GPS/GIS USAGE ON THE FOREST BOUNDARY POINTS SURVEYING AND MAPPING

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In Turkey, forest cadastral surveys still remain technically behind general cadastral surveys. Forest cadastral commissions have some problems as finance and technology for forest surveying. Therefore, forest cadastral surveys have caused a lot of legislative conflicts of ownership between forestlands and agricultural/settlement lands and have had negative effects on forest management in the Eastern Black Sea Region. The objective of this study is to clarify usage of GPS and GIS usage for forest cadastre maps. For this purpose, a study area was selected on Duzkoy District, Tasocagi Village. In this area, the forest cadastre was completed in 1987. The cadastre map was plopped by classical methods. The accuracy of the forest boundary points on the map are determined by applying of GPS terrain data to GIS digital topographical map. According to the results of this study, it is determined that the location of forest boundary points is correct. But, the length between two points is too much. Therefore, there are a lot of conflicts between forest area and private ownerships. It was caused from difficulties of measurement of boundary point on the terrain. The GPS receivers were determined as very effective and accurate. And also GIS has impression capacity for data storage, manipulation and cartographic advantage.
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1. INTRODUCTION

"Forest Cadastre" can generally be defined as the activities that determine the geometric and legal boundaries of forest. [*Basaran and Tuncel,* 1987]. Based upon the issue No 6831 of Forestry Laws, forest cadastre commissions have been charged with the studies of determining the boundaries between the state forest and private-proportion and forests, which somehow remained outside the boundaries of the state forests [*GDF*, 1986]
Until 1960's the work of drawing the forest boundaries was due to closed-polygon shaped activities, which were not connected with the net of land reference marks. After this date some activities partly connected with land-reference marks started; but the maps in use are still technically dissatisfactory. In forest cadastre, some 1/5 000 and 1/10 000 scale maps enlarged out of 1/25 000 scale maps are still in use.

The fact that forest cadastral surveys have technically fallen behind the activities of the general Directorate of Cadastre and Land Registration causes some problems. The first problem is that they avoid some small-scale measures along forest cadastral boundaries and determine same straightforward lines in forestlands next private properties. The point-based fixation of forest boundaries a small-scale map is almost impossible. In addition lands left outside forest boundaries by the surveys of forest cadastral commissions have not been registered in many cases because of the reason that cadastral activities are not technically satisfactory [*Kizilay*, 1991]. For this reason, according to the code issued 3402, all this lands should be re-measured.

It is possible to fix the coordinates of the forest boundary points which were found by the combined activities of GIS and GPS and to transfer this information to computers and to map them without applying classical measurement activities. Global positioning system (GPS) has the ability to determine and measure the coordinate values of a specific point fixed by the survey machine on earth and the one in space. The transferee of these data to GIS software makes it possible to write the accurate coordinate values on numerical maps. This gives us the opportunity to produce low-cost and accurate cadastral maps within a very short period of time.

It has been started that the performance of GPS Technology has been experimented under the conditions of woodland vegetation [*D'eon*, 1995 and *Evans*, 1992] Furthermore; a few studies used GPS primarily to collect accurate data [*Hook, Sumpter and Asher*, 1994]. Some researches studied the efficiency of measuring and correcting the real-time disparities of forest boundary points using GPS [*Sumter and Asher*, 1994]. All these studies and others focused only on the accuracy and efficient of the measurement in the woodlands but never sought the possibility of GPS-GIS integration to collect data.

GPS is a 24-hours activity space-based system of fixing and recording geographical position accurately. Since natural resources are dispersed geographically. GPS and GIS make it easy to record data on database, because they can be used separately and independently in the woodlands. GPS, which is relatively cheap, can be used efficiently since it has the ability to collect accurate data and to correct the positional disparities and problems. Due to some receivers correcting real time disparities, GPS users can apply measuring activities along very sensitive 1-15 m lines [*Brackett and Arvanitis*, 1998].

