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Evaluation of forest management plans in conjunction with the cadastral information: The case of Agva and Beykoz, Istanbul

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Abstract: Determination of land ownership and boundaries is one of the most important purposes of the urban and rural land laws. There can be some boundary problems while preparing forestry area of any urban area when there is not consistency between the borders constructed by different state organizations like land cadastre, forest cadastre and forest management and planning teams. This study aims to illustrate these conflicts in forestry applications process of two different areas (Ağva and Beykoz) having different characteristics. The study was carried out in Ağva and Beykoz districts in the province of Istanbul and focused on the integration in the land and forest cadastral systems. The Beykoz and Ağva Forest Planning Units have different characteristics in terms of population (urban and rural) and social impacts. Analyses of the data obtained from the field studies which it was utilized for the investigation of the data obtained from various base maps, were carried out using GIS software. Many inhabitants of the villages in the Ağva Planning Unit had migrated from the district. Thus, in accordance with Boundary Law number of 6831 part of 2/B some parcels of villages in Ağva were determined to be acting forest and were reassigned as forest land. In Beykoz, however, areas of this nature were few and the destruction of the forests was great. The spatial analysis of the study made it possible to remove discrepancies occurring in the cadastral situation by preparing forest management plans. Consequently, if land cadastre and forest cadastre units carry out work in coordination to determine the cadastral situation, a basis for forest management plans can be established and cadastral problems greatly reduced.

Keywords: Forestry, Forest cadastre, Istanbul, land cadastre, Law number 6831, GIS

Orman amenajman planlarıyla kadastro bilgilerinin birlikte değerlendirilmesi: Ağva ve Beykoz Örneği

Özet: Kentsel ve kırsal alanda arazi hukunun en önemli amaçlarından birisi arazilere ait mülkiyet ve sınırlarının doğru belirlenmesidir. Yerleşim alanlarına sınır teşkil eden ormanların kadastro haritalarının hazırlanmasındaki bazı problemler; genel arazi kadastrosu, orman kadastrosu ve orman amenajman ekipleri tarafından yapılan çalışmaların tutarsızlıklarından kaynaklanır. Bu çalışmada iki farklı özelliğe sahip (Ağva ve Beykoz) bölgede orman amenajman planlaması ve kadastral durumlar arasında oluşan çelişkileri belirlemek amaçlanmıştır. İstanbul İli Ağva ve Beykoz ilçelerinde gerçekleştirilen çalışmalar sonucunda genel arazi kadastrosu, orman kadastrosu ve orman amenajman planı verileri karşılaştırılmıştır. Beykoz ve Ağva Orman İşletme Üniteleri, sosyal (nüfus, kent ve kırsal) ve arazi kullanımı yönünden farklı özelliklere sahip alanlardır. Arazi çalışmaları ve altlık haritalardan sağlanan verilerin analizleri Coğrafi Bilgi Sistemleri (CBS) yazılımıyla sağlanmıştır. Ağva Orman İşletme Ünitesinde köylerden kente göç olmuştur. Bu nedenle 6831 Sayılı Orman Kanunu'nun 2B maddesine göre Ağva'daki köylere ait bazı parseller eylemli orman arazisi olarak ayrılmıştır. Beykoz'da sosyal özellikler sonucunda ormanların tahribi ise fazla olduğu görülmüştür. Çalışmada farklı kadastral verilerin eşzamanlı değerlendirilmesi ve CBS ortamında uygulanan konumsal analizlerle uyumsuzluklar giderilmiştir. Sonuç olarak, kadastral (mülkiyet) durumunun belirlenmesinde genel ve orman kadastro ekiplerinin birlikte çalışması, mülkiyete konu olan problemleri büyük ölçüde azaltmış ve orman amenajman planları için sağlam altlıklar oluşturmuştur.

Anahtar Kelimeler: Ormancılık, orman kadastrosu, İstanbul, alan kadastrosu, 6831 sayılı Orman Kanunu, CBS

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1. INTRODUCTION

A modern country requires both accurate urban and rural geospatial data which are basic components of national spatial data infrastructure (Kelmelis et al., 2003). Incremental update has long been studied as a mechanism for synchronizing geospatial datasets across organizational borders (Scheu et al., 2000; Cooper and Peled, 2001). Providing the most updated and accurate geographic information is one of the challenges faced by the GIS industry (Ding et al., 2004).

