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# The Use of Landscape Character Analysis to Reveal Differences Between Protected and Nonprotected Landscapes in Kapısuyu Basin

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ABSTRACT

The European Landscape Convention (ELC) has directed the landscape classification towards landscape character analysis. Landscape character analysis provides a character-based classification that can combine different values or variables and be applied at different scales to define the landscapes of each country and define the forces on the landscape. In this study, the Kapısuyu Basin of Küre Mountains National Park, which is one of the hot spots in the world in terms of different landscape character and natural quality, was classified by landscape character analysis.

In this study, Kapısuyu basin was analyzed on an analytical ground according to the landscape variables and the basin landscape types, and the landscape character area map were obtained based on the dominant features of the area and the cultural landscape pattern. Throughout the basin, 345 landscape character types and 21 landscape character area were identified. Despite having similar values, the surface area of the protected area in the national park and the rural area had significant differences in landscape character ratios and patchiness ratio. Patchiness was seen to be higher in rural areas. When looked at Shannon Diversity Index (SDI) values, it is seen that a high diversity of Landscape Character Types (LCT) exist in the rural areas. Within the scope of this study, the fact that the landscape character analysis performed at the basin scale in the protected area can be evaluated together with different variables and interpreted from the perspective of holistic landscape planning shows that the technique is a positive approach in the evaluation of protected areas.

Keywords: Landscape character analysis, Landscape variables, Landscape metrics, Küre mountains national park, Kapısuyu basin, Turkey



## 1. Introduction

When the landscape is defined as a whole of natural, cultural, ecological, archaeological, historical, aesthetic, social and perceptual attributes, various approaches related to landscape classification have been developed as it becomes difficult to classify the landscape. Since the landscape classification is critical in monitoring the landscape change and taking precautions, landscape researches has directed the landscape classification towards landscape character analysis with the European Landscape Convention (ELC). ELC refers to landscape characterization by evaluating Landscape as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (ELC Article No. 1) (Council of Europe 2000). Landscape characterization includes two different approaches and classification techniques: landscape character analysis (biophysical values-biophysical approach) and landscape character assessment. Using these techniques, member countries of the ELC developed a typology to classify landscapes of each country and evaluated the landscape at different scales with different variables (Görmüş et al. 2013; Erikstad et al. 2015).

Landscape characterization provides a character-based classification that can combine different values or variables and be applied at different scales in order for each country to describe its landscapes and determine the forces on the landscapes. Depending on the natural or cultural values of the landscape, landscape characterization approach and the variables used may differ. In the classification of natural landscape, landscape character analysis is made, and biophysical variables are taken into account. In the classification of cultural landscape, landscape character evaluation is taken into account and anthropogenic variables and perceptual variables are used.

Landscape Character Analysis (LCA) is performed to define the character of the areas representing the relationship between human and place, to determine the main factors of character change and to evaluate biodiversity values in natural resources (Kim and Pauleit 2007). LCA is considered as a biophysical approach based on natural sciences (Bastian 2008; Sarlöv Herlin 2016) and is adopted by physical geographers and landscape ecologists (Bastian 2008). In the European Landscape Atlas (LANMAP2)

(Pedroli et al. 2007), which is one of the first projects of landscape character analysis studies in Europe, landscape was examined in five groups: geographical landscape, landscape habitats, visual and perceptual landscape, historical landscape and cultural landscape. The variables of these groups vary according to the landscape features of the country. Just as there are countries that use biophysical, natural and cultural variables together or both, some countries focus on historical features (Görmüş et al. 2013). LCA studies were conducted at different scales and approaches ever since Turkey became one of the contracting parties of ELC contract in 2003 (Görmüş & Oğuz 2010; Atik & Ortaceşme 2010; Uzun et al. 2010; Şahin et al. 2013; Görmüş 2012). ELC entered into force in Turkey since 2004 (Atik et al. 2015) and it continues out within the scope of LCA studies of institutional pilot projects and academic research projects (Görmüş et al. 2013).

Despite these studies, the landscape character analysis has not been reflected in the planning legislation and pilot projects are still performed in Turkey. According to Atik et al. (2015), implementing a landscape-scale approach in land use planning and policy with the use of LCA will be an opportunity for the effective management and protection of Turkey's landscape. In order to have this opportunity, a framework model for different scales in the planning of the landscape character analysis in Turkey was developed by Görmüş et al. (2013) and the main basis of the model is the association of approaches and methods with national legislation. Because although planning legislation in Turkey has a structure that can be integrated into landscape character analysis, highlighting only ELC cannot ensure that landscape character analysis is included in the planning legislation. For this reason, it is necessary to relate planning legislation and practices to landscape character analysis approach and to demonstrate the efficiency of LCA in planning.

In Turkey, pilot LCA projects conducted and supported by different institutions were not developed at the national scale. Some projects have been developed on the scale of local administrative boundaries (provincial boundaries), some on NTUS (Nomenclature of Territorial Units for Statistics) regional administrative boundaries and some on the upper basin boundaries. However, in Europe, landscape character analysis studies have been started on a national scale to integrate the LCA approach to national planning legislation. Conversely, in Turkey, a holistic objective in this direction is not yet adopted, thus, conceptual debate about LCA studies are ongoing. The basis of these discussions is based on the fact that the LCA methodology, scale and data set are variable and cannot be standardized. The main argument of this study is the necessity of carrying out landscape character analysis at the basin level in countries like Turkey where there are landscapes with high topological variability and natural quality. It is anticipated that applying LCA in basin scale will provide a base data in macro and micro basins, data loss will not occur due to the detailing or roughening of the data, and data sets will provide continuity in the field. On the other hand, ELC brings the possibility of making landscape character a part of a political decision mechanism with the subjective quality that it brings to the definition of landscape. The working unit of landscape character analysis should be the basin to prevent the landscape from being integrated into a political decision through the character. Because the concept of basin defines an area and scale where everything is interrelated and interconnected just like the concept of landscape. This also applies to protected areas. Because, protected areas are formally and permanently provided with protection in order to prevent from conversion of their natural land cover and it is aimed at partial and total conservation. Such areas also serve ecosystem and habitat invaluably (MEP 2003). While buffer zone encircling the protected areas are mainly able to maintain the natural processes in these areas (Wiens et al. 2002); the unprotected areas, on the other hand, are at high stakes because of human induced disturbances by downsizing the protecting area and ruining ecological cycle and habitat outside it (Parks & Harcourt 2002; Hansen & DeFries 2007). Also, the landscape that surrounds the protected area may restrict the conservation alternatives (USGAO 1994; Cole & Landres 1996; McDonald et al. 2008).

