INVESTIGATION THE DISTRIBUTION OF VEGETATION IN TURKEY BY USING REMOTE SENSING DATA AND GIS

Dursun Z. SEKER, Nebiye MUSAOGLU and Sinasi KAYA
ITU Civil Engineering Faculty Department of Geodesy and Photogrammetry
80626 Maslak Istanbul TURKEY

dzseker@srv.ins.itu.edu.tr
nmusaoglu@srv.ins.itu.edu.tr
skaya@srv.ins.itu.edu.tr

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ABSTRACT

In this study which is based on the information taken from the map of Soil Conservation and Management Master Plan of Turkey published by the Ministry of Agriculture Forestry and Rural Affairs in 1987, all major soil groups were digitized and stored in a computer. After transferring process, the data in a GIS software have been used with different data such as main characteristics of the soils, provincial borders and settlements. For the pilot study, Thrace region, which is located in the North-West part of Turkey has been selected. In order to determine agricultural lands, forests, settlements and pastures in this area, Landsat TM dated 1992 and SPOT PAN images dated 1993 have been used.

For using these data in the same GIS software, remote sensing data have been transferred into UTM coordinate system and image enhancement and classification techniques were used. Obtained information is transferred into GIS software and evaluated together with the other information. Joint use of GIS techniques applied to conventional mapping data and remote sensing data is an efficient tool for the decision-makers about the soil resources.

1 INTRODUCTION

While the population of the World is increasing, the amount of the land on which mankind live and use remains unchanged. For the economic development of some developing countries where agriculture takes place very important role in the economy, such as Turkey, effective land resources management using modern science and technology has become increasingly important (Seker, 1993). For the purpose of planning and providing support to the decision making process, the principal objective of this study is to determine vegetation types grown on the different soil types in Turkey, using remote sensing data and analyzing these data in a GIS for the purpose of planning and decision making.

All planners require up-to-date information to effectively manage land development and plan for change. Because land use map, as a source of thematic information, has been an important component of urban and rural or regional planning for many years. In areas where change is very slow, land use maps are acceptable just to adequately portray current conditions and may provide some sort of information. However this is not the case in areas of rapid change. In such areas, even the most recent map may be of little value to the person requiring up-to-date information (Treitz, at all, 1992).

Even with the availability of satellite imagery and computer storage of information one can not reach the up-to-date information. In this study, a line coverage of Turkey which shows different soil types was obtained from Soil Conservation and Management Master Plan of Turkey published by the Ministry of Agriculture, Forest and Rural Affairs in 1987. All major soil groups were digitized and stored in a computer. After this process these data were also processed in geographic information systems. Many information of land cover and land use data are still out of date for the operational use.

Remote sensing has been recognized as a useful means of supplying up-to-date information on activities within the urban environment, including the rural-urban fringe (Ehlers, at all, 1990). Interfacing of GIS technology with remote sensing will provide maximum information content and analysis capabilities to the land-use planners. There are many advantages of combining remotely sensed data with existing spatial image and statistical data. GIS technology provides a powerful tool for the quantitative analysis of land use change and map revision.

The intensified use of land and destruction of vegetative cover helped by the suitability of the topographic and climatic conditions, led to a countrywide detrimental problem: soil erosion. Erosion control has been negligible up to now, if this situation persists, Turkey will loose entire topsoil and even subsoil in the next fifty years (Tozan, 1998).

2 CASE STUDY

2.1 Study Area

The area located in the Marmara Region in the western part of Turkey, bordered by Tekirdað-Malkara_Kesan highway in the north, Saros Gulf in the west, northern coast of the Dardanelles in the south and the Marmara Sea in the east, was examined as study area. Geographical position of the area lies between 26^0 30’ – 27^0 30’ east and 40^0 20’ – 41^0 00’ north coordinates. The examined area covers approximately 2500 square kilometers. In this area through which western segment of the North Anotolian fault crosses (between Gaziköy – Saros Gulf territorial section), there are Koru Mountain, Isýklar Mountain and Doluca Hills. Furthermore, agricultural land, forest land, maquis fields and settlements exist in the area (Kaya, 1999).

