Coastal land degradation and character assessment of Southern Black Sea landscape

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ABSTRACT

The developing economies have negatively affected sustainability of natural resources. Increasing environmental pollution, global climate change and deforestation are some examples for such effects. Therefore, some leading countries seek for a solution to overcome these problems. Within this frame, "European Landscape Convention" which is also signed by Turkey, foresees to describe and characterize of landscapes in Pan-European level by applying protection and promotion principals for management and planning the landscapes in a sustainable way. Thus, there is an urgent need to describe and characterize our available national landscapes in any scale and resolution. In this study, landscape character assessment for the city center of Rize and adjacent rural vicinity was investigated. The study area is famous for cultivation of industrial plant "CameliaSinensis" and evidently under severe usage as agricultural fields. The results of the study revealed that the area can be described by 5 different landscape characters and 544 landscape units. Spatial analysis carried out in precisely built geo-database showed that the area is under influence of two main vegetation types which are tea plantation areas and coppice cover. Moreover, the study area is highly fragmented due to triple effects; "urbanization", "inheritance law" and "natural land cover alteration".

1. Introduction

Natural resources have been extensively used as a primary food source to meet basic human needs for centuries. However, recent technological developments in the last half of the century and increased demands have accelerated the deterioration of ecological balance (Kareiva et al., 2007). This imbalance is mainly observed and quantitatively defined in ecology as an increasing fragmentation rate and decreasing percentage of the available "green cover". Green cover is not only a visual quality element in landscaping but also a component that improves the ecological sustainability and inhabitability of any landscape parcel. It is very clear that fast and unplanned urbanization triggers green cover fragmentation, this can be validated by carefully examining related infrastructure such as highways and transportation routes. Therefore, it is obvious that

green cover unity should be preserved to provide ecologic connectivity of the adjacent habitats in planning and protection projects. That kind of holistic approach is much more important in rural areas design projects as it is relatively less expensive than a complete urban transformation effort. As revision of an old city plan can be very demanding and long lasting. However, today there is an opportunity for ecologic designing of rural expansions without causing a habitat fragmentation. Moreover, agricultural fields can also be connected to establish ecological networks within frame of landscape designing (Wu and Hobbs, 2002).

Improvement, planning and protection of landscape areas are the main themes among the research priorities of landscape ecology. An important part of landscape planning depends on landscape character assessment techniques, as it offers qualitative and quantitative information on landscape ecology. Natural and cultural properties of a landscape are linearly connected to a landscape definition and they may potentially differ from local to regional scales (Eroglu, 2012). These are mainly biotic, abiotic and cultural factors. More specifically, climatology, geology, geomorphology,

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soil, hydrology, fauna, landuse and vegetation information can be used during the landscape character assessment process (Swanwick, 2002; Mücher et al., 2003; Wascher, 2004).

Recently there are many efforts for determining national landscape structure by using a definite methodology in local or regional scales yet there is no predefined standard that strictly explain and direct the landscape characterization methodology. However, as it is recommended in European Landscape Convention (ELC), each country should define its landscape structure for local and regional scales. Therefore, scientific studies are carried out in different scales by following ELC recommendations in Turkey (Uzun et al., 2011; Guneroglu, 2013).

Definition of a landscape character in any scale or geography should include determination of sub-typologies in order to facilitate landscape protection and planning activities in rural and urbanized regions. In Turkey, dominating landuse form of the transition zone between urban and rural areas is generally agricultural fields which are about 40 million hectares. For this reason, landscape character assessment of agricultural areas has a vital importance in characterization procedure of the transition zone as they are adjacent to urban areas (URL-1, 2013).

Agricultural areas are very important for Turkey in terms of ecological and economical aspects and may affect the prosperity of the region. Moreover, agricultural activities and products are various in Turkey due to its unique geographic location that creates moderate climatic conditions of a transition zone. Different climates and local cultural properties have led to develop unique agriculture types so as a landscape that represents each region such as Aegean section is characterized by "olive cultivation", Thracian region is by "sunflower" and northeastern Anatolia is by "tea and hazelnut" (Dirik, 2005).

In this study, a region specific landscape character assessment procedure together with sub-typologies was proposed and implemented for the first time on tea gardens which are generally located on the skirts of urbanized city of Rize.

2. Study area

The city of Rize is located on northeastern part of Turkey between (40.33160E)-(41.24540E) longitudes and (40.51940N)-(41.32480N) latitudes (Fig. 1). It is surrounded by Trabzon, Erzurum and Artvin cities as well as Black Sea from northern side. Rize has approximately 3922 km² surface area which is mostly covered by tea gardens (*Cameliasinensis*) (Kandemir et al., 2006).