Küre Mountains National Park is an important hotspot in terms of its biological diversity. The Kapısuyu basin, which contains a part of the national park, was chosen as a study area because it is one of the basins with different landscapes, high topographic variability, and biophysical, natural and cultural variables. In addition, a consideration of landscape character analysis both on the protected area and its' perimeter, and on the basin scale will provide a basis for discussing the contribution of landscape character analysis technique to protected area planning and basin planning.

In this study, Kapısuyu basin was analyzed on an analytical approach according to landscape variables and basin landscape types, and landscape character area map were obtained based on dominant features of the natural and cultural landscape pattern. The Kapısuyu basin has been evaluated in three zones: protected area, buffer zone and unprotected rural zone. The protected area consists of two different protected status areas in the Kapisuyu basin: KMNP protected area and Saraytepe archaeological area. The buffer zone is the interaction area determined to provide the protection specified in the KMNP management plan. In the study, it was named as KMNP buffer zone. Rural areas outside the protected area and buffer zone are rural areas without conservation status and are defined as unprotected rural zone in this study. Therefore, in the study, the interaction between the three regions (protected area, buffer zone and unprotected rural zone) is aimed to be resolved with LCA.

The distribution and pattern of landscape character types among the protected zone (KMNP Protected area and Saraytepe Archeological area), KMNP buffer zone, and unprotected rural zone were identified in the basin. This study draws the attention to the interaction between the areas having protection status and areas with no protection status. Moreover, this study aims to emphasize holistic landscape planning using landscape character in basin.

In this regard, the main objectives in this study are as follows: (1) In basin scale, identification of the landscape character types using biophysical, natural and cultural variables, (2) evaluation of patchiness and correlativity of landscape character types,

(3) the identification of the composition and the configuration of the landscape character types in the protected, buffer and unprotected zones of the Kapısuyu Basin, (4) discussion on its meaning in the nature conservation planning of these transitions and the evaluation of necessity of the landscape character analysis in the basin scale.

## 2. Material and Methods

*2.1. Study area*

Kapısuyu Basin (study area) starts at sea level and includes a part of Kastamonu-Bartın Küre Mountains National Park (KMNP) Protected area, Buffer Zone (Figure 1) and rural area. The basin is 8 km long to the east-west, 10-km long on north-south direction and 19.8 km wide on the southwest-northeast. Kapısuyu Basin is 10,600 ha and its elevation has ranged from + 0.00 (Sea Level) to 1384 meters (Figure 1). There are five areas of different status in the Kapisuyu Basin. These are the KMNP protected area, KMNP Buffer Zone, Archaeological Area, rural zone (villages and agricultural lands), and Kapısuyu beach. However, in this study, the Kapısuyu basin was evaluated in three zones considering the areal sizes, the protected zone, the buffer zone and the unprotected rural zone. The protected area includes KMNP protected area (2,117 ha) and Saraytepe archaeological area (146 ha), the interaction area determined to provide protection in the KMNP management plan covers the KMNP buffer zone (5,503 ha), and rural areas outside the protected area and buffer zone include the unprotected rural zone (2,826 ha). Different protection statuses and height variability nourish the habitat diversity of the basin and the distinctness of ecosystem layers.

