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# Determination of Land Data of Ergene Basin (Turkey) by Planning Geographic Information Systems

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**Abstract:** Geographic Information Systems (GIS) provide to gather environmental, legal and positional whole data pertaining to land. GIS is used to make future plans with the maps formed by digitizing informations gathered from land data. In the study, positional data pertaining to Ergene Basin where is chosen as the area of study are first processed into GIS medium and then thematic maps of the region are formed. It is aimed with the maps prepared within the context of the study to form a base in making further plans for basins.

**Key words:** Geographic information systems, thematic maps, databases, MapInfo, river basin

## INTRODUCTION

The fast growing population in the world and the rapid growth in cities have intensified the need to collect data regarding planted areas, preservation of the existing land sources, other issues on protection of nature and information about the population. In various issues, the need for geographical information including information on land has emerged (Fıstıkoğlu, 1996). Accordingly, the organization and processing of high amount of positional data as per needs constantly evolving according to purpose and time have required the use of computer aid and paved the way for the Geographical Information System (GIS). The Geographical Information Systems (GIS) have become an important tool utilized in management of so many and different data that the classic archiving methods could not manage in recent years. Thanks to these systems, it has become pretty easier to process map based data and other data base. In addition, one of the most important benefits of Geographical information system is that they help to make right decisions on events related to geographical assets. Furthermore, through these systems, it has become possible to create thematic maps and make queries related to the position on these maps (Burrough, 1998).

In today's world, GIS is employed for many agricultural purposes such as estimation on plant pattern in agriculture, harvest estimation, determination of lawn and meadow areas, determination of fallowing lands, follow up of plant evolution, soil classification, irrigation and drainage analysis, conservation planning of water resources, estimation on resources regarding agriculture and animal husbandry and determination of rural settlement areas (Yomralıoğlu, 2000; Turoğlu, 2000).

Increases having resulted from employment of new technologies and methods in animal and plant production have contributed to a rise in fertility. However, various chemicals and fertilizers applied to soil and plants as a result of evolving agricultural techniques and practices have negative impacts on the productivity of the soil, underground and surface water resources (Topbaş *et al*., 1998). One of the environmental problems posing threat to the agricultural sector is use of fertile agricultural lands for

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non-agricultural purposes (settlement, military, tourism, industry etc.). Therefore, literature information on the land cover included in the Ergene Basin Environmental Arrangement Plan has been used in this study and maps have been drawn for use of land, soil classes, utilization of fertilizer and pesticides and forestry areas as per cities within the borders of the basin (T.U., 2007). The objective of the study is to make the maps prepared serve as the basis for basin planning studies to be carried out in the future.

## MATERIALS AND METHODS

### Study Area

Ergene Basin is located in the middle of the Thrace region and surrounded by the borders of the Northern Marmara Basin, Meriç Basin and Bulgaria. Ergene Basin is one of the existing 13 sedimentation basins in Turkey. In terms of its geographical structure, it is in the form a basin closed to the sea. The survey of the basin equals to 10.730 km$^2$ and cultivable lands account for about 73% of the basin. Forests, heathlands, rock cliffs, settling areas, industrial places and lake surfaces form the remaining 27% of the basin (Hazar, 1997).

The mountain chain extending from the North of Edirne to Lalapaşa, Kırklareli Merkez, Kofçaz, Demirköy, Vize, Saray towns and remaining between Black Sea coasts is called Istranca (Yıldız) Mountains. To the South of the region extend Ganos Mountains from the region covering Enez, Keşan, Malkara ve Şarköy towns to Tekirdağ. Areas which fall out of the scope of the defined mountainous region of the basin are plateaus of medium height or low ones. These plateaus are very similar to one another in terms of terrestrial forms and natural structure characteristics. The situation of the river basin is given in Fig. 1.

