DESINGING A REGIONAL GEOGRAPHIC DATABASE AND ITS APPLICATION

Selçuk REİS[1], Halil İbrahim İNAN[1], Tahsin YOMRALIOĞLU[1]

[1] Department of Geodesy & Photogrammetry Engineering,
Karadeniz Technical University, Trabzon, Turkey
sreis@ktu.edu.tr, hibrahim@ktu.edu.tr, tahsin@ktu.edu.tr
www.gislab.ktu.edu.tr

Today, the need for environmental management to be able to use natural resources properly requires using of the information system technologies. To control natural resources uses and environmental changes can only be obtained by having a Geographic Data Bases (GDB) in wide extend areas. Regional-based GDB approaches can provide more effective and fast execution opportunities for future planning. In environmental management, however more complicated and intensive spatial data are needed. In Turkey, there are three local administration systems which are province, county and village. Among these, province administrations have the position being civil superior in respect of authority and responsibility. These administrations also prepare development schemes, through supervising urban and rural areas. Therefore, making decisions by province administrator will be possible only by forming GDB and providing base maps aiming at the future planning. In this study, using GIS and Remote Sensing (RS) technologies, an information system design that is directed to develop spatial data for regional planning was formed. In contents of spatial information system, Trabzon City has been selected as a pilot project area. Firstly, it is aimed to establish a GDB capable of providing determination of risk areas in natural disasters or/and forming base maps for tourism and investment activities. Vector-based attribute data collected from government bodies and raster data which acquired by remote sensing techniques are also be combined. In order to use such an organized system, natural and social-economical spatial data by topographic structure, administrative regions, rivers, roads, land use, and geological structure were gathered and some spatial analysis were accomplished and in respect of this studies some cartographic maps were also produced.

1. INTRODUCTION

All over the world and especially in developing countries, in global and regional works (studies), such spatial systems as Geographical Information Systems (GIS) and Remote Sensing (RS) have been tended considerably *[George,* 2000*]*. Applilation stages of these technologies can change from country to country. As well as economical, social, and cultural structure of the Country, legislative arrangements effects GIS applications directyl. Especially, in a developing country like Turkey, that some procedures such as fundamental legislative arrangements and data quality standards have not arised yet make difficult to form any GIS.

The first step consructing spatial databases for large-extent areas is system design and gathering data. Being able to realise GIS applications and projects depend on just availabity of data being proper structure *[Yomralıoğlu*, 2000*]*. Developed countries overcomed this stage and begun to offer their databases on line. In Turkey, the basic problem encountered in construction of spatial databases is the lack of required-quality data. It is needed to constitute some systems to ease gathering process of regional-based spatial datas which is under control by various different foundation and have not yet been able to provide producing with determined standards. When considered that databases which are

being planned to serve for different concepts bring together different diciplines and technological innovations in the 21. Centry make necessary to work collectively professional disciplines, the importance of geographical databases that concern different professions increases. In Turkey, to supply data communication between different disciplines, construction of a nation wide information system called "National Information System" involving all of the public foundations is designation stage.

Regional Geographical Database study was started by chosing the city of Trabzon as pilot area. Prior to the study, it is aimed basicly that this Information System provide base maps for production of Environmental Plans and, guide administrative and investment activities. A planning procces was executed about what kind of and what quality datas should be involved in such a system and what data sources should be used. During the study, the problem of not being able to reach some data through required data sources or in required quality as anticipated in data acquision plan made inevitable to incline some other data sources. In this respect, such methods as comparing the data originated different sources and applying relevant experts were followed. In addition to this, satellite images were also used.

2. PROVINCE ADMINISTRATION AND THE NEED FOR SPATIAL DATA

Provinces form the basic administrative parts of the country and an important base for the public administration because, in accordance with the Turkish constitution, province system is accepted as a base in view of central management. In economical and social development, eliminating regional development differences and providing a nation wide balanced improvement, provinces should be accepted as main units. When cosidered that a plannad improvement consist of local, regional and national stages, provinces forms the most important administrative step for planning and determination of strategies at local level *[DPT,* 1999*]*.

