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## **The Role of Photogrammetry and Remote Sensing on Determining the Forest Boundaries and Unauthorized Buildings in Turkey (A Sample Area: Beykoz (İstanbul))**

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### ***Abstract***

*The 26% (201,992.96 km<sup>2</sup>) of Turkey's land area is (769,604 km<sup>2</sup>) covered by forests. It has been possible to determine the boundaries of 4/5 of the forests of Turkey in 66 years by forest cadastre which was introduced in 1937. But only 1/4 of the demarcated area could be registered into the land registry. Forests are occupied by unauthorized buildings and squatters as a result of creeping operations. Between the years of 1937 and 2003, an area of 4734.19 km<sup>2</sup> has been reassigned as nonforest area because of loosing its forest characteristics. The advantages of remote sensing and photogrammetry technologies have not been taken sufficiently in forestry cadastral works.*

*The forests located in the north of İstanbul, which is a very large city, serve as the lungs of the city. Especially after the recent earthquake experienced in "MARMARA" Region, the pressure on forests has increased because of the jeopardy created by the descending ground. In this study, Beykoz, which is one of the 32 townships of İstanbul Province and located in the north of the city with 313km<sup>2</sup> of area, 80 % of which is covered by forests, has been chosen as a sample area, and the condition of forests in this region has been analyzed.*

### **Keywords**

Forests, Urbanization, Squatter and Unauthorized Buildings, Cadastre and Registered Record, Forestry Cadastre, Photogrammetry, Remote Sensing

## **1. INTRODUCTION**

In Turkey, the "forestry cadastre" works and "ownership cadastre" works are carried out by different institutions and by using different technical (map production) standards.

The forestry cadastre, defined as "demarcation of forests and their registration into the land registry in the name of 'state' as a public property", is carried out in Turkey by forestry cadastral committees formed by five members appointed by the Ministry of Environment and Forestry. These committees functioning in subordination to the General Directorate of Forestry perform their works in accordance with the Forestry Law No. 6831 dated 1956 and the Implementation Regulation dated 11 April 1990.

In this paper, the reasons of not being successful in demarcation of forests and their invasion by unauthorized buildings have been studied by aerial photographs and photogrammetric data belonging to the township of Beykoz located within İstanbul Province.

## **2. SURVEYING TECHNIQUES USED IN TURKEY IN FORESTRY DEMARCATION**

In forestry cadastral works in Turkey, priority has been given to using the ground surveying methods (Regulation 2/B, Article 48). Although the Forestry Law No. 6831 stipulates that the aerial photographs required in forestry demarcation should be taken or cause to be taken by the Ministry of Environment and Forestry (Article 9), in the relevant Implementation Regulation it is stated that the photogrammetric method may be employed providing the forest boundary points or connection points are marked with “aerial signals” (Regulation 2/B, Article 48).

According to the Forestry Law and relevant Implementation Regulation, the techniques of forestry demarcation are as follows:

1. A forest boundary number shall be assigned to each point where the forest boundary line is interrupted. At the forest boundaries, a concrete or other similar stationary marker is placed at every 500 meters to establish the forest boundary points. In settlement area or in their surrounding areas, these points shall be established at every 250 meters (Regulation 2/B, Article 48),
2. In areas provided with a map of 1/5000 or greater scale, if the forest boundaries have been shown on the map, such boundaries shall be exactly complied with, without making any further surveying (Regulation 2/B, Article 48),
3. Where the forest boundaries coincide with the boundaries of a sea, lake, road or the like, no boundary point shall be established. (Regulation 2/B, Article 50),
4. The forest boundaries are measured by the series polygon polar method using instruments sensitive to 1<sup>c</sup>, and their coordinates are calculated with reference to the point of connection (Regulation 2/B, Article 51),
5. The forestry cadastral maps are prepared at a scale of 1/5000, and this scale is taken as a basis in the mapping standards used (Regulation 2/B, Article 52), and
6. The maps showing the forest boundaries are reduced to the scale of 1/25000 to obtain the township forestry maps, and all subsequent implementations shall be monitored on the basis of such maps (Regulation 2/B, Article 53).