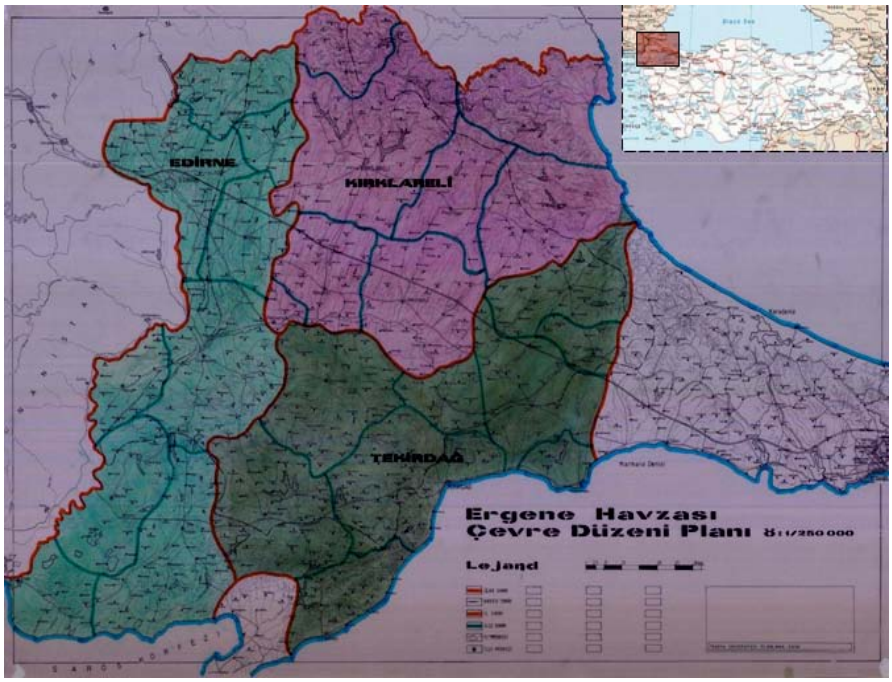



Fig. 1: The situation of the river basin

In general, terrestrial climate reigns over Ergene Basin. December and January are the rainiest and July and August are the driest months of the year. The average annual precipitation is 622 mm. Since Ergene basin is surrounded by very high mountains to the North and South, it receives less precipitation compared with the neighboring lands. There is a wide forestry cover in particular oak and beech throughout the high sections of Istranca Mountains. A great part of Ergene Basin, on the other hand, lacks trees (Kantarcı, 1997; Çengel *et al*., 2001).

The most important surface water resource of the basin is Ergene River and its ramifications. Ergene River stems from resources in about Saray town of Tekirdağ, joins with Çorlu Stream and afterwards flows to the west and flows into Meriç River in Uzunköprü town of Edirne. The total length of the river is 285 km and its average annual flow rate is 27,270 $m^3 h^{-1}$. The most important ramifications of Ergene River are Sulucak Stream, Burgaz Stream, Teke Stream, Şeytan Stream and Hayrabolu Stream (Hazar, 1997).

According to the new soil classification (soil taxonomy), with regards to types of soil, there are Vertisol, Inceptisol, Alfisol, Entisol and Mollisol in the basin. In regards to soil classes, Mollisol is considerably fertile and significant, Alfisol and Inceptisol are cultivable; however Vertisol creates problems when used for agricultural purposes and it accounts for about 30% of the region. Dry and wet farming are performed in the basin and the main crops are wheat, paddy and sunflower. 21.881 ha of the soil in Ergene Basin is exposed to the risk of very severe erosion and 126.324 ha severe erosion (Tok, 1997).

Land use for agricultural purpose in Ergene Basin constitutes approximately 73% of the total land. Agricultural chemicals and pesticide use are as important as that of fertilizer in the basin. Producers of the region prefer use of pesticide instead of manual hoeing or using agricultural machines in fight against weeds as pesticide is cheaper and more efficient. Contaminant nitrogen and phosphor resulting from use of fertilizer in agricultural and forestry areas are amongst important pollutant sources. Chemical fertilizers applied heavily in the basin include more nitrogen.