2.2 Climatic Conditions

Climatic elements of the region were assessed by putting into consideration the data provided by the meteorological stations of Tekirdað and Kesan from 1930 through 1985. Around average temperature value was 14.1^0 C, average maximum temperature was 18.6^0 and average minimum temperature was $9.6\ ^0$. Average rainfall in the Thrace region was between 550 to 1000 mm. As most of the rainfall in the region is in the form of heavy downpour, there is superficial erosional activity caused by sudden rainfall in the slightly sloped hillsides. (Tozan, 1998). Rainfall map of study area can be seen in the figure 1.

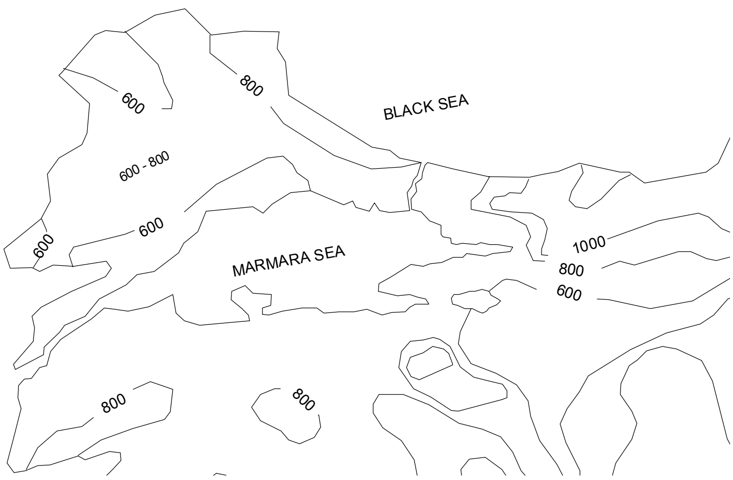

Figure 1. Rainfall map of the study area.

It can be said that coastal areas are affected by Mediterranean climate and in the sections higher than the coastline, the prevailing climate is a sort of climatic condition with characteristics of continental climate.

2.3 Soil Conditions

In Turkey, there are 15 major soil groups categorized under five major soil zones. These major soil groups are further categorized according to three slope groups (slight, moderate, steep) by the Ministry of Agriculture, Forest and Rural Affairs (----, 1987). The Distribution Map of Major Soil Groups in Turkey is taken as the basis in the categorization process.

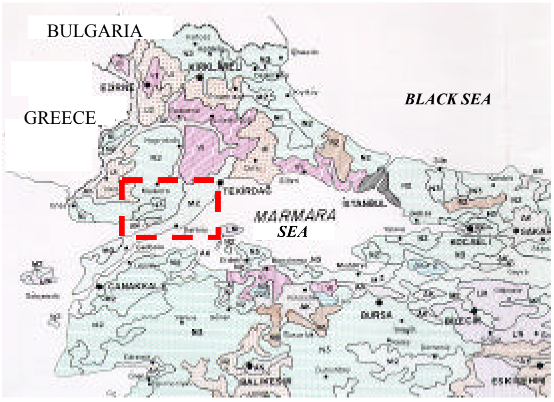

Figure 2. Soil map of the study area.

In this study area four different soil types were determined. Soil map which shows the different soil group of the study area is given in the Figure 2. These four different soil types are:

1. Non Calcareous Brown Forest Soil: developed on sand-clay stone, clayed and pebbled deposits under the influence of humid mild climate where annual precipitation is 500 – 750 mm.

2. Brown forest soil: a soil type seen in the humid – mild climatic regions with dry seasons where annual average precipitation is 620 – 870 mm and developed on clay stones rich with limestone, micas and gneiss. This soil which contains medium level of organic substance has a clayed texture. As it has high water retention capacity, there is relative distinction in vegetation cover.

