it can be adapted to the studies related to landscape classification to be carried out in Europe. It also proves the accuracy of the method used in this study. When climatic, biological and geomorphological diversity etc. the country has at sub-scales taken into consideration, the method enables local information at sub-scales to be incorporated into the landscape classification. In the method, the Corine (2006) data were grouped for the landscape classification works to be carried out in different places of the country not to require a separate study. However, for further studies, as in the studies of Swanwick (2002) and Wascher (2005), the data belonging to land cover can also be grouped.

"ArcGIS 9.3" GIS software was found sufficient for the re-grouping of the polygons obtained by overlaying the

Table 7. Key to regional landscape classification.

Climate (2 Level)	Lithology influencing the landforms (1. Level)	Large soils groups
MegaA Mezo B4 Mezo B3 Mezo B2 Mezo B1 Mikro C2 Mikro C1 Tundra D Don E	0 Aluvium 1 Sandstone, conglomera, flysch formations 2 Alternating clay, marl, limestone 3 Limestone, marmer 4 Schist, gneiss 5 Alternating schist, gneiss, marmer, quarsite 6 Volcanic tuffs, ignimbrit 7 Volcanic lava, agglomerate 8 Ofiolit, serpentine 9. Plutonic rocks	P: Red yellow podzolic soils, G: Grey brown podzolic soils, M: Brown forestry soils, N: Limeless brown forestry soils, CE: Maroon soils, D: Reddy maroon soils, T: Red Mediterranean soils, E: Red brown Mediterranean soils, B: Brown soils, U: Limeless brown soils, F: Reddy brown soils, R: Rendzina, V: Vertisol, Z Sierozem, L: Regosol, X:Basaltoid soils, Y: High Mountain grass soils, A: Alluvial soils,H: Hydromorphic soils, S: Alluvial coastal soils K: Colluvial soils, C: Salty-alcali and Salty-mixed alkali soils, O: Organic soils.

Landscape character type: Climate + Relief classes + Lithology influencing the landforms + Large soils Groups + Land cover	
MezoB4.D8.7.N.DOR312	
Relief classes (2 Level)	**Land cover (3 Level)**
O0 Alluvial plains. O1 Basins with terraces V2 Subsequent depressions r. V3 Large valleys. Y4 Low plateus (D III) on Neogene (Pliocene) formations. Y5 High plateaus (D II) on older formations. T6 Flat topped with D I D II surfaces). T7 Sharp crested, moderate high. D8 Flat topped with D I, D II surfaces D9 Sharp crested, high	**1. Artificial surfaces** YSY: Urban fabric: 111 Continuous urban fabric, 1121 Discontinuous urban fabric, 1122 Discontinuous rural fabric. YSU: Industrial, commercial and transport units121 Industrial or commercial units, 122 Road and rail networks and associated land, 123 Port areas, 124 Airports. YMI: Mine, dumpand construction sites131 Mineral extraction sites, 132 Dump sites, 133 Construction sites. YYA: Artificial non-agricultural vegetated areas141 Green urban areas, 142 Sport and leisure facilities. **2. Agricultural areas** TEA: Arable land: 2111 Non-irrigated arable land, 2112 Non-irrigated arable land (Greenhouse), 2121 Permanently irrigated land, 2122 Permanently irrigated land (Greenhouse), 213 Rice fields. TSÜ: Permanent crops: 221 Vineyards, 2221 Fruit trees and berry plantations without irrigated, 2222 Fruit trees and berry plantations with irrigated, 223 Olive groves. TME: Pastures, 231 Pastures. TKT: Heterogeneous agricultural areas:, 2421 Complex cultivation without irrigated, 2422 Complex cultivation with irrigated, 243 Land principally occupied by agriculture, with significant areas of natural vegetation. **3. Forests and semi-natural areas** DOR: Forests: 311 Broad-leaved forest, 312 Coniferous forest, 313 Mixed forest DMO: Shrub and/or herbaceous vegetation association: 321 Natural grassland, 322 Moors and heathland, 323 Sclerophyllous vegetation, 324 Transitional woodland shrub DBO: Open spaces with little or no vegetation: 331 Beaches, dunes, and sand plains, 3321 Bare rock, 3322 Bare rock (Salty), 333 Sparsely vegetated areas, 334 Burnt areas. **4. Wetlands** IKB: Inland wetlands: 411 Inland marshes, 412 Peatbogs. IDI: Coastal wetlands: 421 Salt marshes, 422 Salines, 423 Intertidal flats. **5. Water bodies** SKS: Marine waters: 511 Water courses, 512 Water bodies. SDS: Marine waters: 521 Coastal lagoons, 522 Estuaries, 523 Sea and ocean.