Province administration that form an integrity in its constituon forms a small model of national administration. When considered in view of national administrative units, province administrations keep most of the public foundations in its interior, and by joining the spatial datas relating to each province, nation wide spatial data sets come together as a whole. Administrative units require spatial datas to carry out their managerial activities. Being able to achive this and provide improvement in province scale can be obtained by improving administrations in centre of population, producing and controlling proper land use plans, planning convenient housing areas and integrating with environmental infrastructure *[Groot,* 2001*]*.

In Turkey, there are three base local administration systems which are province, county and village. Among these, province administrations have the position being civil superior in respect of authority and responsibility. These administrations also prepare development schemes, through supervising urban and rural areas. Therefore, making decisions by province administrator will be possible only by forming Geographic Data-Base (GDB) and providing base maps aiming at the future planning.

3. METHODOLOGY

The city of Trabzon is situated between 39^o 7' 30'' - 40^o 30' east-longitudes and 40^o 30' - 41^o 7' north-latitudes in the middle of East-Blacksea Region (Figure 1). In the city, increasing elevation beginning from the sea-level exceeds 3000m in some areas. Generally, mountains, hills and high plateaus take part in inner land of the region. The city is the most important trade centre in the region with the features of having historical and cultural wealth, being the cetre of other population units as well as its unique geographical position.

Figure 1: The location of Trabzon in Turkey

3.1 Designing Regional Geographical Data-Base

When data-base design for Geographical Information System is dealed with in view of the system, it is understood that this include some componets such as software, hardware, methods, users and data elements. Among this components, although structuring and designing hardware, software, method and user components is easy because this is selected by related foundation, data-base design is an exteremly hard procces.

However, the real success depends on the quality and being serviceable of the data that the sytem includes, being able to offer the high quality data required by the administrators with the least labour and in much more short-time *[Başkent, 1997]*. The first step is determination of user requests and requirements, that is to say, determination of in what aims the produts from the Data-Base will be used. Then, in view of this requirements, Data-Base Design is realised. A region wide Geographical Data-Base may spread in such a wide extent area as provinces and include a gread deal of data types. Therefore, classification of the datas are required according to using propose and extent af the data-base. In respect of this, as a result of a research on public foundations in Trabzon, designed for the city Trabzon as pilot area the Geographic Data-Base Design through which required spatial data types for a regional database were determined is seen in figure 2. In such a database that forms main bases for regional scaled works, it should be chosen for maximum 1/25.000 scale and for minimum 1/250.000 scale in data presentation according to the usage purpose. For instance, while the stream map of a region is 1/100.000 scaled and the map representing litological structure of the same region may be 1/25.000 scaled. Organising of the datas acquired different sources and related to each other should be planned in advance. When this types of datas are gathered in the same database, it will be seen that this datas may have common spatial features or objects. For this reason, this types of data sets should be collected in the same data layer to prevent data repetition and not to experience loss of time and labour in future update processes. For example, when it is required to display province, county and village borders, combination of village borders form county borders and combination of county borders also form province borders. Any modification on any of this graphic data sets related to each other closely, especially near the borders, effects other data sets at the same time. By collecting in the same layer the datas relating to administrative boundries, it is eliminated the loss of labour and time for data-repetition in the process of update.