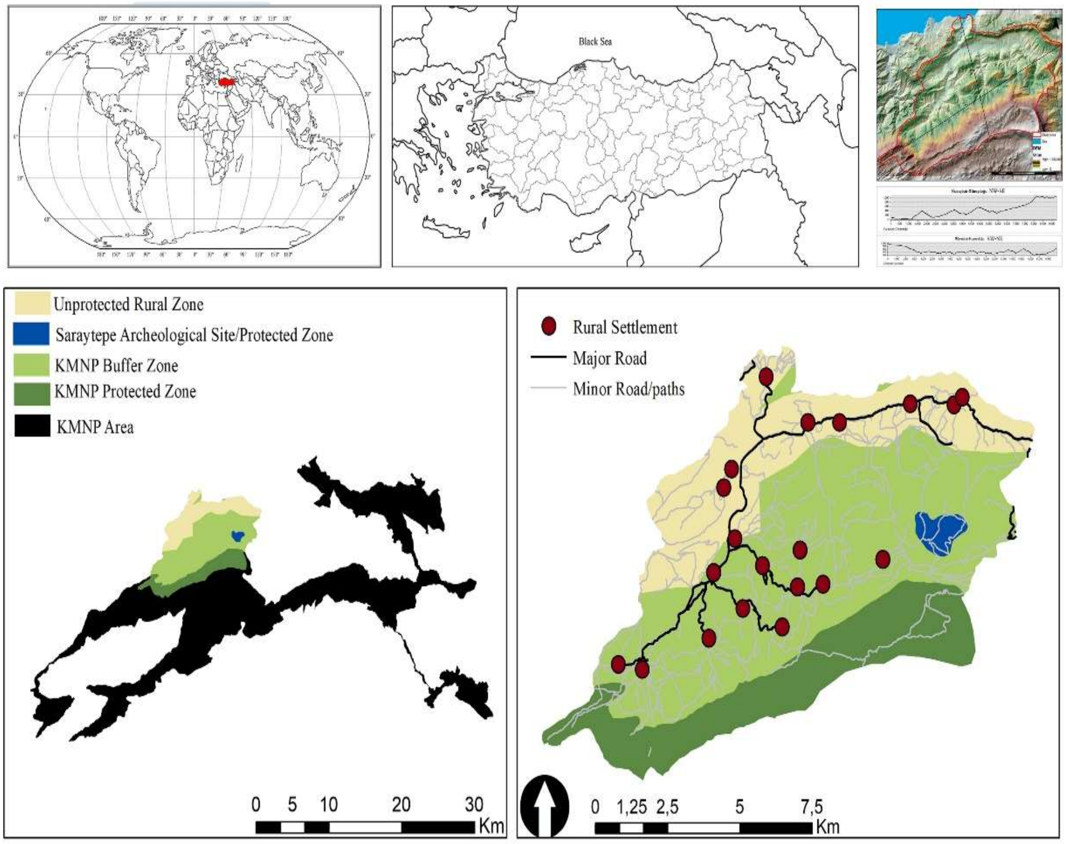


**Figure 1- Location of study area**

In order to carry out the inventory analysis of the study area, natural and cultural data were got via official correspondences from public and private institutions and organizations. In addition, the land use / cover map for the study area was obtained as a result of the classification of the RapidEye satellite image of 2011. For the accuracy assessment of the classification, total 235 ground control points were taken for each land use/cover category with GPS in the field studies.

*2.2. Method*

In this study, landscape character analysis was made at basin scale. The stages followed in the basin landscape character analysis are given below (Figure 2).

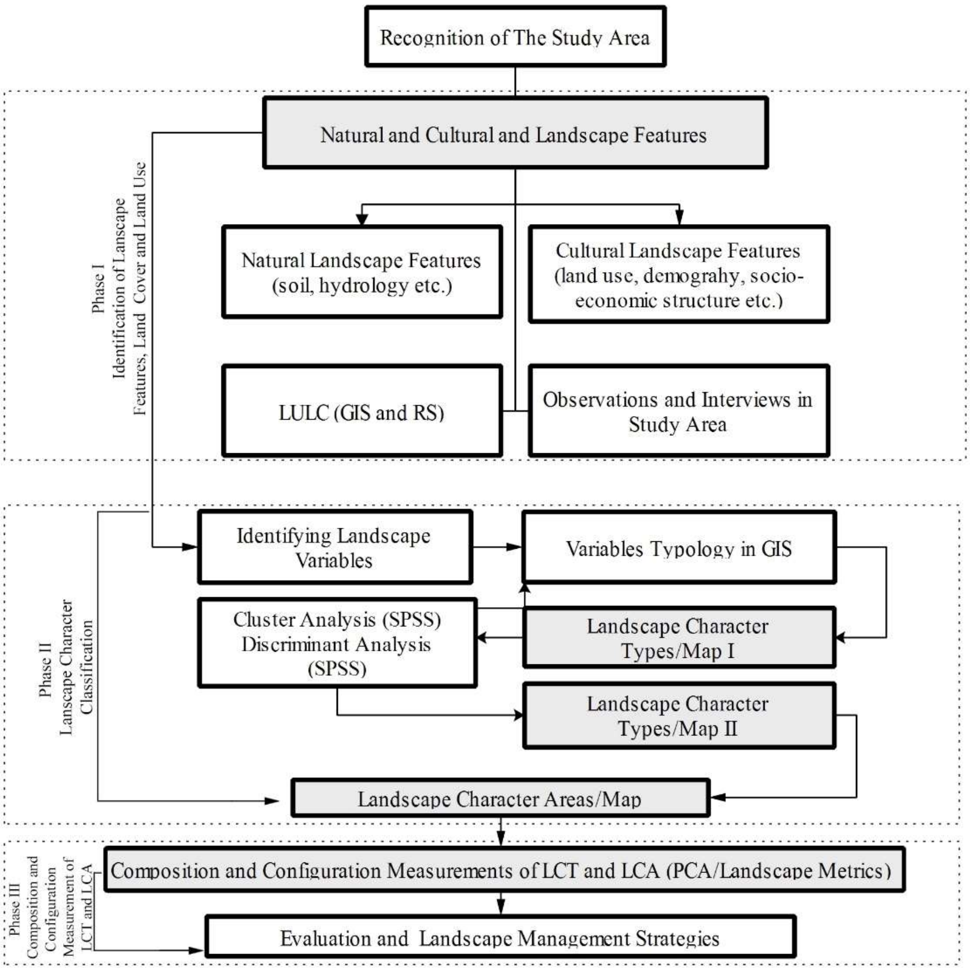


**Figure 2- Flow chart of the study method**

*2.2.1 Phase I: Identification of Landscape features, land cover and land use*

The natural and cultural landscape features of the basin are defined by the data obtained from the classification of the satellite image and the data obtained from the institutions.

In this study, 4 frames of RapidEye satellite images with a cloudiness rate of less than 10%, dated 06/2011, were used. The process of classifying satellite images consists of 3 stages. These are respectively image preprocessing, threshold-based object-based classification of image and accuracy assessment of classification.

**Image preprocessing;** this sub-stage consists of two processes in itself. These are respectively geometric correction and radiometric correction processes. ***Geometric correction;*** Since the RapidEye Ortho Level 3A satellite image used in the research was purchased with the orthorectification process completed, no additional geometric correction was required. ***Radiometric correction;*** Object radiations measured by the sensor system are affected by atmospheric conditions such as change in solar radiation, atmospheric dissipation and scattering, causing different pixel reflection values in different time zones and images obtained from different sensors. Atmospheric correction was applied to the multi-time satellite images used in the analysis under the radiometric correction title. In the study, FLAASH model is used in the atmospheric correction process, which allows the surface reflectance values to be obtained by deriving the atmospheric parameters such as surface reflectivity, surface altitude, water vapor content, aerosol and cloud optic thickness, surface and atmospheric temperatures (Görmüş et al. 2018). 4 frames of satellite images of 2011, whose radiometric and geometric corrections were made, mosaicking of satellite images were done and extracted according to the study area.