**GIS Application**

GIS is based on the integration of three main components of the computer technology. These are methods and techniques for database management, processing, imaging and drawing of data graphical display and positional analysis. In a GIS database, data (processed or raw satellite data, climate, soil, surface measurements, height, precipitation, temperature, population, roads etc.) derived from very different resources regarding the issue to be analyzed and questioned are kept on the computer as layers and new information is produced by questioning the criteria of a certain branch of expertise. For example, the most suitable areas for the production of a new type of plant are designated according to the type of soil, precipitation, temperature, land use and inclination. This information can be realized as an image, map, graphic, statistical analysis etc. (Ordu and Demir, 2007).

In this study, after the selection of GIS package software (MapInfo) to be employed in the application, data have been collected, they have been associated to one another and the system was questioned. In the application study, first of all, necessary details and type of these details (point, line and area), attributes of these details and layers of details have been detected. Separate layers (such as soil and forest etc.) have been established for classes of details. In accordance with the type of detail to be stored in the layer, layers have been created in the form of point, line or area. Afterwards, data have been placed in their places in the most suitable layers. Details in the form of point, line and area are represented by different symbols according to their attributes.

Maps with a scale of 1:250.000 pertaining to Ergene Basin have been digitized and these digital maps have been converted into the format of MapInfo. Since layers are kept as separate files in MapInfo, layers to be associated with the database have been combined as separate files and converted. During the process of conversion, every point, line, area or writing object if there is have been assigned