As an economic and ecological result of land cadastral systems, the interaction between human societies and natural resource management has raised environmental concerns. Forests are one of Turkey's important natural resources due to their numerous economic, ecological and social benefits, not only for the current generation but for future generations as well. The principle of sustainability has arisen from this approach with the aim of protecting, enlarging and improving the forest areas. The principle of sustainability in forestry has been put into practice by the work of forest management teams. The guarantee of forest boundaries is a prerequisite for the protection of forests. Without this discipline and control, it is difficult to discuss the protection of forests. In order to provide for the sustainability of forest areas, forest cadastre commissions and cadastre teams carry out studies to establish land registers provisioned by civil law for determining the boundaries, ownership and classifications of forests and non-forest areas. These studies can make it possible to transfer forests from generation to generation as a valuable trust for the benefit of the national economy.

In common with many European countries generated computerised cadastral maps using digitising techniques. In urban areas, survey control, field notes and field surveys were used to enlarge the number of control points and geometrical constraints. The derivation of digital cadastral maps from paper maps means that most of the features are represented at a graphical accuracy. This means that the digital cadastral map is subject to two different types of maintenance activities by the custodian, updates and upgrades (Scheu et al., 2000). Meanwhile, incremental update is becoming a trend for future spatial database update because it needs less data manipulation and requires shorter updating period also it is easy to store and transfer data (Cooper and Peled, 2001; Zhou et al., 2004; Chen et al., 2007).The land administration perspective includes the relationship of governmental and public lands with the ecosystem and agricultural, infrastructure and business systems. The cadastral focus has turned to human utilization and the degradation of natural areas as well as to sustainable green development and social equity (Williamson and Ting, 2001).

In some of the most populated cities in world, improvement in sustainable natural development has been achieved by integrating the ecological, economic, social, and cultural aspects of urban and rural development stages according to the long-term urban development perspective of UN Rio Conference Agenda 21 (UNEP, 1992). The success of these developments has increased regional, national and global interrelationships. Sustainable development requires effective cadastral laws to conserve natural areas. A participatory approach necessitates a partnership of stakeholders in sustainable development which includes governmental and social groups on different political levels in (Atkinson et al., 2004; Grunwald et al., 2006; Girardet, 2007; Weiland et al., 2011).

The 6831 Forest Law has listed the criteria for areas defined as forest lands. While the initial aim was to protect and develop the forest lands the second article of The Forest Law refers to the areas as "extracting some lands from the definition of forest land" as 2/B Areas. According to the Constitution and The Forest Law, 2/B Areas are: "a) the lands which lost the forest characteristic before 31.12.1981 in terms of science b) agricultural areas such as field, vineyard, garden, orchard, olive grove, hazelnut area, peanut area in the forest boundary, c) the lands in the forest boundary that are useful for livestock such as pasture, sheltered place, mountain pasture, d) settlement areas in the forest boundary which have the city, small town and village structures".

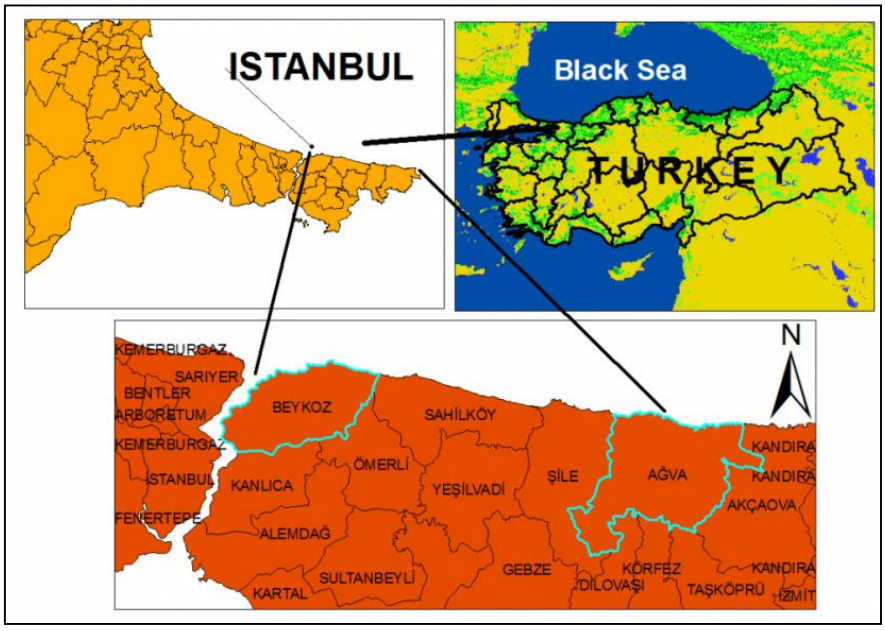
In order to take a land outside of the forest area the forest cadastre commission should determine the forest boundaries primarily. It means that firstly the boundaries of the forest in that place must be defined. This can only be possible if the general cadastre and the forest cadastre are realized at the same time. The