**Threshold-based object-based classification of image;** this technique was used to determine the meaningful pattern groups on the image or in other words, to separate each pixel in the image into different groups according to their spectral properties and to assign the pixel to the corresponding cluster according to the reflection values. Taking into account the purpose of the research and the spatial resolution of the satellite images, land use/land cover categories were determined for classification and classification was carried out. Determined land use/land cover categories for the research are settlement area, road, agricultural area, hazelnut garden, broad-leaved forest, coniferous forest, mixed forest, river, and barren land.

Threshold-based object-based classification process; In itself, it was carried out in 2 steps as segmentation phase and threshold determination phase.

Segmentation; According to the detail (class) inference targeted in the research, scale parameters, shape density values were produced, segmentation parameters were produced at different levels and with different algorithms. *Chessboard segmentation* algorithm is used to divide the image into identical segments in line with the value determined by the user. In this research, the scale parameter was specifically set to "1" to extract the linear classes (transportation networks and streams) at the pixel level on the image. "1" was used as the scale parameter that corresponds to 5x5 meters. *Multiresolution segmentation* algorithm, which clusters the objects on the image according to their similarities at different scales, was used by defining the scale parameter as 0.28, the shape parameter as 0 and the concentration parameter as 0.81.

Threshold determination; Threshold values were determined by establishing mathematical relationships between the bands for each land use/land cover category. In the research, the indices determined according to the land use/land cover categories and the mathematical operations performed to create the indices are as follows; Normalized Difference Vegetation Index (NDVI), Soil Adjusted Vegetation Index (SAVI), The Red-Edge Triangulated Vegetation Index (RTVI Core), and Normalized Difference Water Index (NDWI).

Accuracy analysis; The minimum accuracy for the study was determined as 80%. In the accuracy analysis, error matrices were created by examining the relation between KAPPA index class-based reference data (true ground control points 2011) and classification results. Ground control points used in the study were taken with GPS during the field studies carried out in June-August 2012 period and supported by photographs.

*2.2.2. Phase 2: Landscape character classification*

**Identifying landscape character variables:** To create landscape character analysis, it is necessary to identify the variables representing the landscape of the area. In the current study, the landscape elements representing the area are known as "landscape character variables" (Table 1). Biophysical and natural data were used to determine landscape character types at basin scale. Land form and location names were used in addition to landscape character types in determining landscape character areas.
The landscape character variables and sub-categories belonging to these variables in the landscape character analysis carried out on a basin scale are in Table 1.

**Table 1- Basin scale landscape character variables**

| *Landscape feature* | *Type of variable* | *Variable Name* | *Sub-category* |
|---|---|---|---|
| Physical | Distinctive | Topography (T) | Altitude groups<br>Slope steps |
| Natural | Distinctive | Hydrogeology (H) | Permeability State<br>Porousness |
| Biological | Distinctive | Soil (S) | Large soil groups |
| Biological and human effect | Distinctive | Land cover/ land use (LU/LC) | Forest types<br>Agricultural lands<br>Settlement areas<br>Rocky areas |
| Biological and human | Descriptor | Geomorphography | Definition of landform and land structure |
| Human effect | Descriptor | Cultural structure | Place names |
| Landscape | Indicative | Landscape indexes | Patch, class and landscape scale indexes |

**Variables Typology in GIS:** Ordering of variables in the symbolic expression of landscape character types is in Figure 3. To ensure reliability and accuracy in the statistical classification of the variables in the basin scale, the ratio of variables in the basin were considered in scoring the sub-categories. Accordingly, the variable with the highest spatial ratio in the basin had the highest score. For example, in the topography variable hilly (100-499 m) areas were the most dominant ones in altitude groups. Therefore, they are represented with the number 3 (Table 2).

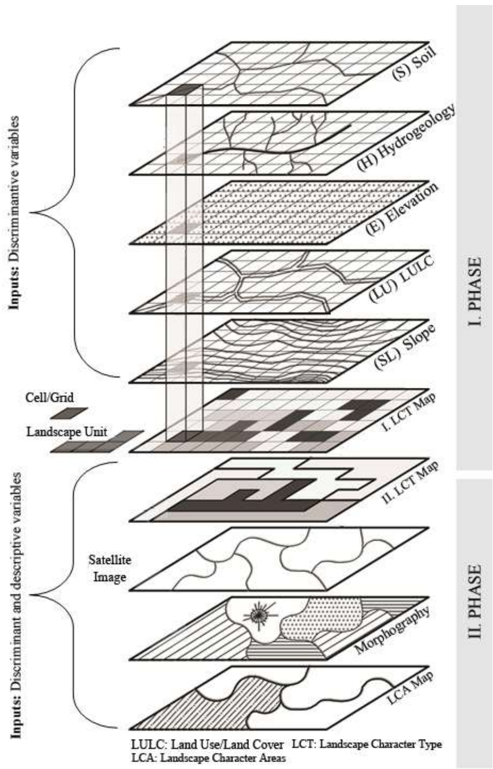


**Figure 3- Phases of landscape characterization**

**Table 2- Variables and symbols used in determining landscape character types**

| Variable name | Sub-category | Criteria | Symbol |
|---|---|---|---|
| Elevation **(E)** | Elevation groups **(E)** | Plane (0-100m) | **1** |
| | | Hilly (100-499m) | **3** |
| | | Mountainous (500-1381m) | **2** |
| Slope **(SL)** | Slope steps **(SL)** | 1-5: slightly sloping surfaces | **3** |
| | | 5-10: sloping surfaces | **2** |
| | | 10-20: moderately sloping | **4** |
| | | 20-50: remarkably sloping | **5** |
| | | 50-100: extremely sloping | **1** |
| Hydrology and hydrogeology **(H)** | Permeability state and porousness | Porous aquifer environment | **4** |
| | | Karst aquifer environment | **3** |
| | | Moderately permeable | **5** |
| | | Low- permeable | **2** |
| | | Impermeable | **1** |
| Soil **(S)** | Soil groups | Areas without a ground cover | **0** |
| | | Alluvial soil. | **1** |
| | | Grey-brown podzolic soil | **2** |
| | | Red-yellow podzolic soil | **3** |
| Land cover/land use **(LU)** | Forest types | Mixed forest | **3** |
| | | Leafy forest | **5** |
| | | Coniferous forest | **2** |
| | Agricultural and settlement areas | Agriculture and settlement | **4** |
| | Rocky areas | Stony-open | **1** |