If the forestry cadastral works were carried out according to the Regulation dated 31 August 1988 Concerning the Production of Large-scale Maps used in the ownership cadastral works, it would be required that;

1. The difference between the two measurements of edges made using electronic distance measuring instrument should not exceed  $\pm 5$  cm (Article 78),
2. The angle measurements should be made by instruments capable of direct measuring of at least 2<sup>cc</sup> (Article 52),
3. The root-mean-square error (RMSE) of angle measurements should not exceed  $\pm 5$  cm (Article 55), and
4. In works carried out using the photogrammetric method, the measurements be made by analytical plotting instruments having an analytical measurement accuracy of less than  $\pm 3$  micrometers (Article 186).

It is, therefore, seen that the methods of measurement and technical (mapping) standards employed in forestry cadastre require lower values as compared to ownership cadastre.

The forests which cover 26% of Turkey's total and area (201 992.96 km<sup>2</sup>) have been faced with invasions and illegal usage despite the protection provided by the provisions of Turkish Constitution and the Forestry Law. As a result, about 23% (4 374.19 Km<sup>2</sup>) of forests has been excluded from the forest land. The main reason why the forestry demarcation works have been unsuccessful is because the topic of forests has been frequently used as a material of political concern and also because of the changes experienced in the forestry laws. Another reason was the use of inadequate measurement techniques in the production of forestry maps. It has been observed "that the information belonging to the presumably demarcated forests were obtained using different surveying methods and different coordinate systems, that such information was not sufficient to effect a re-remarcation of forests in the field, and also that it was not possible to combine all that information under a single coordinate system.". It has been further recognized that such information and documents were not qualified as to enable the registration of forests into the land registry. It can also be said that the carrying out of the works related to the "**demarcation**" of forests and "**determination of their boundaries on the field (limitation)**" as well as "**the measurement of forest boundaries determined in the field**", "**computation**", "**plotting**" and "**staking out**" by the forest engineers since 1937 up to now has played a role in obtaining such results. This process has been brought to an end as a result of the amendment made in the Forestry Law by Law No. 4999 dated 05 November 2003 (Article 10), and it was decided that "with regard to forests whose cadastral works have been completed, the surveying engineers will be authorized and responsible for carrying out the works related to the production of maps, measurement, computation, plotting and staking out". Important developments are anticipated in determining the boundaries of forests and the unauthorized buildings as a result of taking such a decision after 66 years that the forestry maps will be produced by surveying engineers. We may say that, by also making use of photogrammetric and remote sensing techniques, successful results will be achieved in ensuring the security of forests.

### **3. DOCUMENTS TAKEN AS A BASIS IN DETERMINING THE BOUNDARIES OF FORESTS IN TURKEY**

#### **3.1. Procedure of Demarcation and Documents used**

In areas where forestry demarcation has not been realized, the forestry characteristics and legal status of a particular piece of land must be decided on in accordance with the Laws No. 3116, No. 4785, and No. 5658. The Law No. 3116 dated 1937 had defined only the forests belonging to the State. Then all forests were nationalized by Law No. 4785 dated 1945, but by a subsequent law, namely the Law No.. 5658 dated 1950, some of the nationalized forests were returned to their former owners. The Law No. 3116 was the first law stipulating the realization of cadastral works for state forests, while a number of laws introduced later, namely the Laws No. 4785, No. 6381, dated 1956, No. 2896 dated 1983 and No. 3302 dated 1986, enabled the remaking of forestry cadastre in a study area (SINMAZ and KARATAŞ, 1995: 50).

With every change of law, a redetermination of areas qualified as a forest land or not we carried out. The lack of maps and aerial photographs at the time of these works hindered the cadastral activities. The forestry cadastral studies were traced back down to the year 1937, trying to determine wheter a particular area was qualified as a forest land or not starting from that date, and this practice had an unfavorable effect on demarcation works.

Before starting to carry out the forestry cadastre of a particular area, the necessary information and documents are obtained from the following organizations and authorities:

1. State Forestry Enterprise Directorships,
2. Cadastre and Land Registry Directorships, and,
3. Highest Civil Authorities in Provinces and Townships.