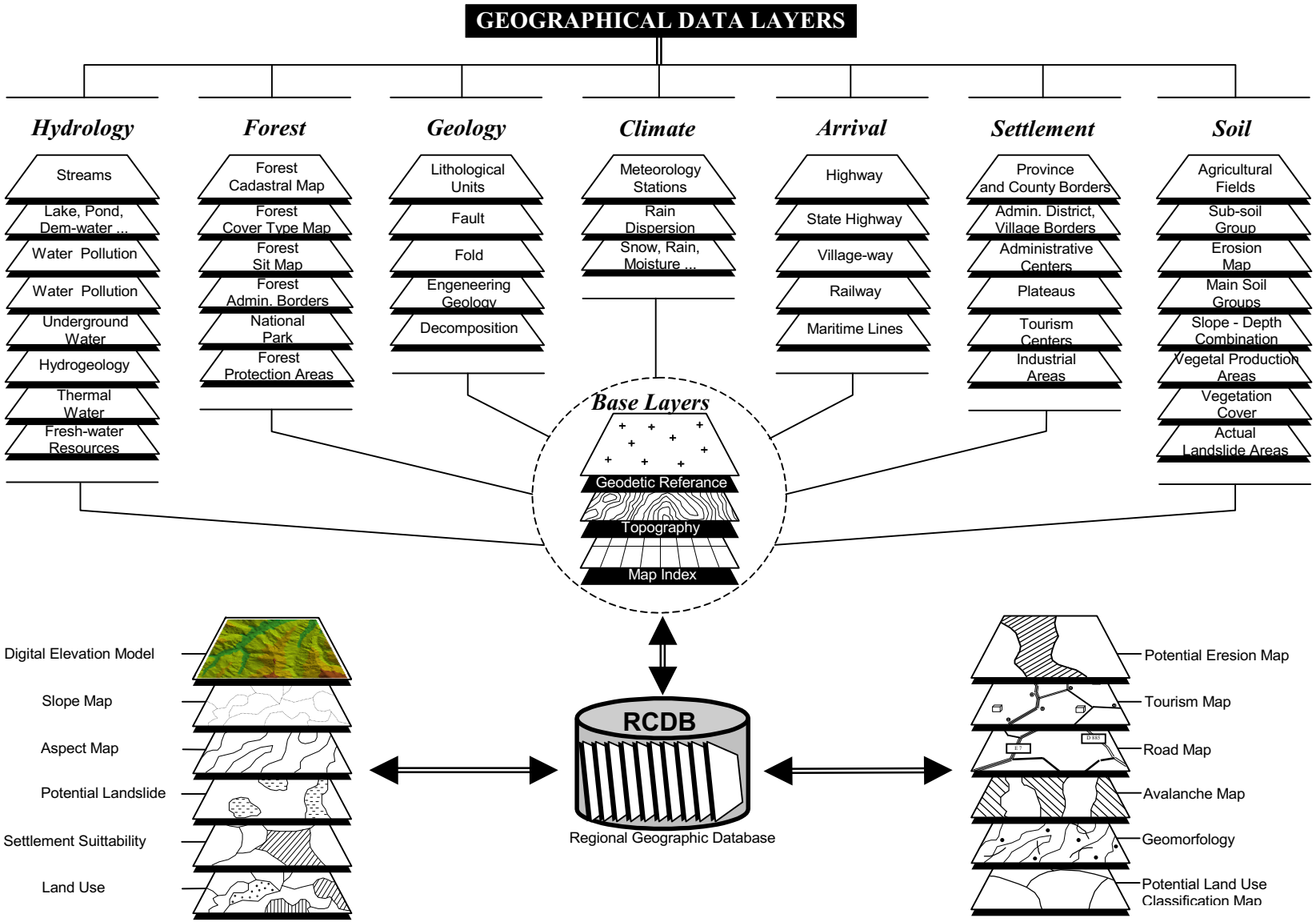


Figure 2: Cartographic design of Regional Spatial Database

3.2 Data Processing Through Geographical Information Systems and Remote Sensing

In producing region wide geographical datas, it was took advantage of high data gathering capacity of the Remote Sensing Techniquies and, in processing gathered data, it was gained from high power querrying and analysing facilities of GIS. The point that should firstly be paid attention is to classify this data in accordance with required standarts, accuracy and scale in acquision process of the data sets. In Turkey, not forming a standard between public foundation in respect of authority and responsibility in producing spatial datas up to now, lots of data types are acquired by different foundations with different quality, scale, occuracy and standards at the same time. Therefore, the proper informations for this study that comes from different sources were entegrated with each other. This informations consist of graphical and non-graphical informations. Graphical informations were combined under the coordinate system that has UTM projection and ED-50 datum.

After the available data existing in the constitution of foundations were acquired, missing data, in accordance with the aim of the study, were acquired through remotely sensed images. By taking advantage of the features of Landsat ETM+ images used most in region wide works and acquiring data related to naturel resources, missing or lacking data were gathered. Landsat ETM+ images have a pancromatic band at 15m resolution as well as a multispectral band at 30m resolution. By combining pancromatic band with multispectral band, a new multispectral band consisting of far more rich informations was obtained afterwards. Data on the image were gathered in two ways as visual interpretation and image processing techniques. Visual interpretation works were carried out by providing the entegration of image with vector data by means of features of ARC/INFO software. In this process, especially, some data that is possible to follow and interpret via the eyes such as routes, streams and shore lines were obtained. The process of gathering land cover informations was realised using supervised classification method via ErMapper software.