**Cluster analysis and Discriminant analysis:** Clustering and discriminant analyses were utilized in order to categorize landscape characters. Landscape features for each unit square of the area and sub-sections are represented in the grid system as a hierarchical diagram and placed on the map, as well. So, it provides with polygonal combination of the unit squares with the same features. Afterwards, spatial maps of the area are superimposed and landscape units are these overlapping polygons.

Landscape types are formed by combining the landscape units defined. Units and polygons are classified via the Clustering Analysis and Discriminant Analysis. The overall aim of Clustering Analysis is to divide the data to be grouped by their similarities and explain them. Based on the similarities between individuals or objects among all the variables in the study, grouping or clustering similar individuals into same groups and estimating to which group a new individual belongs is the basis of Clustering Analysis. (Hair et al. 1992; Tatlıdil 1996; Doğan 2002; Görmüş, 2012; Atik et al. 2015). Discriminant Analysis was used to measure the reliability of the classification carried out via Clustering Analysis (Figure 3).

**Landscape character types/Map I:** Grid cells were used as spatial units to identify the types (identifying the pattern of the classification). Each grid cell represents a polygon in GIS and integrates easier with other data. After the data sources were chosen and variables determined, variables were integrated into the grids by superimposing of data sets in GIS (Parametric method) and transferred into feature tables (Figure 3). In order to identify landscape types, the study area was divided into 30x30 m cells by a grid system. The variables were transferred into cells. Thus, each grid cell was characterized by the distinctive variables used for determining the groups in grid cells. 188,000 cells were obtained in the study. In the case that all types were spatially independent, 14,525 landscape units were obtained.

**Landscape character types/Map II:** As a result of clustering (unifying) cells of the same type in 14,525 landscape units, 345 landscape character types were determined. Landscape units belonging to the landscape character types were visualized on ArcMap 10.1 by color and name (1st Landscape character type map). By forming a landscape character type key, the code for each type was shown in the legend (Figure 4)

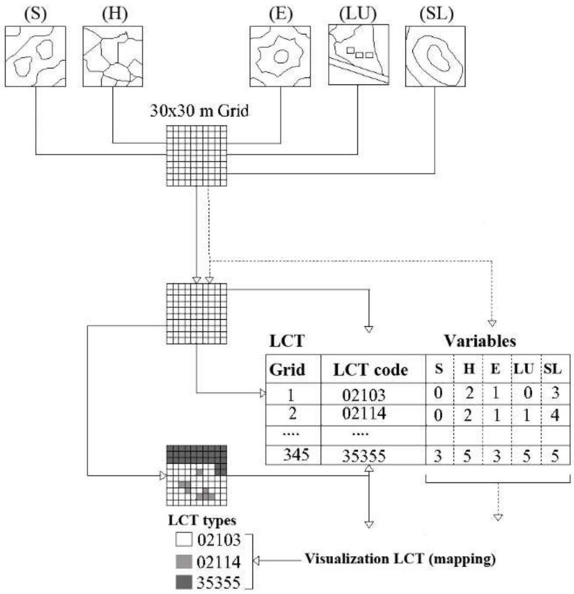


**Figure 4- Typology of landscape types and landscape character type key**

**Landscape Character Areas Map:** Character fields were defined by combining II. Map of Landscape character types with the land form and place names in Arc Map. 10.1 software.

*2.2.3. Phase III: Composition and Configuration Measurements of LCT and LCA*

The pattern of the landscape character types determined in the 2nd step was measured via landscape metrics (Figure 3). Of the configuration metrics defined in the Patch Analysis (Elkie et al. 1999; McGarigal 2002) module, patch density measured at class level, patch size metrics and patch shape metrics were used. Within the scope of the values obtained from the metrics, the composition and configuration of the landscape types around the basin and the distribution of landscape character types by area status were determined and identified. Abiding by the aims and objectives of the study, the landscape ecology principles (Turner 1989; Forman 1995; McGarigal & Cushman 2002; Mas et al. 2010) and metric set suggested by Botequilha-Leitão et al. (2006), a total number of nine composition and configuration metrics were used in the study. Patch Number: PN, Mean Patch Size: MPS, Mean Shape Index: MSI, Class Area: CA, Total Edge: TE, Edge Density: ED, Shannon's Diversity Index: SDI, SEI: Shannon Evenness Index and Shannon Index: SI.

The distribution of landscape character areas and landscape character types within the study area and their interaction with each other is determined. Composition and configuration of the landscape character types and landscape character areas identified are calculated via landscape metrics. This numeric data provides significant contributions in understanding direction of the change in landscape and the elements effecting the landscape character pattern. Based on landscape character type maps, landscape character area maps and numeric data of landscape metrics, problems that could arise from possible political decisions or change in land use and landscape planning and management strategies can be produced.

## 3. Results

### *3.1. Landscape character types and Landscape character areas*

345 landscape character types were identified throughout the basin (Figure 5). At the end of the cluster analysis of the determined 345 LCTs, 21 landscape character areas (Figure 5) were obtained. The composition and configuration analysis of the identified landscape character types were measured using landscape metrics.