The settlement type is "linear-littoral" as very high mountains located parallel to the coast naturally force the urbanization along the coastal zone. Even though the topographic character changes towards the inner regions, plain areas can only be observed by the coast and at major river mouths and they are generally used for settlements as very high buildings (Reis et al., 2008) (Fig. 2).

Climate type is a maritime temperate character with very high humidity through the year. Precipitation is very high, reaching up to 2400 mm and 32-year average is around 2239 mm. Yearly average temperature is approximately 14 °C. Detailed temperature range is given in Table 1 (Kandemir et al., 2006; Reis et al., 2009; Guneroglu, 2013; URL-2, 2013).

Main landuse types of the Rize city can be observed as forests (clusters, groups and coppices), shrubs and meadows. The major proportion of the total vegetation is formed by forests and shrubs. The remaining part is mainly covered by tea gardens and meadows (Kandemir et al., 2006).

Coastal shelves up to 500 m altitude are mainly characterized by broadleaved forests as well as sparsely distributed coniferous species with very rich under forest vegetation. On these relatively high ridges, species like *Acer cappodocicum, Quercuspetrea, Fagus*

orientalis Castanea sativa, Carpinus betulus and *Alnusglutinosa* are dominant. *Picea orientalis* and *Abies nordmanniana* can be also found in some places. The main cultured specie within this range is *Camellia sinensis.* From 500 m to 1500 m elevation zone, the vegetation is formed by mixed type coniferous forests and shrubs such as *Picea orientalis*, *A. nordmanniana F. orientalis*, *Acer cappadocicum* and *Carpinus betulus.* Between 1500 and 1800 m, the dominant species are the *Picea orientalis, A. nordmanniana* and *Pinus sylvestris.* Subalpine and alpine type vegetation characterized by meadows and small shrubs can be observed from 1800 m to 2000 m altitude (Anşin, 1980; Var, 1992).

3. Methodology

3.1. Data preparation

This study aims at landscape character assessment of Rize City and its close vicinity which is a transition zone between urban and rural areas. In order to delineate landuse types with high spatial accuracy, very high resolution (46 cm × 46 cm) multispectral digital aerial images for the year 2009 were obtained from the General Command of Mapping. Some additional data such as IKONOS multispectral image of the year 2008, Rize City plans and cadastral maps were also integrated into geodatabase. Digital Elevation Model (DEM) of the study area was built by using 1/25,000 topographic maps. Moreover, graphic maps of soil types and geologic formation of the study area were digitized and integrated to geodatabase. All map products were processed and coordinated according to ED-1950 datum and 6^0 UTM Zone-37N projections. All GIS process including geodatabase creation, digitizing, mapping and advanced spatial analysis were carried out in ArcGIS 9.3 environment. Integrated main layers were showed in Fig. 3.

Image mosaicking technique was applied to assemble all 6 digital multispectral aerial images to cover the study area in a single layer. Landuse types were manually digitized from image layer as 7 different classes which are named as "single tree, cluster, group, coppice, tea, lane and settlement areas". Therefore the spatial accuracy of each layer is equal to image resolution and it is quite sufficient to be considered very high and fine resolution for a landscape character assessment study. All processed data layers were converted from vector to raster data type and resampled to 5 m × 5 m grid resolution in order to carry out necessary complex spatial analysis in a fast and robust way. Slope and aspect layers were also produced from DEM and integrated into geodatabase. All data layers that used for landscape character assessment (LCA) were first re-scaled to appropriate class number. Layers used for LCA analysis are given in Fig. 4.

3.2. Landscape character assessment (LCA)

Landscape Character Assessment (LCA) analysis was applied by following a hybrid approach that combines previously published methodologies of Wascher (2005) and Swanwick (2002). The basic logic behind the LCA is to define and show the combinations of different mainly physical landscape variables. There are many studies in literature that differs in number and kind of input parameters. These variables are sometimes a combination of cultural data or values but mostly they are physical characteristics of the region of interest (Wascher, 2005). Therefore, there is no limitation on the number and types of data layers to be used for LCA. In this study, landuse, elevation, slope, aspect, geology, land capability classes and fractal dimension data layers were used for assessment of landscape character of Rize City. Fractal dimension (FD) is an ecological index of fragmentation level and shape properties of a landscape parcel (Krummel et al., 1987; Olsen et al., 1993; Imre and