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Araştırma

LAND USE CAPABILITY CLASS DATA WITH LAND FORMS USING GIS CASE STUDY, SAMSUN-BAFRA DISTRICT

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Abstract: Land use capability class (LUCC) is of great importance in guiding on land uses in terms of their potential and conserving natural resources for next generations. The concept of land capability is useful in this respect because it is a composite assessment of land and soil, which incorporates the key physical characteristics that limit sustainable land management. Such an approach is simple and logical in approach, is widely known and accepted in the rural community and has been applied widely. LUCC system the range of suited crops decreased from class 1 to 8 and the management inputs required to produce suited crops increases from class 1 to class 8. However, the combination of soils, climate and types of agriculture in a particular area or region may make certain lower capability lands valuable for agriculture. Join analysis of LUCC with topography offers a precious tool to agricultural practices and land use planners revealing the most suitable land for agricultural aims both from LUCC and physiographic point of view. The main objective of this study was to determine relationship LUCC and land forms using GIS in Bafra Plain and near district found in the Kızılırmak Delta and located in the central Black Sea region of Turkey. The study area covers about 77796.1 ha. In this study, LUCC information derived from soil database prepared by the Rural Affairs General Directory and topographic maps scaled 1:25.000 to generate digital elevation model (DEM) were used. According to LUCC distribution of the study area, suitable land for agricultural application ranged from class 1 to class 4 is 53244.4 ha whereas, 24551.7 ha of the total area is non suitable (from class 5 to 8) for tillage. Land slope, aspect, hill shade, drainage network, creation of a three dimensional network structure of earth surface are among application of DEM. In finally, LUCC map painted in various colors was combined by the hill-shade image to generate three dimensional view images.

Key Words: Land use capability class, Land form, Bafra Plain

1. INTRODUCTION

Land use capability class (LUCC) is of great importance in guiding on land uses in terms of their potential and conserving natural resources for next generations. The concept of land capability is useful in this respect because it is a composite assessment of land and soil, which incorporates the key physical characteristics that limit sustainable land management. Such an approach is simple and logical in approach, is widely known and accepted in the rural community and has been applied widely Klingebiel and Montgomery, 1961; USDA, 2000, CLI, 1965; Bibby et al., 1991).

The LUCC consists of soil components, soil map units, land capability classes, land capability subclasses, and land capability units, (Klingebiel and Montgomery, 1961; Soil Survey Staff, 1958). A soil map unit contains one or more soil components (typically soil series) with soil properties that are defined by precise definitions and may or may not have miscellaneous land types, e.g., rock outcrops (USDA-SCS, 1951, 1993). A soil map unit is a portion of the landscape identified as having similar characteristics and qualities. The LUCC are groups of soil map units with the same relative degrees of hazards or limitations, based on their soil characteristics, for cropland and pasture uses.

The main objective of this study was to determine relationship LUCC and land forms using GIS in Bafra Plain and near district found in the Kızılırmak Delta and located in the central Black Sea region of Turkey.

2. MATERIAL AND METHODS

2.1. Field Description of The Study Area

This study was carried out in Samsun-Bafra delta plain and near district. The Bafra Plain found in the Kızılırmak Delta and located in the central Black Sea region of Turkey (Figure 1). The study area is far 30 km from west of the Samsun province (4620-4600 km N- 230-260 km E UTM), It covers 77796.1 ha and its lies at an elevation from sea level 0-390 m. The current climate in the region is semi-humid. The summers are warmer than winters (the average temperature in July is 22.2 and in January is 6.9 ^{o}C). The mean annual temperature, rainfall and evaporation are 13.6 ºC, 764.3 mm and 726.7 mm respectively. According to Soil Taxonomy (1999), the study site has mesic soil temperature regime and ustic moisture regime. These areas are mainly flat, slightly sloped (0.0-2.0%) and hilly. The majority of soils on alluvial lands were Vertisol, Inceptisol and Entisol in Soil Taxonomy. In their soil properties, top soil texture is heavy (31-60% clay), while sub soil texture is different due to alluvial deposit in the study area. Soil organic matter content ranges from 1.70% to 5.92. EC and pH values of soils are changing 7.28- 8.01 and 0.61-2.79 dS m^{-1}. Flat land of the study area has been under intensive agricultural activities. Rice, maize, pepper, watermelon, cucumber and tomato with sprinkler and furrow irrigations in the summer, and cabbage and leek in the winter have been produced in the study area.