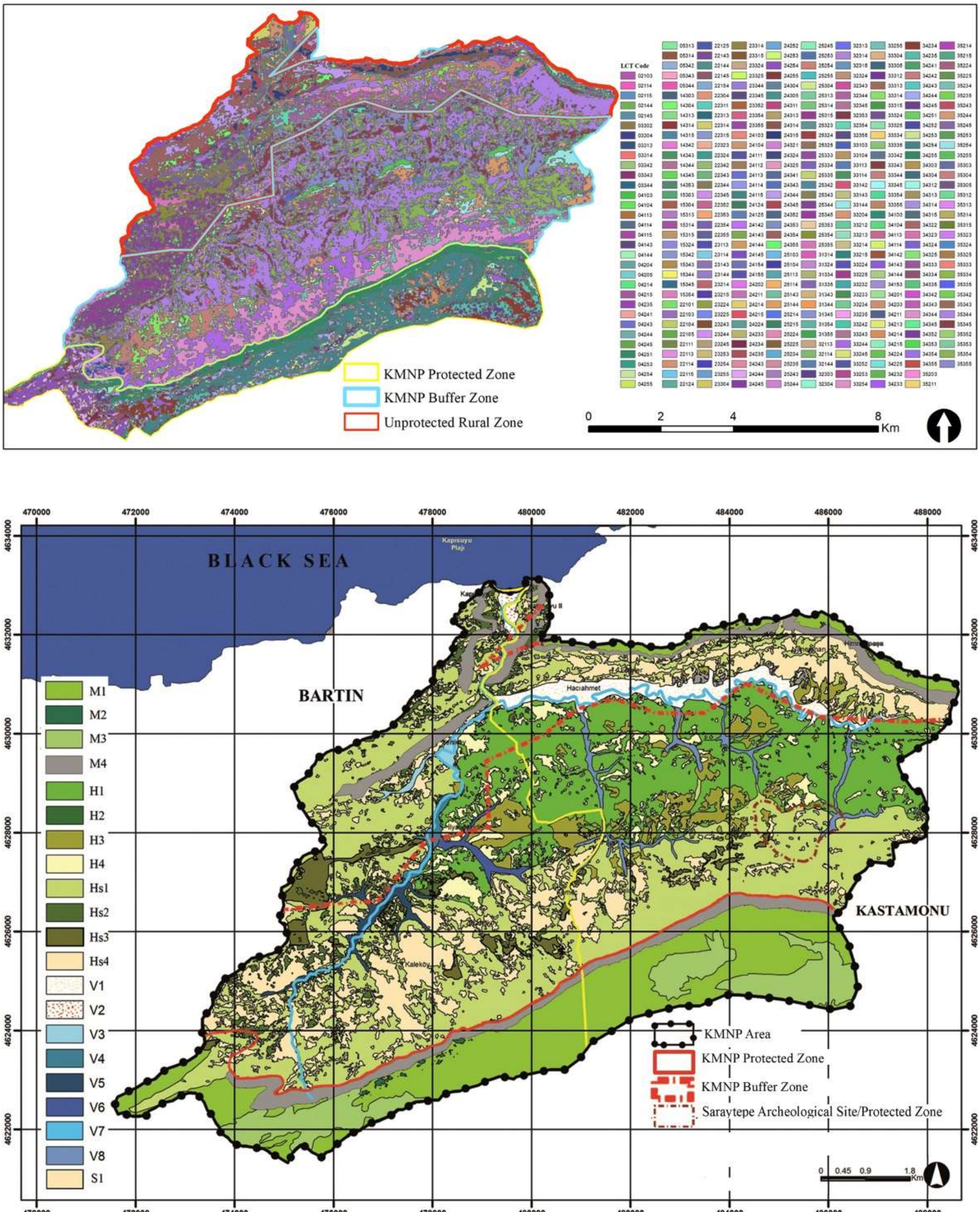


**Figure 5- The codes and units of the landscape character types and landscape character areas throughout the basin**

*3.2 Composition and Configuration of LCT and LCA in the basin*

Based on the metric values, disruption and patchiness of the landscape character types were interpreted for the whole basin and according to the protection status. Obtained metric values provide information on the structure and function of each character type in the basin. The distribution of the landscape character types in the basin were identified by their area status. The distribution of the landscape character types by area status (and their fragmentation states) were identified by considering ED, SI, PN, TE, MPS, MSI and CA (Figure 6) metrics together. Landscape diversity and patch condition in places with and unprotected rural zone status were identified by comparing SDI, SEI, PN and type number (Table 3 and Table 4). Although the surface area of KMNP Protected zone and unprotected rural zone have similar values, there are significant differences in landscape character type ratios and patchiness ratios. Patchiness in unprotected rural zone is higher. When SDI values are taken into consideration, the LCT diversity in unprotected rural zone is high. The areal distribution of landscape character types according to SEI values in KMNP Protected zone shows a more irregular structure compared to unprotected rural zone.