3. Non Calcareous Brown Soil: developed on pebbled, sandy, clayed deposits and on calciferous sandy clay and sandy clay stones where the climate is semi-humid. Water retention capacity of the soil in sand texture is low and vegetation cover is grass and mixture of grass and shrubs.

4. Alluvial soil: existing on young sediments brought and accumulated by rivers on the basis or the in the catchment area of surface waters, this type of soil is flat or almost flatly sloped, azonal thin layered, well-drained.

2.4 Method

In this study, LANDSAT TM image dated 11 July 1992 was used. For the purpose of joint eveluation and integration of different data groups, firstly satellite image was transformed into UTM coordinate system by using 1/25000 scale topographic maps. Coordinate transformation realized by using polynom equations with 0.5 pixel RMS. Uncontrolled classification algorithm (ISODATA) was applied to satellite image for the classes of land use in the area of study.

ISODATA (Iterative Self Organising Data Analysis Technique) is a widely used clustering algorithm (Tou and Gonzales,1977: Sabins, 1987 : Jain,1989: Jensen, 1996). The ISODATA method uses spectral distance and iteratively classifies the pixels, redefines the criteria for each class, and classifies again, so that the spectral distance patterns in the data gradualy emerge (ERDAS, 1991).

Classification procedure was realized with 20 classes. As a result of the classification identical classes were combined to differentiate 10 classes of land use (Figure 3). Accuracy of the classification result was tested by means of high resolution satellite images, aerial photographs and terrestrial studies. In figure 4, aerial photograph of the Ak part of study area merged with Landsat image can be seen.