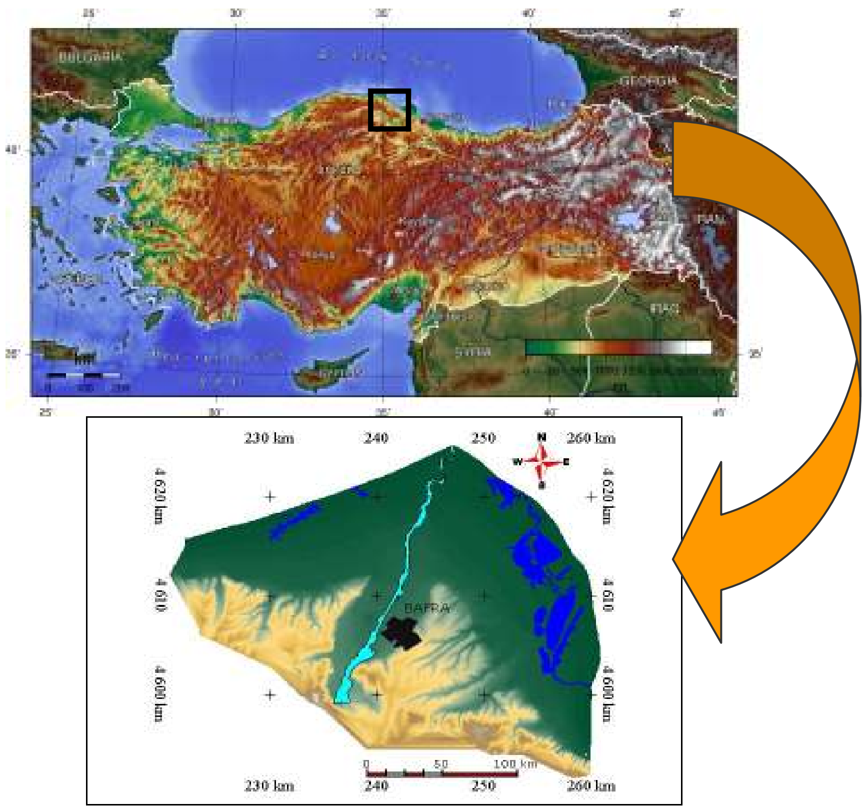

Figure 1. Location of the study area

2.2. Method

The main objective of this study was to determine relationship LUCC and land forms using GIS in Bafra Plain and near district found in the Kızılırmak Delta and located in the central Black Sea region of Turkey. For this aim, LUCC information derived from soil database prepared by the Rural Affairs General Directory and topographic maps scaled 1:25.000 to generate digital elevation model (DEM) were used. Land slope, aspect, hill shade, drainage network, creation of a three dimensional network structure of earth surface are among application of DEM (Figure 2). In finally, LUCC map painted in various colors was combined by the hill-shade image to generate three dimensional view image. During these stages, TNT Mips 6v and ArcGIS 9.3 geographic information system programs were used.