3.3 Analysing and Querrying Databases Through GIS

A. Analysing Land Cover:

In the study for land management, spatial data in map form is always required. It has been understood that remotely sensed images gathering data continiously about vast broad frames are useful in determining land cover *[Bronsveld et al.,* 1994*]*. Land cover types were obtained by classifying Landsat ETM+ images in Ermapper software with supervised classification technique (Figure 3). Then, it was calculated areal proportion for each class. Thus, land class proportions and percentages were obtained for the province (Table 1). More than half of the province area is covered with plant. Among this plants, hard wood with 38 percetage and hazelnut raised with agricultural propose with 15 pecentage have largest proportion.

Table 1: Areal proportions and percentages of land classes

	Land Class	Area(h)	Percentage
1	HARD WOOD	176.171	%38,0
2	RANGE	86.313	%18,5
3	EGRICULTURE	79.446	%17,0
4	HAZELNUT	71.298	%15,0
5	HARD-SOFT WOOD	23.953	%5,0
6	SOFT WOOD	10.698	%2,5
7	ROCKY	6.037	%1,5
8	GREEN TEA	5.038	%1,0
9	SETTLEMENT	4.605	%1,0
10	CLOUD	2.489	%0,5
	TOTAL	**466.063**	**%100,00**

Land-use classes of Trabzon were collected under 11 classes after spervised classification and image enhancement works were executed. The class having the largest proportion out of this classes is hard wood with 38 percentage. This class includes some hard wood species such as beech, hornbeam, chestnut, etc. The class of agricultural areas involves mainly corn, tobacco, bean and the other agricultural species raised in the region. Because agricultural areas are scattered in smal peaces as a result of topographical structure of region, also considering the precision of used image, this areas were combined under one class. The reason for determination of green tea ares of the province as 5.000h arises from mixing this areas with hard wood trees. The most important reason for this stuation is the obligation of working with a single image sensed a fixed time. Working with different dated images, especially on dates of leaving leaves of hard wood trees makes possible determination of green tea areas much more precisely.