In Eastern Black Sea Turkey, users have reached an accuracy value of 7.5m after some experiments to fix the GPS data-quality under spruce vegetation. This value is bellow the accuracy value of 10 m accepted as the standard one to be used in GPS cadastral activities [United States Department of Agriculture-Forest Service and Us Department of the Interior-Bureau of Land Management, 2001] [*Yoshimura et al.,* 2002]

2. MATERIAL AND METHOD

2.1. Material

This study was conducted in Duzkoy District, Tasocagı Village, Trabzon. In this village the forest cadastral surveys were conducted by the no.29 Committee of General Directorate of Forests. Surveys started in 1977 and were completed by the no.28 commission in 1987 and put into practice.
In this study, which intend to measure and map the forest cadastral boundary points. The research a 1/25 000 scale topographic map produced by the general Directorate of Mapping and prepared by the cadastral commission no.28 and including the information on forest cadastral file and its survey area.
A Trimble Geo Explorer III GPS receiver was used together forest boundary point coordinate information. To evaluate this piece of information Trimble Pathfinder office software was used and Arcview 3.2, which is GIS software, was used to map all this information.

2.2. Method

In this study an area of 2150 m length between the 18th and 33rd forest boundary points was used to apply survey activities.

The survey of forest boundary points was conducted using a Trimble Geo Explorer III GPS receiver with a free static measure. Standing on the boundary point fixed on earth, users made 30 records for each point. These data where evaluate using Pathfinder software and was formed as "Arcview shape file" (Figure 1).