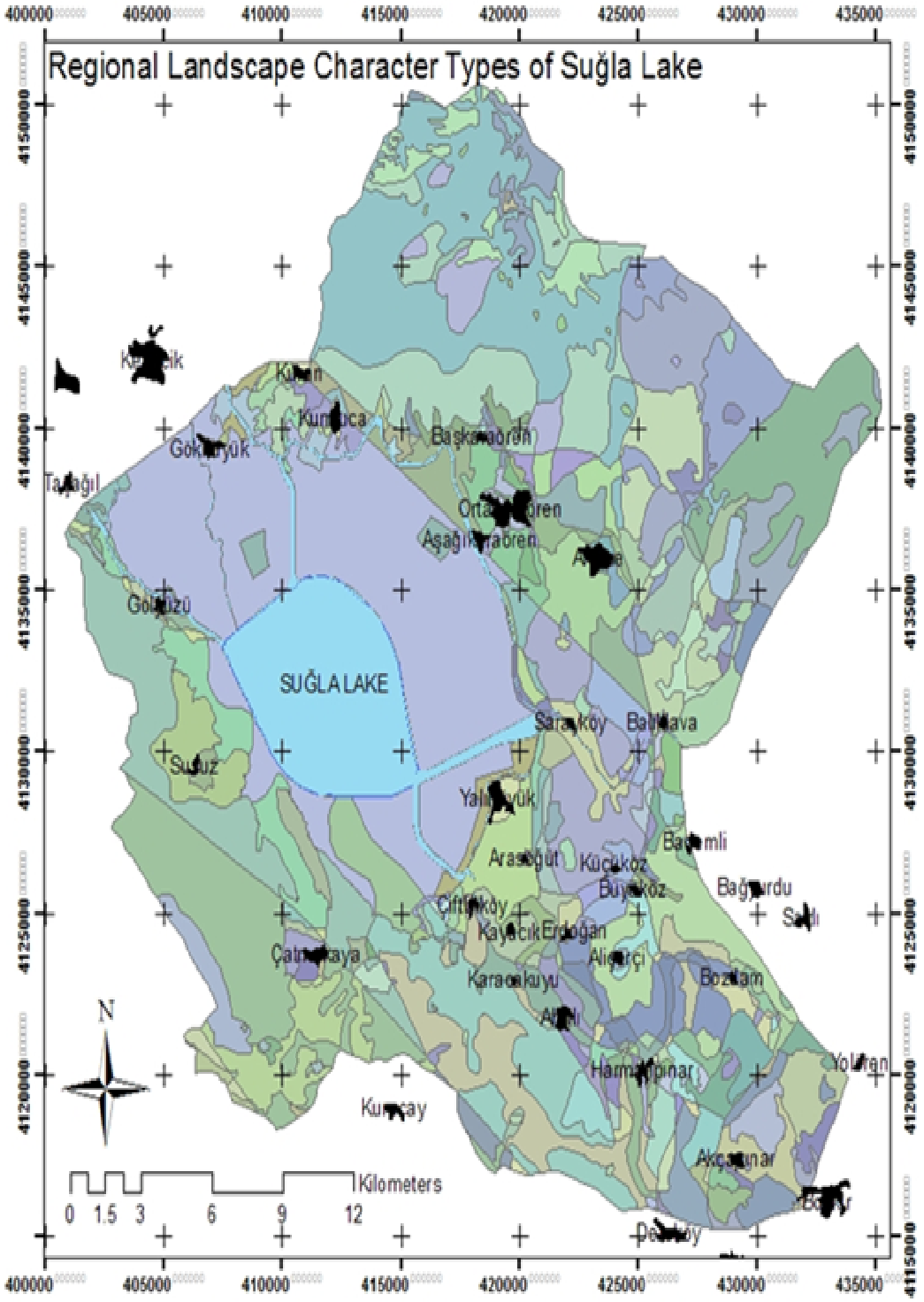


Figure 4. Regional landscape character types of Suğla Lake and its surrounding area.