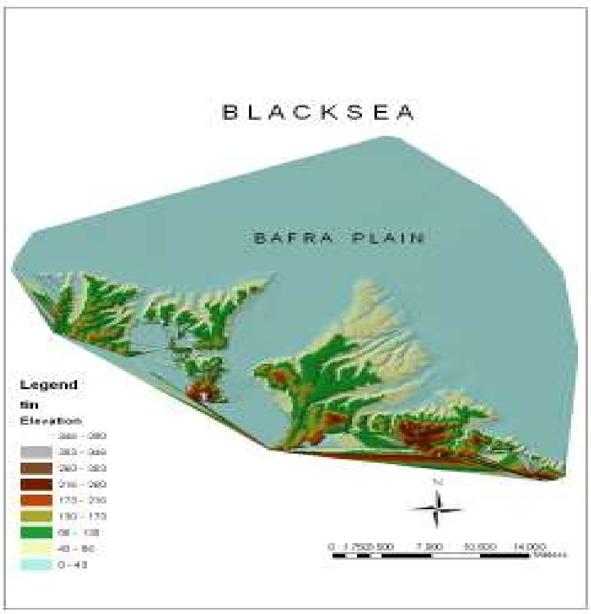

Figure 2. Digital elevation model (DEM) map of the study area

3. RESULTS AND DISCUSSION

Slope is undoubtedly one of the most important determinants of LUCC. Hill shade and slope groups (Figure 3 and Figure 4) derived from DEM are presented in Table 1. It can be seen that 90.2% of the study area has less than 12 % slope (very gentle and gentle) and 8.8% has more than 12% slope, varying from steep to very steep, from which runoff can easily occur. Steep and very steep areas are located on sought parts of the study area used for forest land, rangeland and rainfed agriculture activities.

LUCC was established by the Soil Conservation Service de USA according to the system proposed by Klingebiel and Montgomery (1961) and has been widely used throughout the world with numerous adaptations. It is a categorical system that uses qualitative criteria. The inclusion of a soil within a class is made in the inverse manner that is, without directly analysing its capacity, but rather its degree of limitation with respect to a parameter according to a concrete use. Some factors that restrict soil use can be used to define the productive capacity (intrinsic: soil depth, texture, structure, permeability, rockiness, salinity, soil management; extrinsic: temperature and rainfall) and yield loss (slope of the terrain and degree of erosion). Five systems of permanent agricultural exploitation are considered: permanent soil cultivation, occasional soil cultivation, pasture, woods and natural reserves. This system seeks maximum production with minimum losses in potential. Three levels of classification ware established: classes, subclasses and units. Also, 8 classes with increasing limitations in use are defined from I to VIII. As a function of the permitted uses, 4 use groups can be distinguished: permanent soil cultivation (or any type of exploitation; Class I, suitable soils; Class II, good soils but with some limitations; Class III, soils acceptable but with severe limitations), occasional soil cultivation (pastures, woods or natural reserves; Class IV, not recommended for agricultural use for severe limitations and/or required careful management); no soil cultivation, only pastures (in forests or natural reserves; Classes V, VI and VII) and natural reserves (Class VIII). The capability units represent similar proposals of use and management. In the study area, 30518.8 ha of the total area is suitable and good land (39.2%) in terms of agricultural activities whereas, 20939.0 ha of the study area is no cultivation land due to severe limitations such as high salinity, steep slope, soil erosion and shallow soil depth etc (Figure 5). In addition, from pedologic perspective, topography is important because it exerts a strong influence on the disposition of energy and matter experienced by soils on the landscape. Topography can also indirectly affect the vegetation cover of an area (Brady and Weil, 2001). Consequently, topography or relief so strongly affects pedogenetic processes, many researchers stated that specific soils are associated with specific landforms and soil patterns are repeating and predictable (Amundson, 1994; Daniels and Hammer, 1992; Young and Hammer, 2000). Finally, LUCC map of the study area painted in various colors was combined by the hill-shade image to generate three dimensional view image (Figure 6). Thus, it can be easily evaluated the study area for land use planning or management studies.

4. CONCLUSION

The Land Use Capability Classification is one of many interpretative groupings that can be used to evaluate arable and non arable lands for limitations or hazards for producing commodity crops using soil characteristics. The classification system involves soil components, soil map units, land use capability classes, land capability subclasses, and land capability unit.

This system provides a highly general classification of soil capacity, since it dispenses with many soil characteristics of undeniable interest, but has the advantage of not requiring a detailed knowledge of the soil. On not using all the limiting factors that affect the use capacity of a soil, important information is lost for the user. Its use proves quite subjective, though it adapts well to the experience of the evaluator. Its results materialize very well on a map, avoiding the erroneous evaluations that parametric methods can produce (McRae and Burnham, 1981). It also provides a mechanism to assess these natural resource limitations, but also allows for the incorporation into the scheme of more detailed and comprehensive techniques based on the modeling of natural resource processes.

