

**Makale
(Article)**

The Cadastral Maps Used in Turkey and The Renewal of These Maps

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Abstract

In our country, cadastral studies are performed by TKGM and changes that have been occurring after completion of cadastre are updated by Cadastre Directorate in line to request of related parties. However, changes which have been already carried out on the ground have not been reflected to cadastre sheets while there are not any requests. So that, cadastre sheets using currently are technically insufficient against the development of technologies, inapplicable and are starting to no longer reflect the ground. In the future respective of cadastre, making suitable cadastre sheets to recent conditions and current technologies, in other words necessity of renovation, keeping up to date of cadastre sheets have been arise out. With this respect in the study, the Cadastre sheets which had been lost actuality and insufficient had been examined in detail of TKGM's usage in the renovation studies and, the cadastre sheets which are produced in our country had been evaluated on technical and legal perspectives. The renovation studies for cadastre sheets in Eskişehir province had been handled as of the pilot implementation area. 57,000,000 parcels have been produced by TKGM up today. In the result of review and evaluations which have been done by, at the first stage 8,100,000 parcels had been decided to renovate urgently.

Keywords : Cadastre, Cadastral map, Renewal of cadastral map

Türkiye’de Kullanılan Kadastral Haritalar ve Bu Haritaların Yenilenmesi

Özet

Ülkemizde kadastro çalışmaları Tapu ve Kadastro Genel Müdürlüğü (TKGM) tarafından yürütülmekte, kadastro sonrası meydana gelen değişiklikler ilgililerin talepleri üzerine kadastro müdürlüğünce güncellenmektedir. Ancak zeminde fiilen gerçekleştirilen değişiklikler talep olmadığı sürece kadastro paftasına yansıtılmamaktadır. Bu nedenle günümüzde kullanılan kadastro paftaları gelişen teknoloji karşısında teknik yönden yetersiz kalmış, uygulama niteliğini kaybetmiş ve artık kadastro haritaları zemini yansıtmamaya başlamıştır. Kadastronun geleceği açısından, güncelliğini yitirmiş kadastro haritalarının günümüz koşullarına ve teknolojiye uygun hale getirilmesi, güncelliğini koruması, başka bir ifadeyle yenilenmesi gerekliliği ortaya çıkmıştır. Bu çalışmada, ülkemizde üretilen kadastro haritaları teknik ve hukuki açıdan değerlendirilmiş; yetersiz ve güncelliğini yitirmiş kadastro paftalarının TKGM’ce yapılan yenileme çalışmalarında kullanılabilirliği detaylıca incelenmiştir. Örnek uygulama alanı olarak Eskişehir ilinde yapılan kadastro paftalarının yenilenmesi çalışmaları ele alınmıştır. TKGM tarafından bu güne kadar yaklaşık olarak 57.000.000 parsel üretilmiştir. Yapılan inceleme ve araştırmalar sonucunda acil olarak 8.100.000 parselin ilk etapta yenilenmesine karar verilmiştir.

Anahtar Kelimeler: Kadastro, Kadastral harita, Kadastral haritaların yenilenmesi

Bu makaleye atıf yapmak için

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1. INTRODUCTION

Maps produced by cadastral work are used for the preparation and implementation of zoning plans, expropriation and engineering services. To serve as a basis for these works, cadastral maps should be produced in line with today’s technology and requirements. Cadastral maps produced in previous years cannot address to the needs of today as they lack technical adequacy and as they were produced to address to the needs of their time. For this reason, cadastral maps need to be updated, in other words, be renewed, to address to today’s technology and conditions. Following the completion stage of Turkey’s cadastre, all types of information system studies were given priority, which gave rise to the need of renewing previous cadastral maps according to today’s technology.

2. CADASTRE IN TURKEY

In Turkey, cadastral services were started and implemented to produce modern title deed registries stipulated by the Turkish Civil Code by producing maps through the identification of boundaries of properties on lands and related rights. As per Cadastral Law no 3402, cadastral services are provided by cadastral technicians (public servants) in provincial cadastral directorates and by a team consisting of minimum three experts and village headman elected by village association or municipal assembly within the study area, where cadastral study will be conducted. However, following the enactment of law no 5304 within the scope of Emergency Action Plan, cadastral works began to be carried out through service procurement from the private sector. Cadastral works in Turkey are at the stage of completion. Table 1 presents the status of cadastre in Turkey as of the end of 2012.