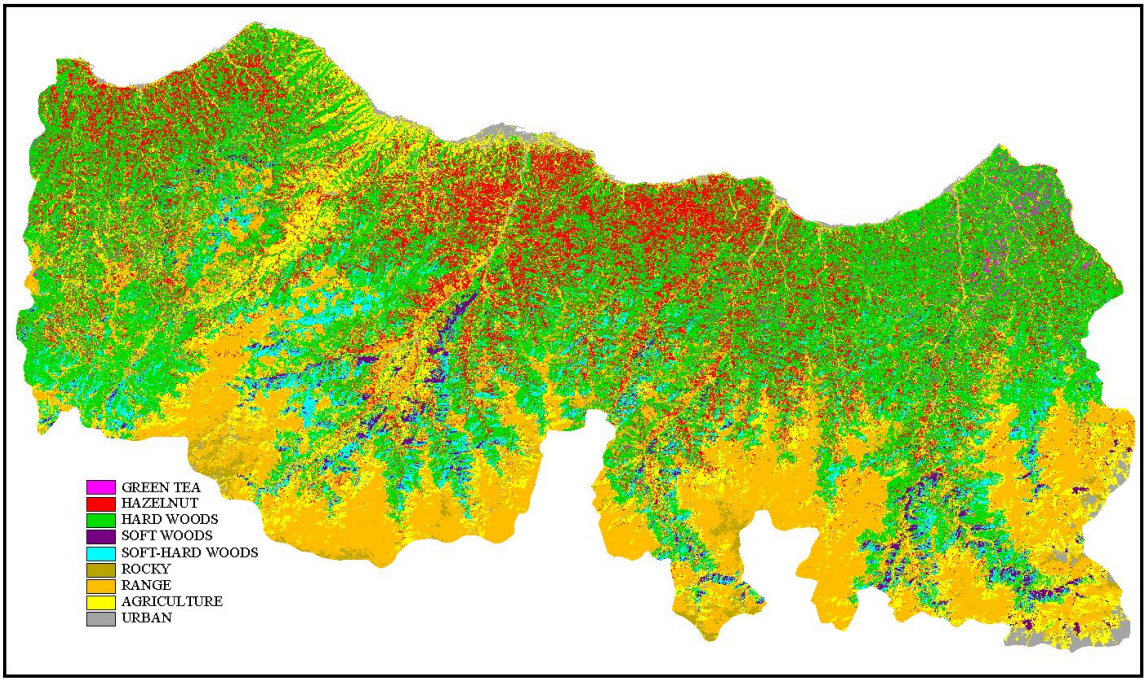


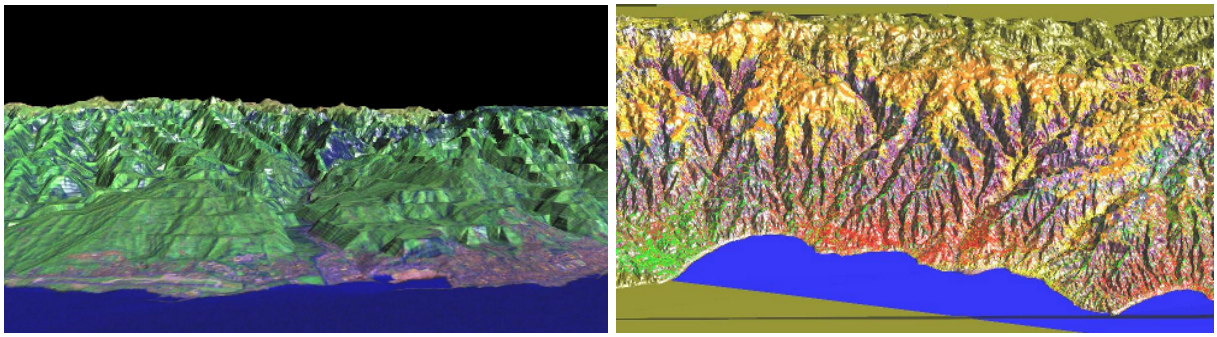
Figure 3: Land cover map of Trabzon

B. 3D Model Analysis:

A 3D model of the area in TIN data model was formed using izohips representing the topographical structure of the province. The 3D model was converted to GRID data model in propose of overlapping with remotely sensed image. Digital Elevation Model (DEM) obtained with resolution of the image by re-sampling was overlapped with the image, and thus, a real model of the province was constituted (Figure 4). Using this model, slope and aspect informations were obtained as data layers. In the table below, areal and percentage proportions are listed in accordance with the slope classes. Comparing with the total area, thirty percentage of the area is belove 30% slope ratio and the rest (70%) has a slope ratio above 30%. This, in general, indicates that the province has a rough and sloping topographical structure. Additionally, the volume of province beginning from sea-level as 5819 km^3 and the surface area as 5414 km^2 were determined.

Table 2: Slope classes and proportions of Trabzon

EĞİM SINIFI	%(0-10)	%(10-20)	%(20-30)	%(30-40)	%(40-50)	%(50-60)	%(60-80)	%(80-100)	>%100
ALAN(km^2)	762	168	443	631	767	709	822	245	112
ORAN(%)	16,35	3,61	9,50	13,54	16,46	15,22	17,64	5,27	2,41



(a) (b)

Figure 4: Integration of DEM with image using ErMapper; (a) Merged pan and multispektral image of Trabzon, (b) 3D view of classified Landsat ETM+ a covering Trabzon province