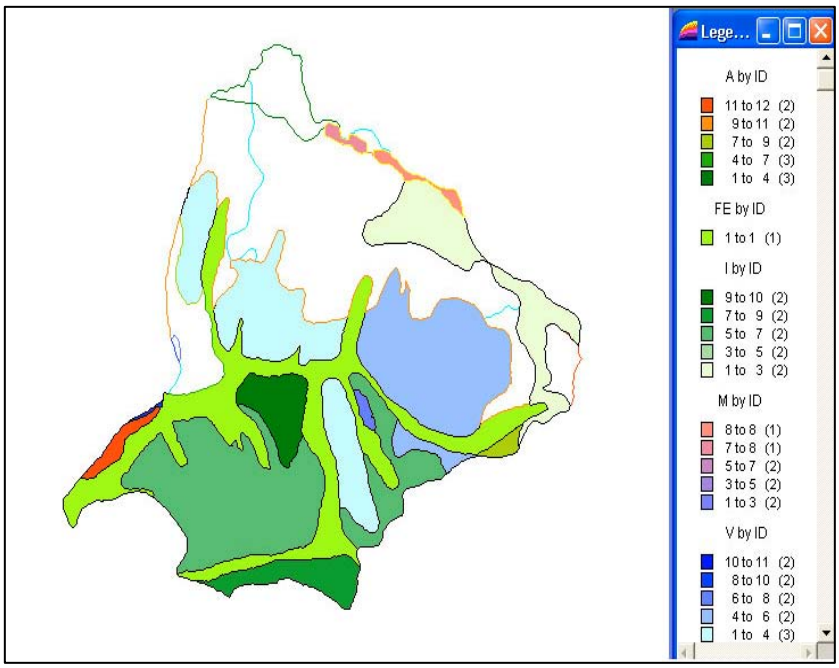


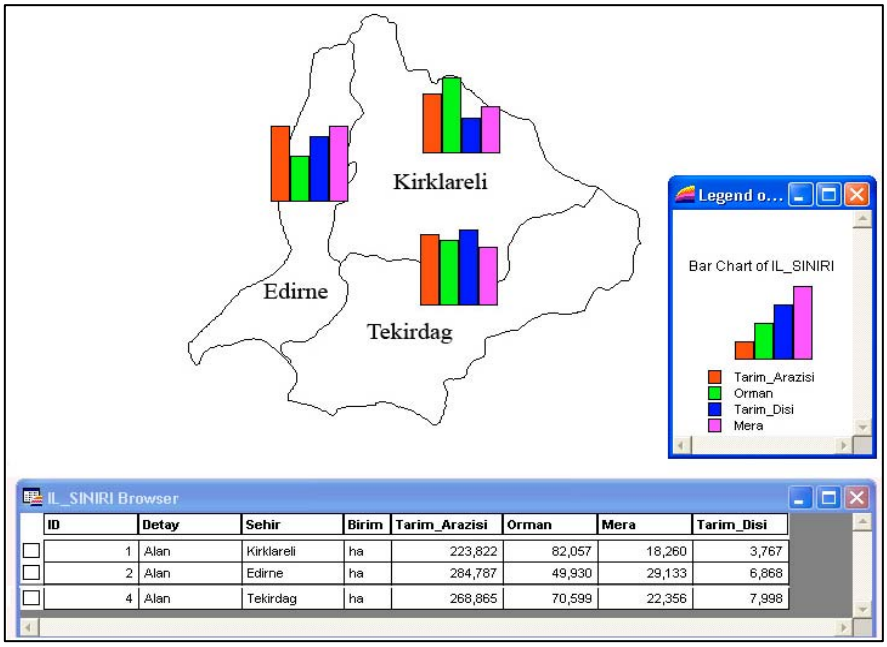

Fig. 2: Thematic display of classes of soil

an ID no. While entering data of attribute, either new attributes are added to tables of the existing layers or a table which does not include a layer is constituted, new registers are added via the existing program and as many attributes as possible can be entered. However, if data tables are Microsoft Excel etc., based, it is not possible to make any operation (geographical analysis) without converting these tables into MapInfo format. This conversion process is ready in the relevant program. Combination process of non-graphical data prepared in a different software program (Microsoft Excel) and graphical data has been realized through Table>Update Column>Join. These data are combined via common areas in tables.

In GIS, it is possible to mark information of attribute pertaining to data in a layer on the region upon the info instruction and display it in tables. If there is more than one object in the same geographical location, the Info Tool window display how many objects there are and to which tables they belong to.

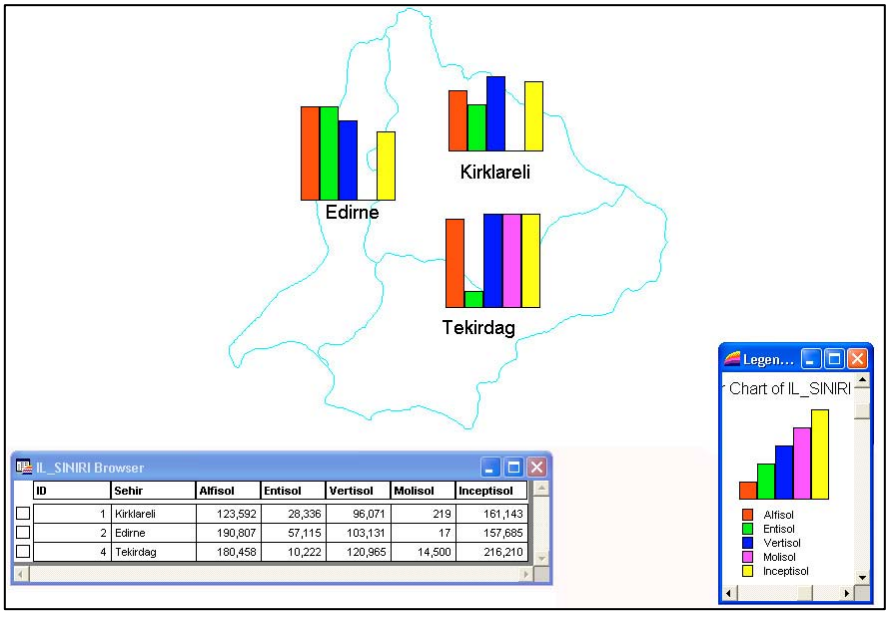
The most important steps of GIS are making queries, necessary analysis and receiving results. Thematic maps have been drawn up by storing all the existing digital data in a database. A thematic map can be defined as the change of the map to the different forms depending on the underlying information. In this way, we can display the same data in very different forms via thematic maps.