Table 1. Status of Cadastre in Turkey (www.tkgm.gov.tr)

Total Unit		Completed		Continuing		Problematic	
District	Village	District	Village	District	Village	District	Village
17753	34686	17666	33928	56	402	31	356
52439		51594		458		387	
		98.39%		0.87%		%0.74	

Distribution of cadastral maps produced by cadastral works in Turkey according to measurement systems is presented in Table 2; distribution of maps according to coordinate systems is presented in Table 3.

Table 2. Cadastral maps according to measurement systems (www.tkgm.gov.tr)

Measurement Method	Number of	Percentage
Prismatic	49955	7.84
Graphic	106371	17.05
Digital	258802	40.29
Classical	32713	5.02
Photogrammetric	79344	12.98
Polar	99905	15.45
Photoplan	627	0.10
Tachometric	8463	1.27
Total	636180	100

Table 3. Cadastral maps according to coordinate systems (www.tkgm.gov.tr)

Coordinate System	Number of Sheet	Percentage
ITRF	113607	17.86
French	20	0.00
Regional	93910	14.76
Country (ED50)	319312	50.19
No coordinate	109331	17.19
Total	636180	100

3. TYPES OF CADASTRAL MAP USED IN TURKEY

3.1 Graphic Maps

These maps are produced according to geodetic measurement methods without any coordinate system until 1970. Sheet size is variable; they are drawn on paper and cardboard (Figure 1). Classical drawing tools were used to draw the maps. The point positioning accuracy of these maps, which are generally produced in urban areas, is approximately ± 2 meters.

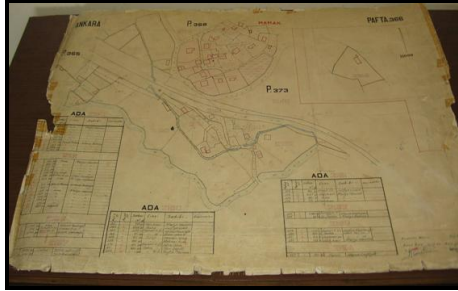


Figure 1. Graphic sheet sample (www.tkgm.gov.tr)

3.2 Photoplan Maps

These maps are produced from partly debugged aerial photos. They are approximately 1:5000 scaled maps, with a sheet size in the form of 50x70 cm photos. The point positioning accuracy of these maps is approximately ± 5 meters. Lots of detail data disappear from the map due to deterioration in the emulsion substance of the photograph (Figure 2).



Figure 2. Photoplan sheet sample (www.tkgm.gov.tr)

3.3 Photogrammetric Maps

These maps are produced after 1955 according to ED50 datum and contain standard sheet sections. Deficiencies of the maps produced from aerial photos associated with ground control points were completed with geodetic measurements. Sheets are produced in country coordinate system and transparent and in the form of non-changing dimension. They are generally used to map rural areas (Figure 3).

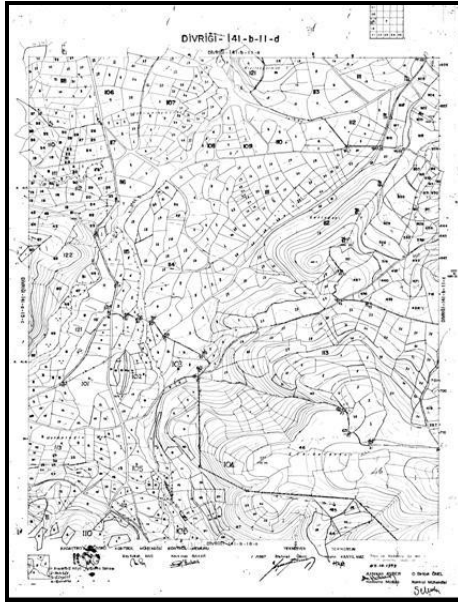


Figure 3. Photogrammetric sheet sample (www.tkgm.gov.tr)

3.4 Maps Produced by Classical Measurement Method

These maps are generally produced by using polar measurement methods according to ground control points on the local coordinate system. They are drawn on transparent or cardboard bases. Ground control points are transferred to the map according to coordinates, while detail points are transferred to the map according to control points (Figure 4).