After obtaining the necessary information and documents, the documents furnished by relevant persons for areas within the forests or in the neighborhood are examined. The examination of these documents furnished by individuals for determination of ownership is another factor causing a delay in realization of forestry cadastral works. The maps of forests whose cadastral works have been completed are then signed by the Chairman of the Committee, and the protocols prepared are announced to the public for a period of 6 months. An application may be made to the appointed Court within 6 months from the date of said announcement, to raise an objection to the protocols and decisions taken with regard to demarcation. Said period is defined as the “period of forfeiture”. The cases of objection are brought against the Ministry of Environment and Forestry and the General Directorate of Forestry. Following the completion of cadastral works, the files relevant to these works are forwarded to the General Directorate of Forestry for correction of any “**formal and legal shortcomings**”, and after such corrections are made, the decisions taken are put into implementation with the approval of relevant Governor. The forests belonging to the State, whose ownership has become final by completion of their cadastral works, are then registered into the land registry in the name of Treasury, by the Cadastre and Land Registry Directorships without collection of any fees, taxes or duties.

In the Forestry Law, Implementation Regulation and judicial decisions, the “**base maps**” “**aerial photographs**” and “**‘Amenagement’ plans**” are considered as final evidence in disputes related to forests.

### **3.1.1. Base Maps**

The term defined in the Forestry Law as base maps with a scale of 1/25 000 and larger means “the maps having a scale of 1/25 000 and 1/5 000, because when we examine the mapping services in our country with respect to scales and purposes, we observe that two series of maps are produced as based on our national geodetic network. These are 1) maps with a scale of 1/25 000 and 2) maps with a scale of 1/5 000.

- **Maps with a scale of 1/25 000:** Upon declaration of Republic of Turkey (29 October 1923), these maps were started to be produced by the General Command of Mapping, with the purpose of first the defense of the country, and were completed with the production of 5547 maps covering the whole Turkey.
- **Maps with a Scale of 1/5 000:** These maps are produced by the General Command of Mapping and the General Directorate of Land Registry and Cadastre using the photogrammetric method, to cover a large area of 500 thousand square kilometers.

### **3.1.2. Aerial Photographs**

The term defined as “aerial photograph” in the Forestry Law and judicial decisions means “the photographs used in the production of maps with a scale of 1/25 000 and 1/5 000”.

### **3.1.3. ‘Amenagement’ Maps**

The term ‘amenagement’ is specific to the forestry sector. The process of planning the operations of forestry enterprises is called the “‘amenagement’ plan” in the language of forestry (SINMAZ and KARTATAŞ, 1995:83). The use of an ‘amenagement’ plan, will ensure the proper organization of forestry enterprises so that they will operate according to a plan.

## **3.2. Evaluation of Documents used in Determining the Forest Boundaries**

In disputes related to forests in Turkey, an 'amenagement' plan alone is not sufficient to indicate whether an immovable is qualified as a forest or not. In addition to it, an old dated base map or aerial photographs must also be used. The term "base map", which is considered as a final evidence in the Forestry Law and relevant Regulation as well as in judicial decisions, is not used correctly. The judicial decisions stating that the forest boundaries are determined "by application of a base map with a scale of 1/25 000" are incorrect from a technical point of view. The marking of forest boundaries on a map of 1/25 000 scale is contrary to the cadastral technical standards. Such practices are not in agreement either with the technical standards stipulated in "**Regulation Concerning the Production of Large-scale Maps, dated 30 January 1988**", taken as basis in ownership cadastral works. Similarly, the evaluations such as "**in the event of a doubt regarding the prior qualification of an immovable in forestry disputes, the aerial photographs of that region should be used, and aerial photographs should be considered among indispensable evidences in forestry cases.**" are also wrong from a technical point of view. **In fact , it would be better to adopt the term "orthophoto map of 1/5 000 scale" instead of the term of aerial photograph, and the term "standard topographic map of 1/5 000 scale with cadastral overlay" instead of the term of base map.**

The use of inadequate surveying techniques and documents in forestry demarcation activities prevents the registration of forests into the land registry with information so obtained. Such information and documents insufficient for registration into land registry create important problems.