data in the method. However, for more detailed studies, using statistically-based programs like “eCognition” Wascher (2005) or “Twinspan” (NE, 2009) etc. will increase the accuracy of the method. Management, protection and planning of the landscapes should be carried out in coordination. Both processes related to the identification and assessment of the landscapes should be simultaneous and successive. Some experts, on the

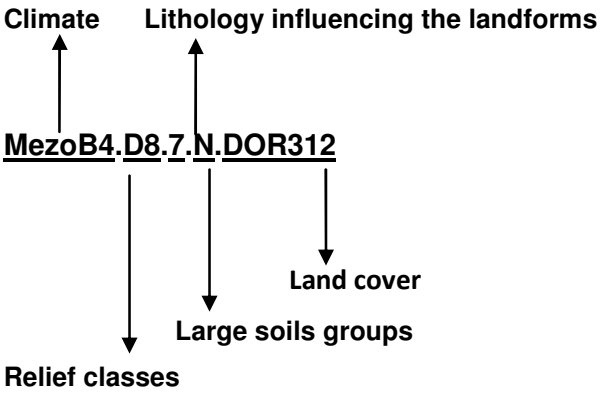


Figure 5. Codification of landscape character types.

other hand, assert that identification and assessment of the landscapes should be carried out before the protection and planning procedures. Some others think that identification and assessment should be carried out independent from protection and planning; thus, basic information about the landscapes people use will be obtained. This approach was applied by some countries (France, England, Norway and Spain). "Landscape atlases" were produced by considering the inventory consisting of different landscape types and their dynamic structures in these countries (Luginbühl, 2002).

In our country, firstly, a landscape atlas should be produced by determining the landscape character types at national level. Landscape character assessment includes the identification, classification and mapping of the landscape characters. The classifications at national level and then regional level will be a guide to the decisionmakers when taking decisions about the future management of the landscape characters of our country. According to Mücher et al. (2005), LANMAP2 (European landscape character map) is a tool that provides accurate information about the character and distribution of the different landscape areas in Europe today. Their primary duty for future years is to add the other information like population and cultural heritage into the data along with the formation of the environmental information (for example, soil type and natural flora) database; to help attain political data like the planning of the protected areas and landscape laws. However, it will be possible to use LANMAP for landscape monitoring and area change in the future (Wascher, 2005).

Of the impediments determined by Wascher (2005) about the use of LCA in Europe, those valid for our country are as follows:

i) Lack of information and experience is seen about the potential use of the system.
ii) The authorization about the protection, management and planning of the landscapes is possessed by different institutions in our country.
iii) Since landscape objectives are not clearly stated at national scale, some LCA works carried out locally are independent from national framework.
iv) Because it is not a standard method, the relationship between the identification of the landscape character and landscape assessment is not clear.
v) LCA is perceived as a tool that asseses, judges and controls "negative" developments instead of moving towards a positive approach.
vi) The results of LCA lack integrity with political developments and landscape plans. Even, landscape planning lacks legal status in our country.
vii) There is a lack of awareness about landscape and landscape management both by private and public authorities at local, regional and national levels.

The initiatives and works conducted related to the signing of ELC and identification of country landscapes following the establishment of the Landscape Protection Branch of the Nature Conservation Office of the General Directorate of Nature Conservation and National Parks under the Ministry of Environment and Forestry; producing policies at national, regional and local scales; putting them into practice; integrating landscape planning with the plans of the other sectors have gained speed. This study is the first study to identify the landscapes at national and regional levels in our country.

The "Konya closed basin" has an area of 53.250 km^2. While there are 367 landscape character types in this area, there being 54 landscape character types in the research area, which is 740 km^2, emphasizes the importance of the area in terms of landscape diversity when the entire basin is considered. Besides, there are 214 landscape character types at regional level in Suğla Lake and its surrounding area. These landscape character types obtained at regional scale could be used for the decision-making process during physical planning process since they are composed of homogenous units. Also, decisions about land use during the landscape and physical planning processes will be made

ecologically-based by analyzing each landscape character type in terms of water process function, soil protection function, biodiversity function, bioclimate function and habitat function. Moreover, the policies related to rural development, environmental impact assessment, and protection of biodiversity could be developed with the LCA works.

As a conclusion, a “Landscape character classification” method was created at regional and local levels in the “Konya closed basin”, Suğla Lake and its surrounding area. The method was applied to the basin at regional scale and the applicability of the method was tested and proved. According to the commitment in ELC, it is suggested that the related method be implemented for the other 25 big river basins and sub-regions by using the suggested data sets.

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