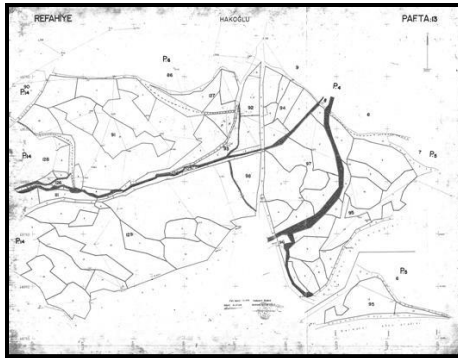


Figure 4. Sheet sample produced with classical measurement method (www.tkgm.gov.tr)

3.5 Maps Produced by Prismatic Measurement Method

These maps are generally produced in areas with excessive housing, on the local coordinate system, using prismatic measurement methods. Sheet bases are aluminum, transparent substances or cardboard. Ground control points are transferred to the map according to coordinates while detail points are transferred to the map according to ground control points using classical drawing tools (Figure 5).



Figure 5. Sheet sample produced by prismatic measurement method (www.tkgm.gov.tr)

3.5 Digital Maps

These maps are produced on the country coordinate system according to ground control points and giving coordinate to detail points. Generally polyester materials are used as a sheet bases. They are drawn by computer assisted map drawing methods (Figure 6).

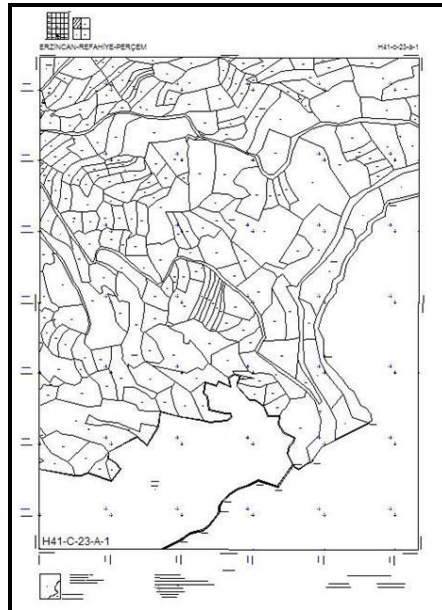


Figure 6. Digital Map sample (www.tkgm.gov.tr)

4. RENEWAL OF CADASTRE SHEETS

Cadastral maps produced until today don't make it possible to solve problems in technical terms and data quality isn't appropriate to form a parcel based information system. Today, the biggest problem of Turkish cadastre is that there is a wide variety of maps of different scale and coordinate systems, drawn to different types of bases using different production methods. To form cadaster information system in Turkey, parcel corner coordinates should be obtained by converting all linear maps into digital maps and permanent surface areas should be obtained according to these coordinates. Cadastral maps with the new

scope and content should be produced. It is foreseen that these maps should be produced in ED50 datum, in national sheet division system according to the principles of Gauss Kruger projection in digital format; they should be appropriate for storage and it should be possible to take output in the form of linear maps when requested.

Erkan (2001) defined renewal as “updating data and documents about constantly changing properties” and pointed out to the importance and maintenance of cadaster [1]. This definition has changed, particularly in the last 20 years. In modern countries, renewal is perceived as the works to prepare cadastre into an information system. A cadastral structure in the past should be adapted to the present qualities and needs [2]. In this context, in addition to updating the cadastre, works to identify data to be incorporated into the cadastral system at appropriate standards; association and presentation to users of data in an information system approach based on the possibilities of the country and future needs are considered as cadastral renewal [3].

5. THE USE OF ORTHOPHOTO MAPS IN RENEWAL WORKS

Orthophoto maps produced by photogrammetric methods are widely used today. Orthophoto images are photos with corrected distortions caused by flight altitude, camera lens and camera slants during photographic intake [4]. Orthophotos show all information, a photo shows. However, unlike a photo, they contain details that correlate topographic elements in linear maps and land use and land cover. In addition, thanks to their location accuracy, orthophoto maps can be used like a map to measure horizontal distance, angle, locating and area [5]. Orthophoto maps are increasingly used as data extracted from orthophoto images are an ideal base for Geographic Information Systems. Orthophoto maps can be obtained much faster and cheaper than maps produced with geodetic methods (Figure 7).