boundary of the villages is the cadastral working area in rural areas. If the cadastral working area consist any forest in it, General Directorate of Land Registry and Cadastre informs the General Directorate of Forestry just before two months ago from the beginning of cadastral studies. The studies are realized by forest cadastre teams in accordance with the provisions of Forest Law and Cadastre Law. The boundaries are drawn on sheets and maps by cadastre teams. Essentially, identifying the forest boundaries is not the concern of cadastre teams. Their basic aim of them is to determine the boundary of working area. As a result, extracting a land to outside of a forest to register on state or private owners is not the job of cadastres (surveying) teams. So, based on cadastral terms, forest areas can be analysed in three groups: a) the lands having forest cadastre, b) the lands having general land cadastre and c) the lands have forest management plans boundary. Urban and rural land use planning covers several phases, of which the legal (cadastral) ownership system is the starting point. The areas selected for this study were the districts of Beykoz and Ağva in Istanbul Province. The aim was to examine three different mapping systems, those of general land cadastre, forest cadastre and forest management planning, and to determine the social and spatial inconsistencies resulting from the different regulations upon which they were based and finally, to provide solutions for the problems occurring from these spatial differences.

2. MATERIAL

2.1 Study Areas

Beykoz is surrounded by the Kocaeli Peninsula, the Bosporus Strait and the Riva River. The Beykoz Forest Planning Unit is dominated by steep terrain with altitudes ranging from 0 to 240 m above sea level. The coordinates of the area are between 41° 07'- 41° 09' North and 29° 21' - 29° 05' East (Figure / Şekil 1). The mean annual temperature is 20.2 °C and the mean annual precipitation is 75.7 mm. As of 2010, forests covered 40% of the district, with dominant species being *Pinus pinaster, Castanea sativa, Fagus orientalis, Quercus* spp., and *Alnus* spp.. *Ağva* is located in the Sile Forest Planning Unit and is surrounded by the Kocaeli Peninsula and the Black Sea coast (Figure / Şekil 1). Ağva is characterized by steep terrain with altitudes ranging from 0 to 126 m above sea level. Forest covers 79% of the land and agricultural land makes up another 10%, with the remaining 11% consisting of other land types. Ağva coordinates are between 41° 12' - 41° 06' North and 29° 19'- 29° East (Guler, 2013).



Şekil 1. Çalışma alanları
Figure 1. Study areas

2.2 Digital Orthoimagery

Digital orthophotography has been used as a basic source of land information. It has been applied in our country coverage for multiple reasons, e.g., environmental monitoring, mapping, and update of existing maps since 1963. The digital orthophotos are used as the standard planimetric base for cadastral data survey and forestland mapping.

2.3 Forest Stand Type Maps

The spatial database, developed as a part of this study, consisted of forest stand type maps derived from remote Sensing data (aerial photographs and satellite images) and field survey. Aerial photographs of the study area were obtained from the General Directorate of Forestry (GDF), for the years 2009 (1:15,000 colour infrared aerial photographs), 0,50 meter resolution IKONOS images for the years 2009 and 1/5000 ortophoto high resolution images for the years 1996. Forest stand type maps, generated through aerial photographs and field survey data were also gathered from the GDF database. All vector data was generated and processed using a Geographic Information System (ArcGIS 9.3). Accuracy of spatial database was about 0.50 meters (Çakır, 2006).

The aim of digital forest mapping process is to develop forestland database and related Forest Maps as a final product. A Forest Map combines the reference background orthoimage with the boundaries of forestlands along with their characterization. The boundaries of current forestlands are delineated on the recent orthophoto dataset based on recent aerial stereoscopic photointerpretation and field controls.