Table 1. Slope class distribution of the study area

Slope class	Area (ha)	Ratio (%)
0-2 %	50383.7	64.8
2-6 %	11471.9	14.8
6-12 %	8257.5	10.6
12-20 %	6048.0	7.8
20-30 %	1370.5	1.8
30+ %	264.5	0.2

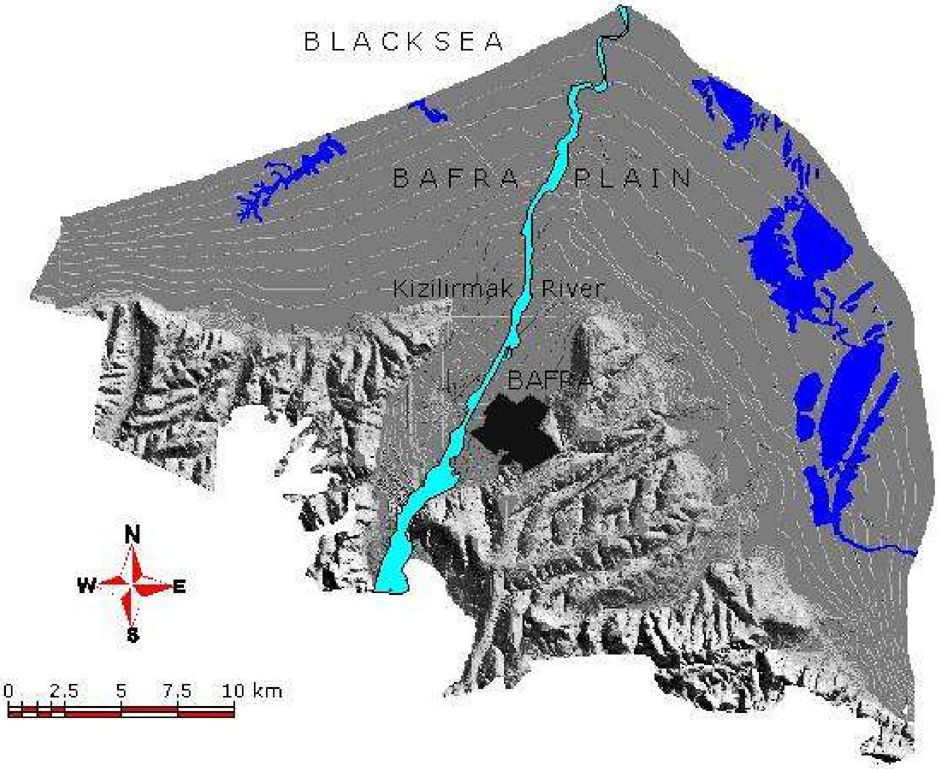

Figure 3. Hill shade map of the study area

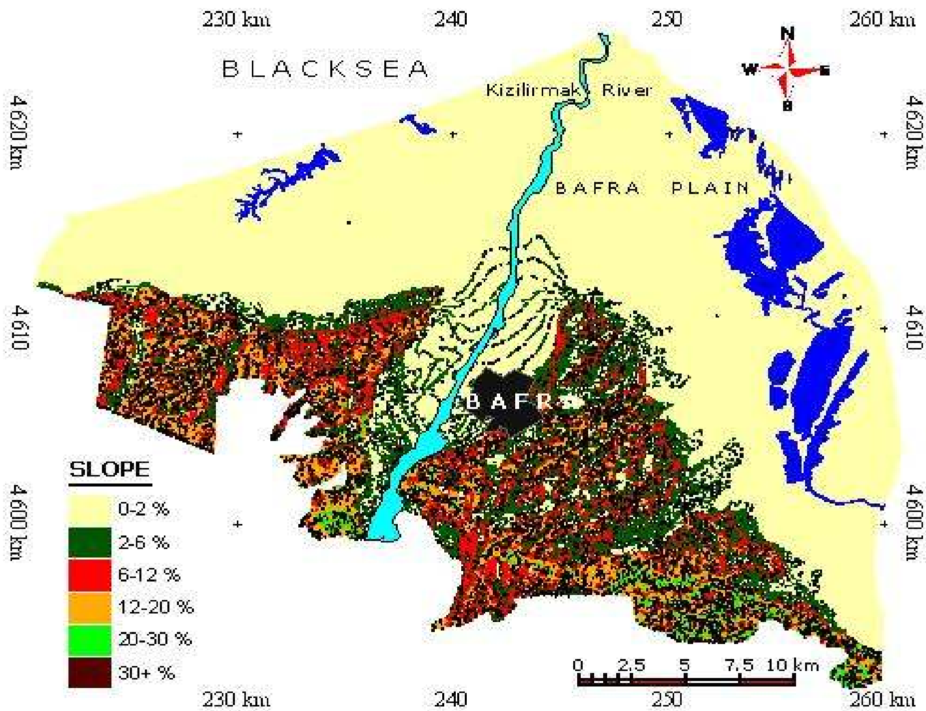

Figure 4. Slope map of the study area