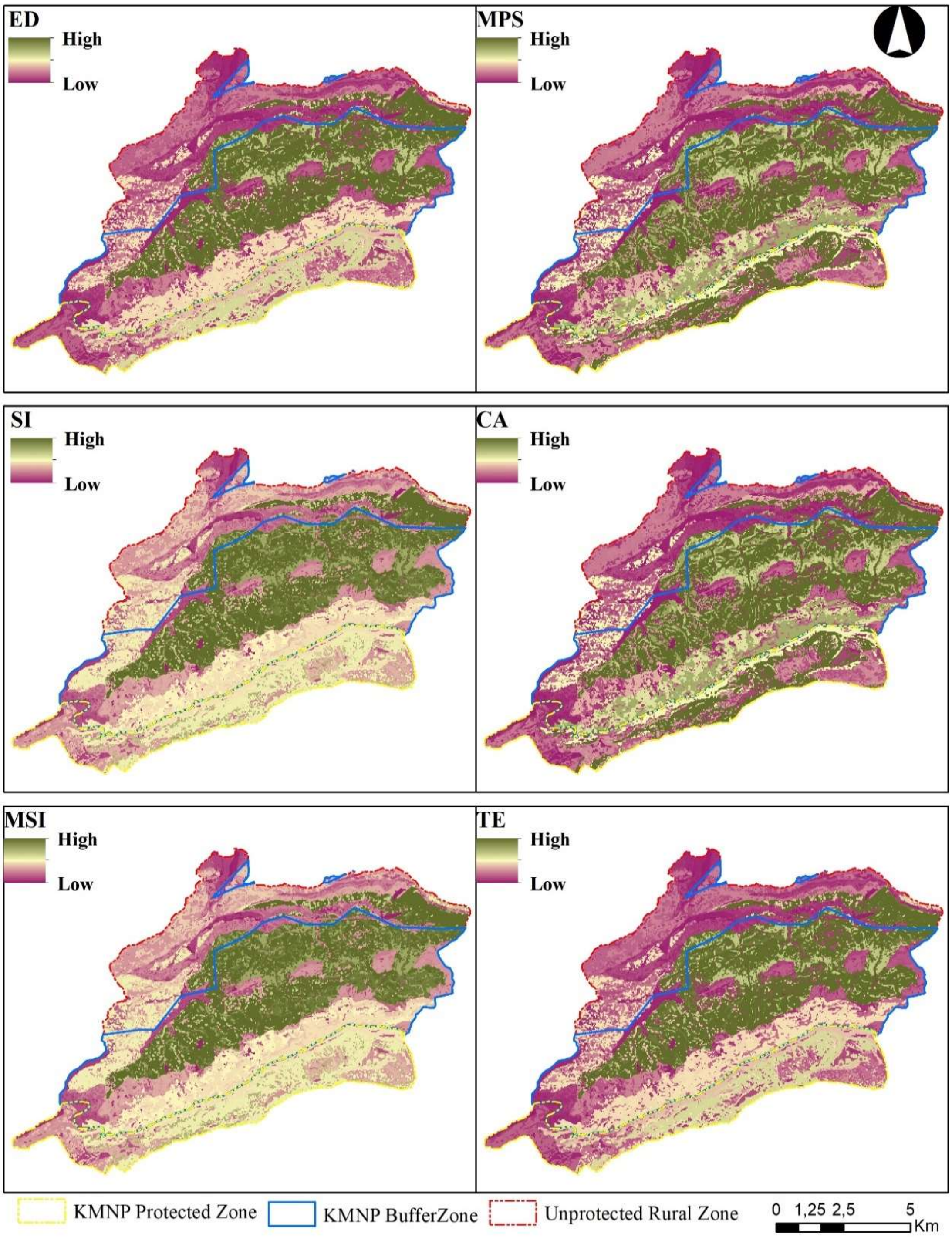


**Figure 6- Landscape metrics value of LCT**

**Table 3- Landscape character type patchiness ratio and index values by area status**

| *Areas (Surface/ha)* | *LCT number* | *PN* | *SDI* | *SEI* | *LCT ratio in the basin (%)* | *Patchiness ratio in the basin (%)* |
|---|---|---|---|---|---|---|
| KMNP Protected zone (2.117) | 61 | 2793 | 2.462685 | 0.599066 | 17.68 | 19.2 |
| KMNP Buffer zone (5.650) | 205 | 7598 | 3.125414 | 0.587152 | 59.4 | 52.3 |
| Unprotected Rural Zone (2.827) (off Buffer zone) | 252 | 4592 | 3.887638 | 0.703081 | 73 | 31.6 |
| Archeologic Area (0.146) | 24 | 199 | 1.770577 | 0.557126 | 6.9 | 1.1 |
| Basin Area (10.600) | 345 | 14525 | 3.86 | 0.66 | | |

LCT: Landscape Character Type; PN: Patch Number; SDI: Shannon's Diversity Index; SEI: Shannon Evenness Index

**Table 4- LCA measurements**

| *Symbol* | *Landscape Character Areas (LCA)* | *Patch density and patch size* | | | *Landscape diversity* | | |
|---|---|---|---|---|---|---|---|
| | | *MPS* | *PN* | *CA* | *SDI* | *SEI* | *PN (LCT cell)* |
| M1 | Küre Mountains Broad-Leaved Forest | 136.9 | 1 | 136.9 | 2.1 | 0.5 | 156 |
| M2 | Küre Mountains Coniferous Forest | 0.5 | 20 | 0.9 | 1.9 | 0.8 | 54 |
| M3 | Küre Mountains Mixed Forest | 17.5 | 3 | 52.7 | 2.1 | 0.6 | 48 |
| M4 | Küre Mountains Rocky and Carstic Landscape Character Area | | 5 | | 2.9 | 0.6 | 179 |
| H1 | Kapısuyu Basin Hills Area Broad-Leaved Forest | 1.2 | 134 | 165.8 | 2.3 | 0.5 | 464 |
| H2 | Kapısuyu Basin Hills Area Coniferous Forest | 0.9 | 412 | 36.8 | 2.6 | 0.6 | 1089 |
| H3 | Kapısuyu Basin Hills Area Mixed Forest | 0.9 | 43 | 42.8 | 2.3 | 0.5 | 395 |
| H4 | Kapısuyu Basin Hills Area Foothill Agriculture | 1 | 469 | 46.1 | 1.9 | 0.4 | 129 |
| Hs1 | Kapısuyu Basin Broad-leaved forest on the slope | 0.4 | 618 | 307.1 | 3.1 | 0.6 | 2826 |
| Hs2 | Kapısuyu Basin Coniferous forest on the slope | 0.6 | 461 | 29.5 | 3.8 | 0.7 | 1296 |
| Hs3 | Kapısuyu Basin mixed forest on the slope | 0. 9 | 24 | 223.9 | 3.1 | 0.7 | 77 |
| Hs4 | Kapısuyu Basin Foothill Agriculture | 0.19 | 959 | 189 | 3.1 | 0.6 | 2826 |
| V1 | Emirler Valley Bottom Agriculture | 26.2 | 1 | 26.2 | 2.9 | 0.6 | 79 |
| V2 | Kapısuyu Valley Bottom Agriculture | 2.9 | 1 | 2.9 | 1.9 | 0.6 | 22 |
| V3 | İdare Stream Valley | | 1 | | 3.2 | 0.8 | 57 |
| V4 | İlyas Stream Valley | | 1 | | 2.9 | 0.8 | 34 |
| V5 | Başköy Stream Valley | | 1 | | 2.7 | 0.7 | 45 |
| V6 | Atak Stream Valley | | 1 | | 2.1 | 0.6 | 28 |
| V7 | Kapısuyu Stream Valley | | 1 | | 1.9 | 0.6 | 18 |
| V8 | Hills Area Furrow Valleys | | 5 | | 1.6 | 0.5 | 52 |
| S1 | Kapısuyu Sand Dune and Outlet | | 1 | | - | - | - |