2.4 Cadastral vector data generation

The cadastral maps of the villages obtained from the Forest Cadastral Commission in Düzce Forest Enterprise were scanned and converted to vector format in NETCAD 5.0 GIS environment. Vector cadastral maps and forest management plan maps (stand type maps) were combined with attribute data. The features such as urban, rural, forest, non-forest etc. were digitized as polygon features. Spatial database was geo-linked by integrated with cadaster data and converted into *.shp/*.dxf file format. The quality assurance was complying with the all accuracy such as positional, attribute and logical consistency. Total area of the villages obtained by aggregating the parcels, etc. was compared with the area available with the GIS Land Records. Analyses of the different mapping studies were carried out using NETCAD 5.0 GIS at the 134th Forest Cadastral Commission in the Düzce Forest Enterprise and ArcGIS 9.3 in the Department of Forest Management and Planning at Düzce University Faculty of Forestry.

2.5 Field Survey

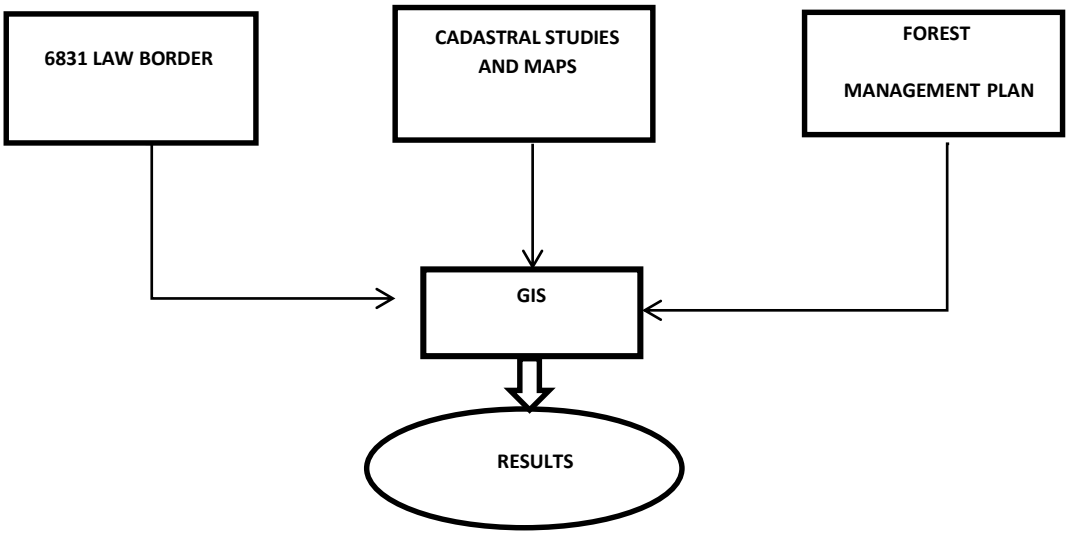
Field studies were carried out by the support of Forest Department officials to locate and draw cadastral forest boundaries using field GPS data (Garmin GPS receiver accuracy 10 centimetre) and photogrammetric techniques in 2012.

3. METHODS

Several data sets were used to realize the study. These are as follows; (a) 2009 satellite imagery were used as the base data sources. High resolution IKONOS panchromatic satellite images has a 0.50 m resolution and colour images of 1.86 m accuracy that was acquired for study areas in 25/01/2009. (b) Cadastral Map of the study areas were collected from Duzce Forest Enterprise Cadastral Teams and used to generate cadastral planimetric vector data. These maps were then georeferenced and overlaid on the satellite imagery for further analyses. (c) **Forest stand type maps** were provided from Istanbul Forest Enterprise. (d) 1/5000 scale orthophotos. e) 1/5000 scale photogrammetric maps f) 1/25000 scale **topographic maps** and g) field survey with Garmin GPS receiver to collect data about Ground Control Points (GCP). All data were converted to the UTM European1950 35th zone geographic projection system.

There were selected for these study 5 villages in Beykoz and 9 villages in Ağva. In the selected villages, the cadastral situation displayed different characteristics in terms of social impacts. In the Ağva villages, all cadastral work had been completed such as land registry and cadastre, forest cadastre, and forest management plans. Those data were evaluated and overlaid using various databases. The situation in Beykoz exhibited rapid urbanization, intensive social pressure and more encroachment into the forest openings. On the other hand, in Ağva, only moderate social pressure for urbanization was evident and much of the land was returning to forestry area. All data was overlaid, analysed and mapped in GIS (ArcInfo 9.3 TM) software.