The thematic maps prepared are as follows: The thematic map of the basin has been drawn up in the soil layer according to classes of soil. Every class of soil (Alfisol, Inceptisol, Mollisol and Vertisol) has been colored differently according to their ID numbers. The distribution of class of soil, use of land and utilization of pesticide and fertilizer have been located on in the form of bar graphics on every city in the basin. In this way, it becomes possible to make comparison of different data on a visual basis. Thematic display of classes of soil is presented in Fig. 2, land use in the basin in Fig. 3 and types of soil in the basin in Fig. 4. Use of pesticide and fertilizer is displayed in Fig. 5.




| ID | Detay | Sehir | Birim | Tarim_Arazisi | Orman | Mera | Tarim_Disi |
|---|---|---|---|---|---|---|---|
| 1 | Alan | Kirklareli | ha | 223,822 | 82,057 | 18,260 | 3,767 |
| 2 | Alan | Edirne | ha | 284,787 | 49,930 | 29,133 | 6,868 |
| 4 | Alan | Tekirdag | ha | 268,865 | 70,599 | 22,356 | 7,998 |

Fig. 3: Land use in the basin




| ID | Sehir | Alfisol | Entisol | Vertisol | Molisol | Inceptisol |
|---|---|---|---|---|---|---|
| 1 | Kirklareli | 123,592 | 28,336 | 96,071 | 219 | 161,143 |
| 2 | Edirne | 190,807 | 57,115 | 103,131 | 17 | 157,685 |
| 4 | Tekirdag | 180,458 | 10,222 | 120,965 | 14,500 | 216,210 |