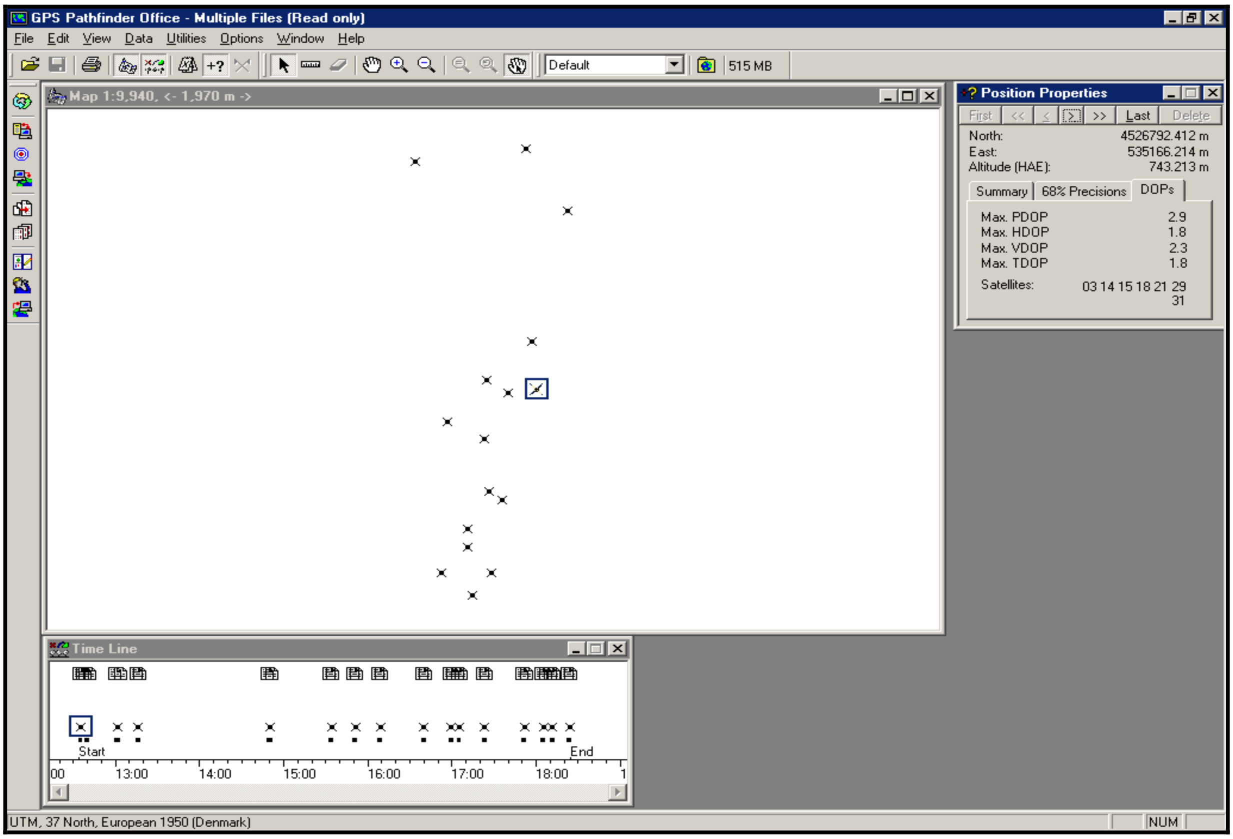

Figure 1. Trimble GPS Pathfinder Software used to process GPS data

The data in arcview shape were transferred to Arcview software. Analyzing the topographic map, on arcview software was constructed on the database. The coordinate information on the upper-right hand corner of the analyzed picture was transferred to a descriptive file using UTM coordinate system and ED50 datum transformation. Pixel dimension and central coordinates were defined in this file.
After forming the map, editing the transformed forest boundary points the new forest cadastral map was produced. In the following figure, a general view of GIS database produced in Arcview software is presented (Figure 2).