According to the forest boundary points of parcels registered in the forest cadastral survey based on article 2/B of Forest Law were found on land in one of the study areas. In the past, some technical mistakes had been made as a result of using forest cadastral maps along with maps drawn up after surveys done at different times. By using the information obtained from all the relevant documents, the incompatibilities were corrected. Wooded areas within reassigned forest boundary lines were identified and designated as acting forest (Figure / Şekil 2). The general workflow of the study was developed by reviewing the literature, evaluating field studies and analysing the data obtained from various base maps.



Şekil 2. İş akış planı
Figure 2. Workflow of the study

4. RESULTS AND DISCUSSION

In both of the study areas, Land Cadaster Law # of 766 applications was utilized. Land conditions were separated into two types: registered areas and unregistered areas. The total area of the villages in Ağva was determined as 7697.96 ha and in Beykoz, as 2687.67 ha. As shown in Table / Tablo 1, the registered areas in Ağva totaled 2041.02 ha, and 5656.94 ha (5470.30 forest and 186.64 ha other) were found to be unregistered. In Beykoz, according to Law # of 766, 77.01 ha were registered and an area of 2610.66 ha was unregistered. In Ağva, according to forest cadastral data, agricultural areas consisted of 2179.45 ha and forest areas of 5191.41 ha (Table / Tablo 1).

According to forest cadastral data, 327.10 ha of the forest area were covered by the article 2/B of Forest Law. An additional 551.08 ha were also determined to be subject to the article 2/B of Forest Law. Thus, only 327.10 ha of this area conformed to the 2/B laws. In Beykoz, 42.09 ha were agriculture areas and 2094.50 ha forest areas. As a result of the cadastral surveys, more areas were designated as agricultural areas in Ağva, while in Beykoz, the agricultural areas were decreased. A total of 26.5% of the land in Ağva

was registered, while only 2.9% of land was registered in Beykoz. This situation can be attributed to the presence of more residential areas in Ağva (Table / Tablo 1).

Tablo 1. Ağva ve Beykoz'da kadastral durumun karşılaştırılması
Table 1. Comparison of the cadastral situation in Ağva and Beykoz

	AĞVA	Land Cadaster (ha)			Total
		Registered	Unregistered		
			Forest	Other	
Forest Cadaster	**Forest**	-	5191.41	-	5191.41
	2/B	48.21	278.89		327.10
	Agricul-ture	1992.81		186.64	2179.45
	Total	2041.02	5470.30	186.64	7697.96

	BEYKOZ	Land Cadaster (ha)		Total
		Registered	Unregistered	
			Forest	
Forest Cadaster	**Forest**	-	2094.50	2094.50
	2/B	34.92	516.16	551.08
	Agricul-ture	42.09	-	42.09
	Total	77.01	2610.66	2687.67

These situations demonstrate that the determination of characteristics differed between the two study areas in terms of spatial restrictions. In villages belonging to the Ağva Planning Unit, an area of 137.4 ha was classified as agricultural in the forest management plans, with a finalized 1568.24 ha as forest areas. In the villages of the Beykoz Planning Unit, 132.79 ha were categorized as settlement and 9.16 ha as agricultural areas by forest management teams, with a finalized 1568.24 ha of forest area. In villages belonging to Ağva, 45.2 ha of a 55.92 ha area were previously defined as 2/B, but then returned to acting forest. These 45.2 ha were seen as agricultural land in the forest management plans. These types of areas in the Beykoz villages totaled 9.34 ha, 3.03 ha of which were listed as settlement and 0.67 ha agricultural on the forest management plans. In the Ağva villages, because of migration from the district, areas previously determined as 2/B were reclassified as forest. In the villages belonging to Beykoz, the areas of acting forest were relatively smaller and forest openings had been occupied by settlements (Table / Tablo 2 and 3).

Tablo 2. Beykoz'daki köyler için mevcut arazi kadastrosu ile orman amenajman planlarındaki durum karşılaştırılması
Table 2. Comparison of the current land registry situation with the forest management plans for the villages of Beykoz

	BEYKOZ	Situation of forest management plans (hectare)								Total
		SGY	KGY	SIY	KIY	Special Forest	ForOp	Setl.	Agr.	
Current Situation after land registry	**Forest**	992.78	298.92	63.50	17.28	20.87	32.94	132.79	9.16	**1568.24**
	2/B Law	29.11	25.51	1.30	0.81	3.06	8.90	395.03	8.88	**472.58**
	5831 Law Acting Forest area	4.28	1.34	-	-		-	3.03	0.67	**9.34**
	Land registry	6.89	0.31	-	-	0.88	2.28	31.73	-	**42.09**
	Deed given-2/B Law area	14.29	-			0.33		13.70	6.60	**34.92**
	Special Forest	25.64	7.27	-	-	486.12	-	6.21	1.03	**526.26**
	2/B Law Special Forest	4.37	-			26.97		-	2.88	**34.24**
	Total	1077.36	333.34	64.80	18.08	538.23	44.12	582.49	29.22	**2687.67**