Fig. 4: Types of soil in the basin

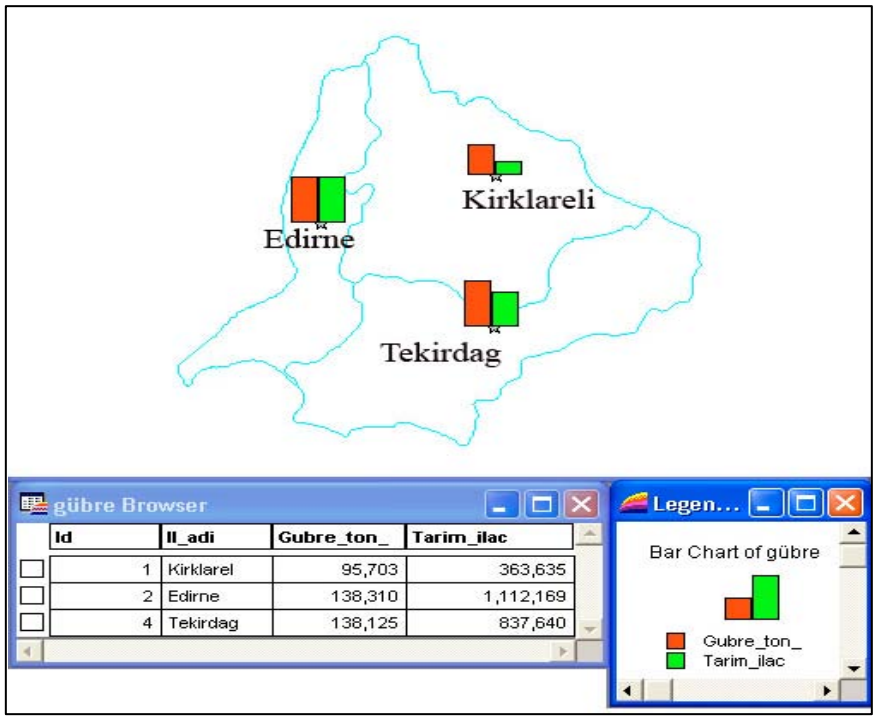



Fig. 5: Use of pesticide and fertilizer

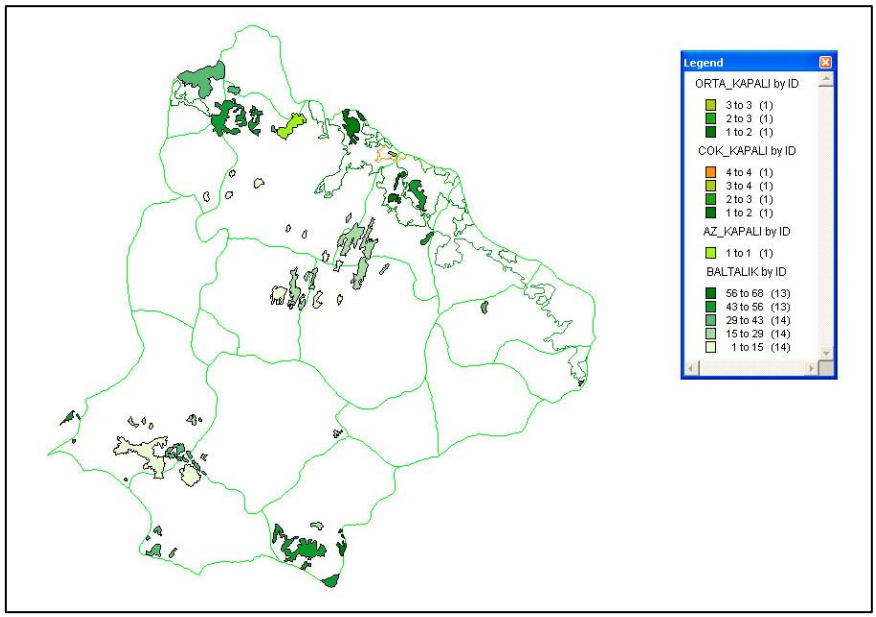



Fig. 6: The thematic display of the forestry areas

Thematic maps have been drawn up as Ranges and Individual according to characteristics of data. Data displayed in parenthesis in the legend window of the thematic map are the number registers within this range.

In the layer of forest, the distribution of forestry areas in the basin has been displayed. Forestry areas have been ranked from the dark color to light ones. Dark colors indicate more intense forestry areas while light colors less dense ones. Names of the layers are listed as very dense, medium dense, coppice and lowly dense and they have been colored accordingly. Forestry areas exist only in the northern part of the basin and the surface of forestry areas becomes less day by day. The thematic display of the forestry areas is presented in Fig. 6.

## RESULTS AND DISCUSSION

In today's world, there is a need for comprehensive information on field in studies conducted on natural environment. In this case, Geographical information systems are the most efficient technological tool in order to collect environmental data, store in the digital environment and realize positional analysis.

There are various features of a river basin such as its topography, geology, land use, basin borders, population intensity and these features include very different parameters related to the basin. It is very difficult to evaluate such type of comprehensive information. Thus, it has become inevitable to employ geographical information systems in management and planning of a basin in recent years.

Ergene basin on which this study has been conducted covers a significant part of Thrace. This basin includes the most important agricultural lands of the region and has a considerable industrial power. The mainstay of the basin is mainly based on agricultural activities. Nitrogen and phosphor components emanating from over fertilization of agricultural lands become a part of water resources through the surface flow. In particular, wastewater including fertilizers and pesticides from lands of paddy which requires much water play an important role in pollution. There should be efforts in the basin to prevent water pollution resulting from agricultural activities. Natural methods should be developed in the fight against insects instead of use of pesticide. In addition, new Technologies in agriculture should be followed. The feasibility of use of methods such as ecological agriculture, pesticide rotation and resistant seed should be studied in the region.

In this study, the attention has been attracted to the increasing non-agricultural use lands in Ergene basin the main economy of which is based on agriculture. Though the size of non-agricultural land use varies according to cities, it is mainly settlement areas of low and high density, industrial area, military area and tourist area. In thematic maps drawn up, the use of land and soil types of the basin have been defined and it has been exemplified that agricultural soil of I. and II. class is utilized for non agricultural purposes.

This study has defined the existing situation in the basin and aimed to form the basis for planning, development and management of basin resources in the future. The presentation of visual digital data to the decision making authority is very important in accelerating the decision making process. Furthermore, techniques of distance perception can be employed in future planning studies. On the other hand, the presented study has also delineated the fact that the use of GIS at the most efficient level requires sufficient and suitable databases and an understanding of GIS system capabilities.

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