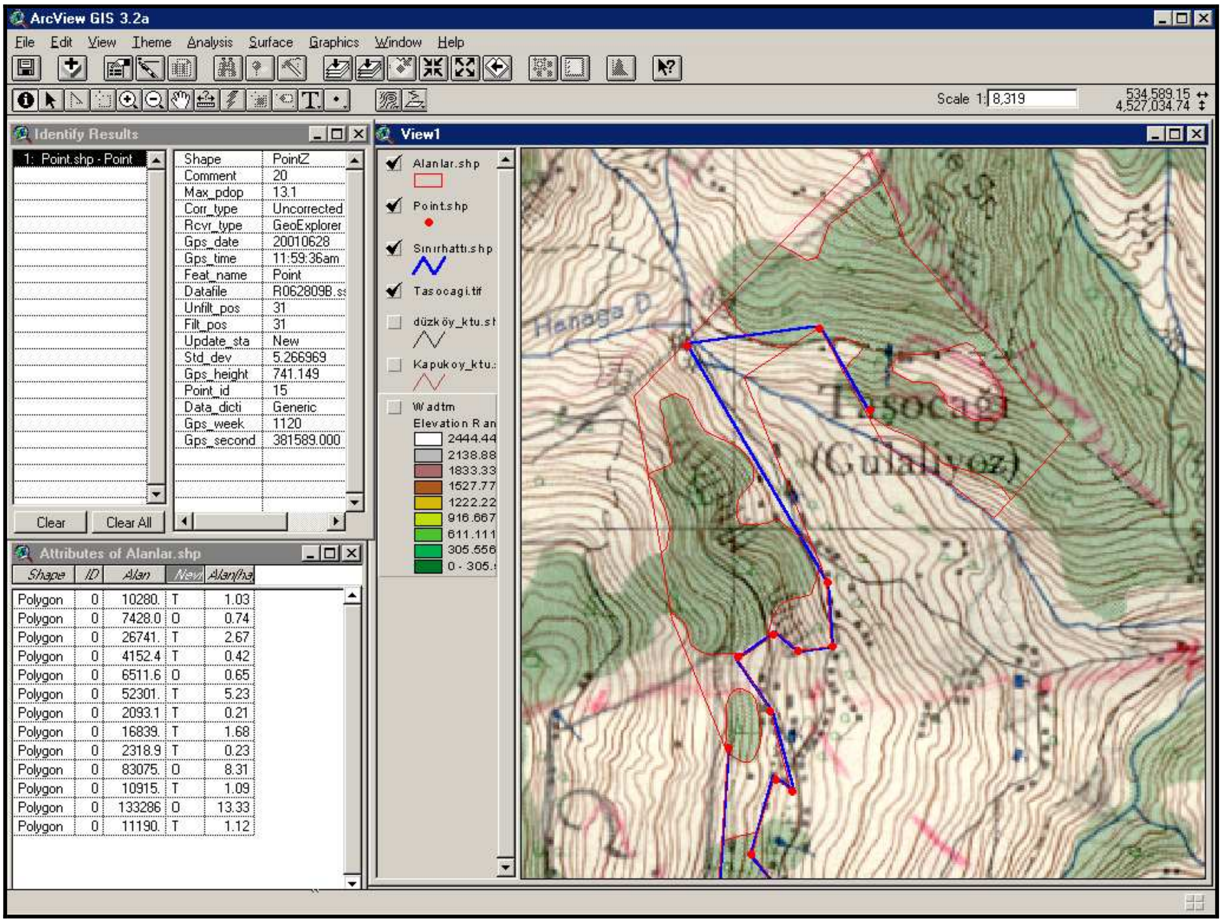

Figure 2 Arcview GIS graphic and self-quality database.

3. FINDINGS

Figure 3 presents the point of Tasocagı Village forest cadastral map showing the 18th and 33rd forest boundary points and produced as the conclusion of the surveys conducted on land surface with Trimble Goe Explorer III GPS receiver transferring the data related to the forest boundary points to topographic maps.

In this study, a comparison between and evaluation of the cadastral map made by the commission and the one produced after the survey on the numeric grants is made.

To serve this purpose, with the closure of the polygon between the surveyed 18th and 33 rd forest boundary points, a forest-border drawing was made possible. Depending upon this information, a questioning was made on the database of this area, which was defined as the states forest land.

It was determined that there was a private property of forestland of 13.68 ha in the total land area of 36.71 ha defined as the state forest land by the cadastral commission. To make this determination, we used topographic map information.