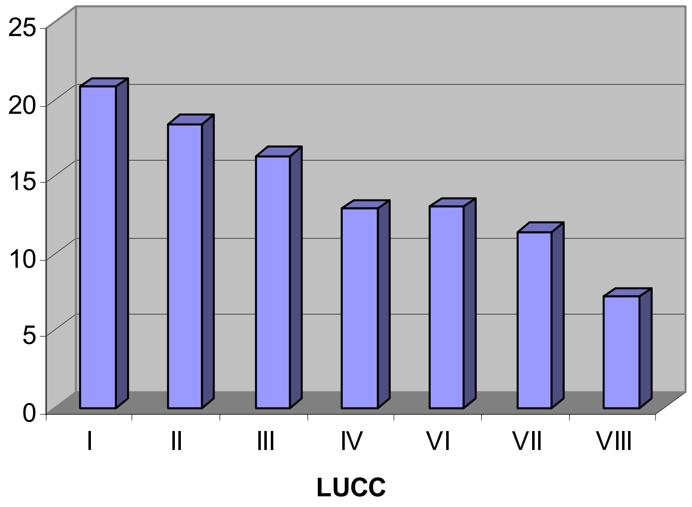

Figure 5. Distribution of Land Use Capability Classification of the study area

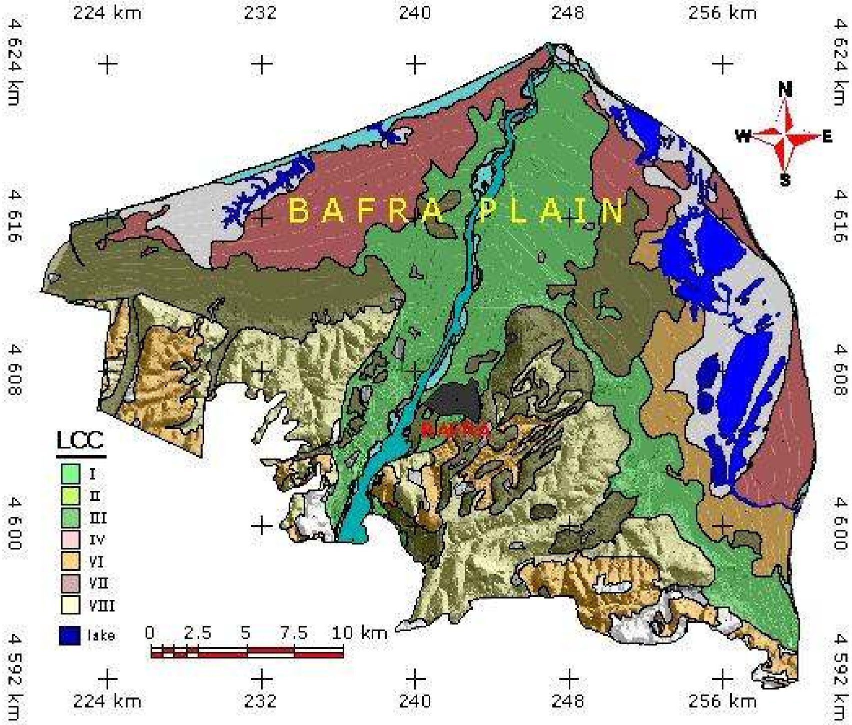

Figure 6. Distribution of Land Use Capability Classification on hill shade map of the study area

5. ACKNOWLEDGEMENT

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