The forestry remarcation works carried out by forestry cadastral committees but could not be registered into the land registry should be provided with an opportunity for implementation. With the amendment made in the Forestry Law No.6831 by Law No.4999 dated 05 November 2003, if any "**technical errors**" such as errors of area due to reasons other than changes in qualification and ownership, and arising from staking out, measurement, plotting and computations, are observed in areas whose forestry "**limitation**" or "**cadastre**" has been completed and become final by announcement, such errors are allowed to be corrected by the **forestry cadastral committees** , under the knowledge and supervision of General Directorate of Forestry This change realized in the Forestry Law after 66 years offers an important opportunity with regard to imparting registration capability to those remarcation documents which could not be registered into the land registry until now.

#### **4. A SAMPLE AREA: BEYKOZ (ISTANBUL)**

With regard to preservation and ensuring the security of forests and other vegetative cover in our country, the town of Beykoz (İstanbul) is considered as the first area requiring the taking of necessary measurements in this respect (DİE 2003). There are many reasons for this.

About 1/5 (36km<sup>2</sup>) of areas excluded from forest area in İstanbul is located in Beykoz township, known as one of the lungs of the city. The destruction of forests in İstanbul is concentrated in the northern part where the township of Beykoz is also located. The building of second Bosphorus Bridge (Fatih Sultan Bridge), and also the announcement of Beykoz as a safe area with regard to soil structure after the occurrence of Marmara Earthquake have acted as accelerating factors on this process. The failures experienced in forestry remarcation works in Turkey is observed to have adverse effects on Beykoz (İstanbul), too.

Both the development and implementation of urbanization plans in Beykoz (İstanbul) have failed. Legal, technical and administrative measures need to be taken in order to stop the process leading to the destruction of forests, natural vegetative cover and green field.

The foremost technical measure required to be taken is to ensure the completion of Beykoz (İstanbul)'s ownership and forestry, cadastral works with no loss of time, and to determine the land use boundaries. To achieve this, the GPS, photogrammetry and remote sensing technologies must be put into service. When said technologies not taken advantage of until now are put into service, the

ensuring of control in management of land would be highly facilitated. It would be possible to detect and monitor the squatter houses and illegal buildings by making periodical observations. When the photogrammetric and remote sensing data are employed as a base in the stages of analysis of development and planning, it will be possible to solve the existing problems within relatively short time.

## 5. CONCLUSIONS

It must be kept in mind that the term of "cadastre" refers to a concept of "integrated recording system" for immovables. The separation of cadastre into parts, and then distributing the powers and authorities on the basis of such parts, but without establishing the required relationship between the parts, will yield nothing but failure in the realization of integrated benefit expected from cadastre.

The prerequisite of preserving and development of forest wealth on global scale on countrywide basis and at city level is to ensure the safeguarding of forest boundaries. Such safeguarding must be ensured by the use of proper markings placed on the land and also by provision of necessary documents. The sustainability of safeguarding may be realized only if such documents are produced according to the requirements of cadastral technique.

It is at this point that the mapping, the profession of determining the place-related data, and its methods enters into the picture. It is imperative that the cadastral works should be carried out using the contemporary technologies in order to remarcate the forests, and to preserve and develop them both in quality and quantity. For this purpose, any and all advanced technologies (total station, GPS, photogrammetry, remote sensing) should be employed, either singly or in combination, depending on specific local conditions.

We cannot be contented with merely the marking of forest boundaries and their surveying by the use of advanced technologies. In our days it is considered imperative that the efforts in this respect should be directed towards the information systems and geographical information systems based on such data. The forestry information systems to be set up for forest wealth should be established as a result of interdisciplinary studies. As for all of our natural wealth, our forest wealth, too, may only be preserved and developed as a result of healthy cooperation to be established, within the scope of the essence of their existence, between the disciplines concerned and other relevant disciplines.

The development of this awareness must be achieved on global scale.

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