**MPS:** Mean Shape Index**; PN:** Number of Patch**; CA:** Class Area**; SDI:** Shannon's Diversity Index**,** Shannon's **Evenness Index LCT:** Landscape Character Type

Landscape diversity is higher in unprotected rural zone compared to the KMNP Protected zone and the areal distribution of landscape character types is more regular. According to the KMNP Protected zone and KMNP Buffer zone values, the patchiness ratio in the KMNP buffer zone as well as the landscape diversity is high and the distribution of landscape character types is more irregular. Although the Saraytepe archeological area is small area, the number of LCT it includes is high. The landscape character types' diversity in this area is small and the areal distribution of these types is irregular. The patchiness of the landscape character types in KMNP Protected zone, KMNP Buffer zone and unprotected rural zone is high in KMNP Buffer Zone, low in rural areas that off buffer zone and lowest in KMNP Buffer zone. The class area and patch number of these types have the highest value in national park protection area. The patchiness level of the types in KMNP Buffer zone and unprotected rural zone that is out of the buffer zone is highest in KMNP Buffer zone. (Table 3, Table 4).

## 4. Conclusions and Discussion

345 landscape character types were determined in the basin scale. The fact that the landscape character types are high indicates that physical, natural, biological and cultural factors are intense in basin. It is clear that topographic change has an impact on the formation of landscape character types. However, when considering the variables taken into account in determining LCT, it is clear that the most important factor providing the LCT diversity is human impact. When LCT correlation is examined in all three regions and between regions, it is concluded that the number of LCTs, patchiness in landscape and landscape regularity increases

with the human effect. It is seen that human intervention causes an increase in landscape character types and patchiness in landscape, and forms regularity in landscape (spatial order of land uses). The unprotected rural area is an area where the intervention is settled, however, the intervention shifts to the KMNP buffer zone, causing serious damage to the habitats due to the increase in the rates of patchiness in this zone. It is very clear that the buffer zone, which is designated to protect the protected area from cultural interventions of its surrounding, could not provide the protection duty. It is understood from the number of LCTs that the Saraytepe archaeological site in the buffer zone was also exposed to intervention due to the search for treasures. Inclusion of this area in the KMNP protection zone would be a more accurate approach in terms of protection. When the LCT number, irregularity and patchiness transitions between all three regions are taken into account, it is seen that LCA is useful in monitoring the transitions of areas with different conservation statuses and, if applied at the basin scale, can provide a more meaningful, accurate and rapid contribution to nature protection planning.

One of the most important problems of protected areas in Turkey is the landscape fragmentation caused by the usage pressure. It has been observed that efficient outputs will be obtained with landscape character analysis approach on basin scale about determining the interaction of the protected area with its environment in the planning of protected areas in Turkey.

Using LCA at the basin scale, where everything is interrelated and interconnected, enables planning decisions to be made in accordance with the scale. Determining the interaction between the pattern and the process at the appropriate scale is the most important situation in making the right decisions in landscape planning. Lack of basin management on a local and regional scale and the fact that the concept of "the bigger the better" of the scale is being the basic rule of decision makers may cause the ecological land use planning to be largely ignored. Habitats and ecosystems become more sensitive as a result of not using the appropriate scale. The fact that national, regional and local planning objectives are in conflict with each other in the management of KMNP and its environment (buffer zone), which is one of the areas with sensitive ecosystems, causes landscape fragmentation on the area. National park management interacts with national NGOs instead of local NGOs, developing conservation and use policies in the national park. The fact that these policies, which are implemented in specific areas in the national park, regardless of national and regional plans (The policies developed by the national park management with national NGOs can be in conflict with the national-regional plans and targets), do not find any response in the local population, causes an increase in usage pressures on the area. Because in these implementations, scale, landscape pattern, landscape process was applied specifically regardless of the process of the economic patterns developed by the local people with the protected area. Even if the implementations developed with this understanding are the correct uses, they attract the reaction of local communities, especially small groups that do not have economic investment power, and causes more damage to the habitats.

Landscape character analysis and landscape metrics were assessed together in the basin scale and thus, a new approach in determining the pattern-process interaction in protected area and its environment has been developed. In this approach the most dominant features of the basin were evaluated by raster and vector. Studying the area by dividing it into grid vectors made map production faster. No problems were encountered in calculating the units, obtained by combining similar grid cells, through landscape metrics. Assessing the pattern-process interaction with the environment of protected areas on a basin scale is necessary and important for ecology-based landscape planning. In this assessment, realizing the landscape classification with the landscape characterization technique allows for faster assessment of risk factors and monitoring of land use change. In addition, the applied technique and produced data can be used in landscape protection, protection of biological diversity and landscape management studies.

Landscape character analysis carried out within the scope of this study is carried out on grid base (at 30x 30 m cell level). Because this approach will save time in processing any map changes, it will make decision making process faster and more objective. Planning is established on decisions.

This study shows that the multivariate and multi-scale structure of landscape character analysis is a positive approach in the assessment of the protected areas. In addition, associating landscape character classification with landscape ecology through landscape metrics provides the opportunity to interpret landscape pattern and landscape process. Assessment of biophysical and anthropogenic variables by landscape character analysis technique and estimating the ecological structure of the area by measuring the obtained character types and character areas through landscape metrics gives a positive acceleration especially in protected area management.

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