SGY: hardwood, KGY: mixed hardwood, SIY: softwood, KIY: mixed softwood, ForOp: Forest Opening, Setl: settlement, Agr: Agriculture B.H.: Energy Pipeline

Tablo 3. Ağva'daki köyler için mevcut arazi kadastrosu ile orman amenajman planlarındaki durum karşılaştırılması
Table 3. Comparison of the current land registry situation with the forest management plans for the villages of Ağva

	AĞVA	Situation of forest management plans (area hectare)									Total
		SGY	KGY	SIY	KIY	B.H	Water	Sandy	ForOp	Agr.	
Current Situation after land registry	**Forest**	584.75	4013.13	-	-	24.99	8.69	7.15	415.45	137.24	**5191.40**
	2/B Law	1.16	5.43	-	-	1.32	-	-	10.74	204.33	**222.98**
	5831 Law Acting Forest area	1.14	4.63	-	-	-	0.81	-	4.14	45.20	**55.92**
	Deed given-2/B Law area	-	0.27	-	-	-	-	-	-	47.94	**48.21**
	Land Registry	0.67	4.55	-	-	-	7.53	-	6.18	1973.87	**1992.80**
	Sandy area	-	-	-	-	-	-	0.17	-	15.75	**15.92**
	Unregistered	0.47	7.08	-	-	-	-	-	8.21	154.97	**170.73**
	Total	588.19	4035.09	-	-	26.31	17.03	7.32	444.72	2579.3	**7697.96**

SGY: hardwood, KGY: mixed hardwood, SIY: softwood, KIY: mixed softwood, ForOp: Forest Opening, Setl: settlement, Agr: Agriculture B.H.: Energy Pipeline

5. CONCLUSION

The trend toward ownership mapping has proven important in the achievement of dynamic land use changes for sustainable environmental development (Ting and Williamson, 1999). The cadastral situation must be considered when preparing forest management plans in order to remove the spatial or areal incompatibilities. Both forested and non-forest areas in Turkey can benefit from operating e-governmental applications, making optimal plans and applying decisions without encountering legal difficulties (Guler, 2013; Çakır, 2006). This can be achieved by setting the spatial relations and finishing the cadastre registration of unregistered areas. In addition, problems can be further decreased if land and forest cadastre teams work in coordination to determine the cadastral situation which will form the base for planning. By providing the required information and documents, forest cadastre commissions can help improve decision-making in the classification of areas. In order to provide accurate information about the cadastral situation, previous cadastre applications must be carefully evaluated and village boundary lines allocated without leaving any gaps in the area. The cadastre applications which are not yet completed need to be finished immediately. The various forest enterprises along with the General Directorate of Forestry must give increased importance to their archives and keep them updated. Forest cadastre commissions should be supported by qualified personnel having background in the technical and legal extents of the land cadastre.

Such an updating may be implemented with a predefined periodic cycle (annually or multi-annually) or on the basis of an on-demand service (Cooper and Peled, 2001). Many updating projects have been using remote sensed data at high resolution in topographic data updating (Holland et al., 2006), land use updating (Malinverni et al., 2011).

Recently, emphasis has been given to the importance of cadastral land administration, as the current use of Information Systems requires a more detailed national land administration infrastructure in all countries (Williamson, 2001). A good forest management plan can be prepared for registering all land use types. This infrastructure will benefit landowners as well as promote more efficient government land usage.

Forest Information System refers to the process of generating geospatial data, sharing of spatial information about forestlands and their associated resources and management activities, for their sustainable management. Current study was done to prepare the forest cadastre map of Ağva and Beykoz using high resolution remote sensing data and GPS survey to compare with existing general cadastre data and stand type maps which also show the borders of forests and other land uses. This study illustrates the development

of geospatial infrastructure for assessment and monitoring of forestlands and their resources to develop transparency in forestland administration that support better decision and policy making and suggests using forest cadastre maps in delineating the borders of any planning unit to prevent any further ownership conflicts.

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