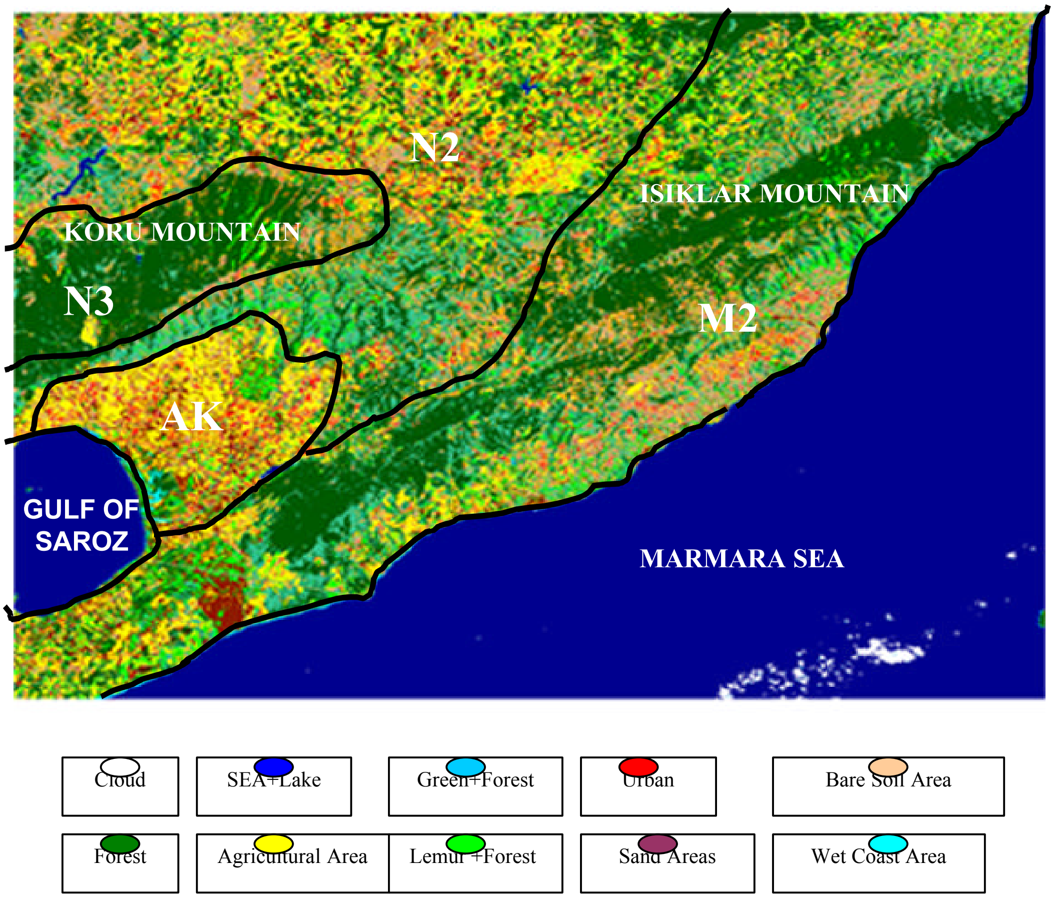

Figure 3. Classification result of study area.

Figure 4. Aerial photographs of AK region merged with Landsat image.

3 CORRELATION OF THE CLASSIFICATION RESULTS WITH THE VEGETATIVE COVER AND SOIL TYPE.

Soil is a heterogeneous system whereby various characteristics dynamically affect one another. Physical features of the soil include different aspects such as depth of the soil, granularity, internal structure of the soil, its texture and related water content, soil air, soil temperature and color (Kantarcý, 1987). In determining the vegetative growth surroundings all of these features are jointly evaluated with topographic and climatic conditions (Musaoglu, 1999).

In this study, classes of land use and breakdown of vegetative cover have been classified by means of satellite images and they were correlated with the map of soil type which was digitized and transferred into computer media.

The soil types in the area of study are named as Ak, N2, N3 and M3. These soil groups can be seen on the classified image of the study area which is given in Figure 3. When the classification results obtained from the satellite image are compared to these soil types, it is seen that the entire area covered with Ak type soil, in the western part of the area, consists of fertile agricultural lands. In this area the Evrese Plain which consists of alluvion and watery lands is especially covered with large and fertile agricultural land. On the other hand, the region of Koru Mountain lying in the northwest of the study area consists of N3 soil type. As for the vegetation cover in this area coniferous forest types are predominantly seen. In the N2 soil type that exists in the area with slightly sloped topography was covered with agricultural lands and the areas with unsuitable slope was in parts covered with forest lands.

In the region of Isiklar Mountain M2 soil type, mixes forest vegetative cover is widely seen in steep slopes. In the relatively slight-sloped parts which are alongside the southern coast of the area, vineyard farming is common.

4 INTEGRATION OF DIFFERENT TYPE DATA IN GIS

In this study ArcView GIS was used for integrating and analyzing different type of data in a common system. Some of the main raster coverages added to systems are: satellite image, classified satellite image and filtered image. Rainfall map of Turkey, Soil map of Turkey, slope map and geomorphological map were added to system as vector type data. Attributes data related to these coverages were also entered into system. After the analysis of soil map area of different soils group were calculated. In Figure 5 soil coverage can be seen. Using this data distribution of major soil groups within major soil zones throughout Turkey were determined and these groups can be seen in Figure 6.