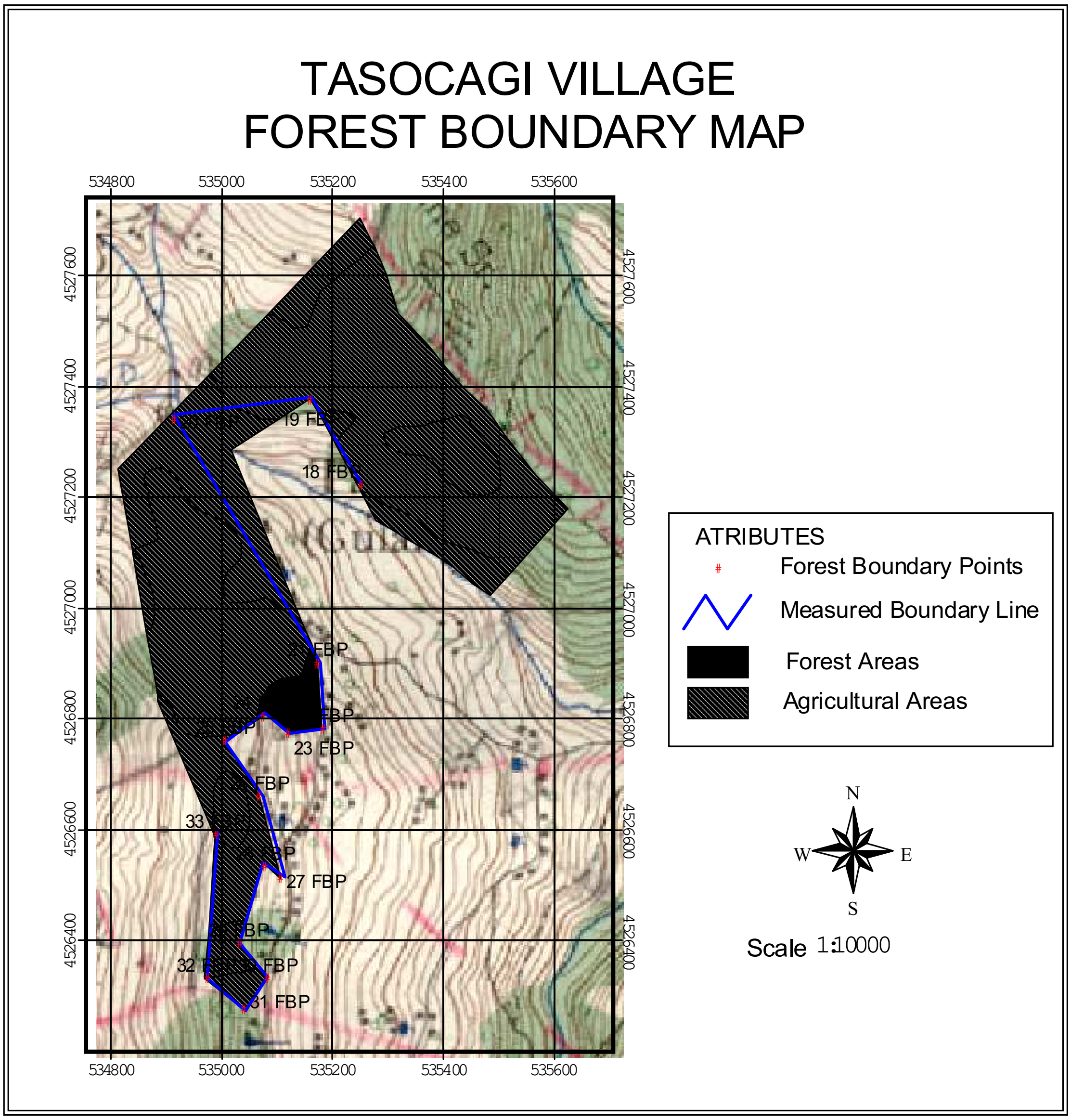

Figure 3. Numeric (Quantitative) Forest Cadastral Map made on GIS ground.

It was found that the no 20-forest boundary point fixed on the land surface had been positioned wrongly on the topographic map during the process of mapping. In terms of the methodology used in this study, all the coordinate information gathered by GPS was accurately and automatically transferred to the numeric maps. In this way, it is possible to eliminate any errors during the process of drawing the forest boundaries

4. RESULTS AND DISCUSSIONS

It has been concluded that GPS data can be used in accordance with the international standards in the Black sea forests.

Using GPS receivers and free static measurement techniques, it is possible to obtain %95 accurate data below 10m lines. This value is valid and acceptable in forest cadastral surveys. There is no probability of making any errors in transferring the data gathered by GPS to GIS database. This activity is conducted very rapidly and completely under numerical conditions.

The introduction of the maps analyzed thoroughly on the database according to the coordinate system seems to be very easy. That is, in Turkey the surveyors have the opportunity to scan the paper-printed topographic maps used as base for cadastral activity and then to introduce them on the GIS database very easily.

Area (square), length other measures in the GIS numerical database are considerably easy. Meanwhile, updating the data is not problematic and not expensive. This study shows that the combination of GIS and GPS activities play a crucial role in developing the surveys of the boundary points and making and duplicating forest cadastral maps. This approach provides without any difficulties a number of advantages for those who work on woodlands.

It is considered to be necessary to use the integration of GIS and GPS to prepare forest cadastral maps. In terms of this system, details like scale changes, map updating, and coordinate-value determinations are conducted accurately, easily and very rapidly. Apart from this, painting, some special signs, maximizing and minimizing and duplicating could be achieved easily and rapidly.

General Directorate of Forest has started some pilot studies in cadastral activities to integrate GPS and GIS facilities. It is necessary to make these studies wide spread and complete the work of forest cadastre throughout the country.

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