C. Demografic Analysis:

Province, county and village borders of Trabzon were obtained with a meticulous work. The map showing province, county and village borders is seen in Figure 5. Through administrative and demographical structure represented by graphical and non-graphical data in database, it can be made various querries and analyses aiming at different purposes. This anayses perform an important role in exequting properly investments and services related to human beings. In accordance with some statistics obtained using the Database, the total area of the province is 4.660 km2 and it has a population of 979.259 accoding to uncertain cesus of 2000. The censuses being realized in the province at different times since 1940 is shown in Table 3. In the province having a population growth of 10% untill 1975, since this date, population growth has decreased increasingly. However, according to uncertain census of 2000, the population of the province decreased with a 15% rate in three years period. The province of Trabzon consists of 18 counties including the cenre of province in 2002. In addition to this, excep for the counties, there are 537 administrative units with bucak, belde and village statute. Entegrating this units with land cover informations, land cover of each administrative unit was obtained. As a result of the analyses made in hazelnut areas the most productive crop of the province directed to counties and villages, the county having the most proportion of hazelnut area is Trabzon, the centre of province, with 38,6 percentage (8.893h) and the least is Çaykara with 5,5 percentage (3.111h). And as for the villages, the village having the most proportion of hazelnut area is the village called “Dilek” in Arsin (a county in Trabzon) with 76,5 percentage (156h).

Table 3: Population information about Trabzon

	POPULATION			*INCREASE(%)*		
	CITY	VILLAGE	TOTAL	*CITY*	*VILLAGE*	*TOTAL*
1940	43,015	347,718	390,733	-	-	-
1945	40,243	355,141	395,384	*-6,44*	*2,13*	*1,19*
1950	46,089	374,190	420,279	*14,53*	*5,36*	*6,30*
1955	59,781	402,468	462,249	*29,71*	*7,56*	*9,99*
1960	83,692	449,307	532,999	*40,00*	*11,64*	*15,31*
1965	108,492	487,290	595,782	*29,63*	*8,45*	*11,78*
1970	138,435	520,685	659,120	*27,60*	*6,85*	*10,63*
1975	171,570	547,438	719,008	*23,94*	*5,14*	*9,09*
1980	186,580	544,465	731,045	*8,75*	*-0,54*	*1,67*
1985	239,553	546,641	786,194	*28,39*	*0,40*	*7,54*
1990	331,321	464,528	795,849	*38,31*	*-15,02*	*1,23*
1997	419,867	427,009	846,876	*26,73*	*-8,08*	*6,41*
2000*	485,081	494,214	979,295	*15,53*	*15,74*	*15,64*

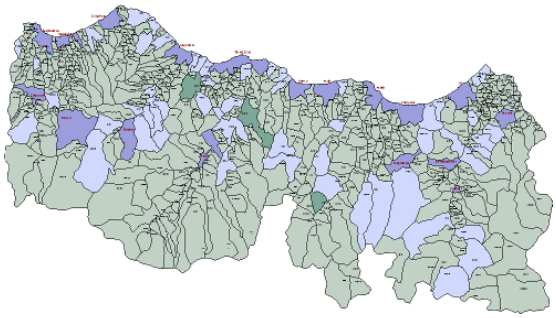


Figure 5: Administrative units of Trabzon

* uncertain census.

D. Analysis of the other information:

There are various types of data sets in the geographic data base. It is especially mentioned here querries about roads, streams and tourism informations. The data about road-network were classified in accordance with road types as the roads with two lanes or more, permanent vehicle road, summer vehicle road. The length of all types of this roads weer determined as 490 km in total. The total length of the streams have computed as 2290 km in the administrative bordes of Trabzon province. The highest hill is "Demirkapi" having 3376 m elevation.

Besides, a tourism map was prepared through geographic data base for purpose of better advertisement historical and touristic wealth of the region and guiding tourism activities. This thematic map with its thematic features addresses to the end users.

4. CONCLUSION

One of the most important problem in our country is uncontrolled rapid growth of the cities. The GIS studies have been become more dense here. Especially, in late years, in large scale municipalities, GIS usage have been increased rapidly. But it covers small areas and due to taking along time working with more detailed features, to establish and to spread large areas is getting slow. In Turkey there are insufficient GIS studies at large areas involving rural areas. However, local administrations are responsible for both of urban and rural areas. This areas are the fields spreading much more large fields and also including far mor various spatial details. Local administrations must be supply the best management and make decisions. Decision making just can best with regional plan, territorial plan and environment effect evaluation report which is prepared only up to date information and todays technological conditions. It could possible if the plan and reports prepare rapidly, accurately and up to date. For this reason making a Geographic Database in province scale, initially fulfill the local administration environmental management, control the natural resources and planning the future.

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