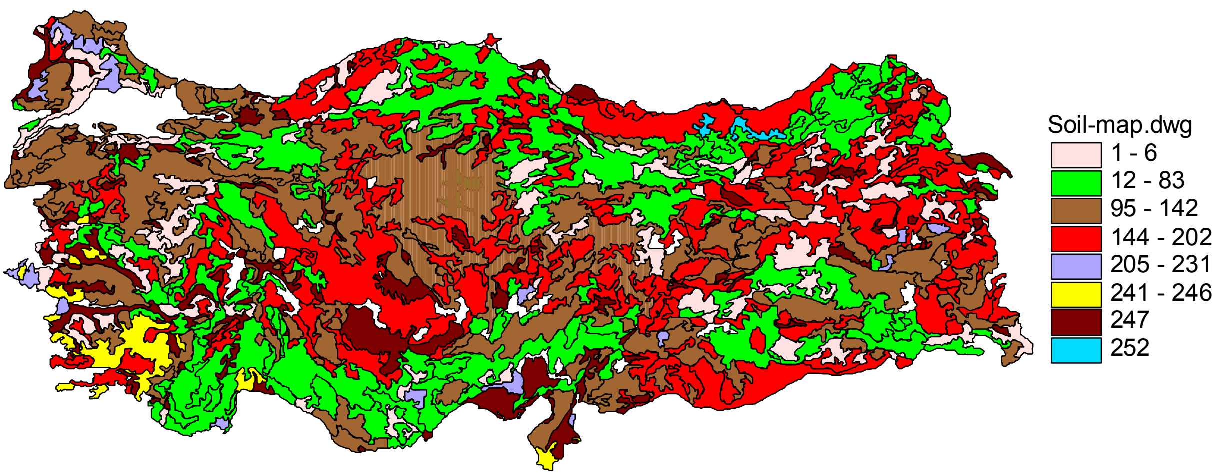

Figure 5. Soil coverage with represents different type of soils.

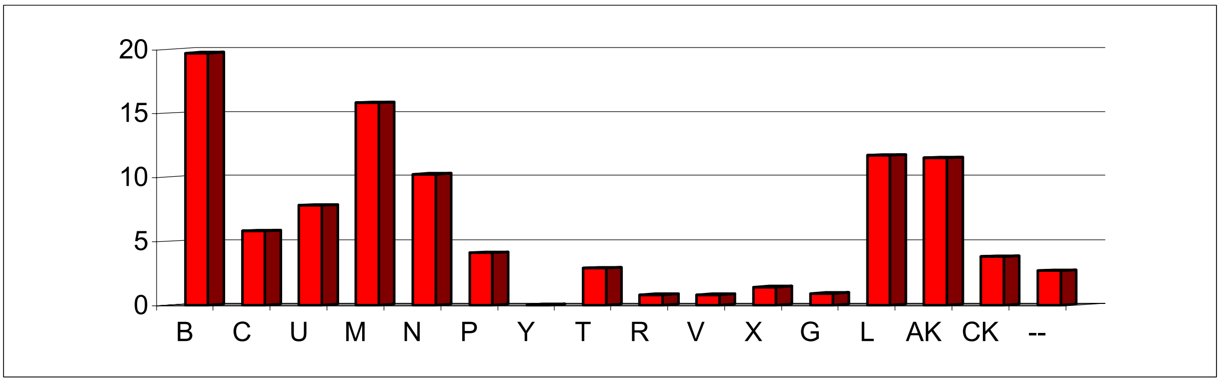

Figure 6. Distribution of major soil groups within major soil zones throughout Turkey.

5 CONCLUSIONS AND SUGGESTIONS

In this study, correlation of satellite images and GIS with soil classes, land use and vegetative cover has been studied. From the classified satellite images, coverages such as agricultural lands, forest lands and settlements have been investigated and it has been seen that the classes of soil map can be accurately interpreted by means of satellite images. It has further been observed that all of these data could be evaluated in GIS media and the information needed for countrywide and regional planning could be produced fast, accurately and economically. Moreover, by considering topographic structure and breakdown of vegetative covers, a simulation model could help determine the erosion zones which is one of the biggest problem of the country high as well as areas with exposure to erosion, and such information can serve as the basic data in planning erosion prevention.

As a result of joint assessment of land use classes to be obtained from satellite images together with other data in a GIS, the possibility of quickly and accurately determining and analysing the changes on land will be ensured which in turn will be extremely useful for planners. As a result of these analyses, locations where local emigration to urban areas which is an ever so increasing problem and direction such move can be determined. Thus, by means of this system planning at this direction can be made. Furthermore, this system will make it possible to monitor the changes such as decreasing agricultural lands due to human settlements and other reasons.

In order to obtain the findings of the study area also for the entire country, to healthily assess the national resources and to plan the use of such resources in the most efective way, one has to ensure that remote sensing and the other data sources are used within the same GIS.

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