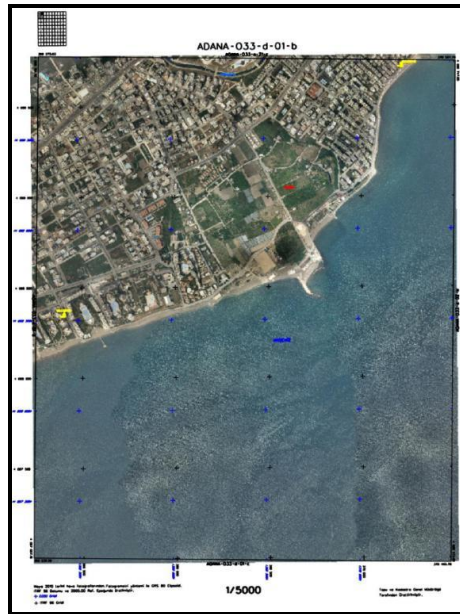


Figure 7. Orthophoto map

Studies for the renewal of cadastral maps using sheet-ground-measurement analysis using orthophoto maps will make it possible to conduct studies in all regions of the unit instead of a certain section of the area. Following sheet-ground-measurement analysis, the sketch, which will be added to application report, will be prepared in a more reliable manner and orthophoto maps will facilitate approvals for application. The use of orthophoto maps will accelerate the approval process for application and this will please the people, institutions and organizations how wait for renewal. Pre-study works will be made more accurately; cadastre team will conduct boundary detection works in the field in a more proper and fast manner. This will facilitate the duties of measurement team. In boundary detection sketches, which

used orthophoto maps, since detail points and details will be clearer, the measurement team will work in the field more comfortably. Ground status identified in cadastre and existing ground statuses are indicated in superpositions in Figure 8. Orthophoto maps reflect changes on the ground and utilization statuses exactly the same.

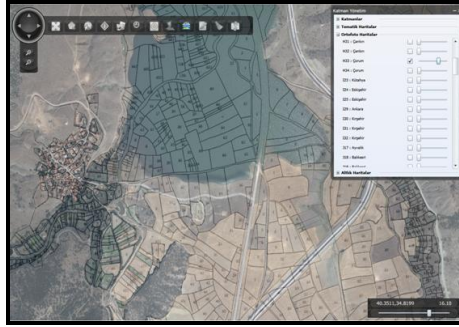


Figure 8. Orthophoto map

6. SAMPLES OF RENEWAL OF CADASTRAL MAPS

Due to the changes in existing boundary types in the land, as a sample to the renewal of cadastral maps, boundary detection and measurement works performed in application areas during cadastre works are indicated on an orthophoto map in Figure 9.



Figure 9. Superimposition of orthophoto map and cadaster

Renewal works for this region with different ground utilization status and cadastre detection were requested by the users. The next step for the renewal works was to purchase land to detect the final status and to determine boundary types. As indicated in Figure 10, the land which was determined as a single cadastre section during cadastral studies, was in fact used in such a way to divide in two cadastral sections. Boundary types were determined based on village headman specifications and available data and documents.



Figure 10. Usage status of orthophoto map and ground

As indicated in Figure 10, some boundaries of parcels no 3,4,5,6, which were detected during cadastre according to technical documents and information, however which were used in combination according to the current situation, were indicated in brown color as undefined boundaries. The outer boundaries of parcels no 7,8,9 were indicated in green color, as a boundary that can be considered as valid for neighboring boundaries, since they were constant and there was no disagreement between the parcels. Since the owners of parcels no 12,13 showed parcel boundaries differently and since there is a disagreement, these boundaries were indicated in red as disputed boundaries. Some boundaries of parcels no 1,3,9,10 were indicated in orange color as there was no problem in sheet and technical documents. On the other hand, the boundaries which are existing on the ground, however remain unchanged according to cadastre, title deed, amendment documents or expert reports were indicated in black color. In addition, the locations which were detected during the cadastre, however were not currently used are indicated in dashes and cadastral maps of this region were renewed.

In the study area which was selected as a sample of the studies for the renewal of cadastral maps produced by classical methods, cadastral works were completed in 1981. The first measurement works in the study area were completed by a prismatic method in urban areas and by tachometric methods in rural areas. Cadastral maps were digitized according to tachometric measurement and prismatic measurements and were converted into ITRF96 datum (Figure 11).

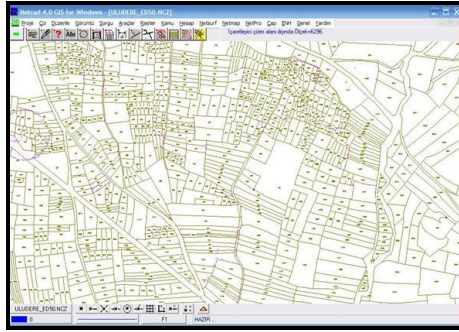


Figure 11. Digitization of the study area

New polygons established in the study area were measured by electronic devices in urban areas and by RTK or TUSAGA-Active system in rural areas (Figure 12).

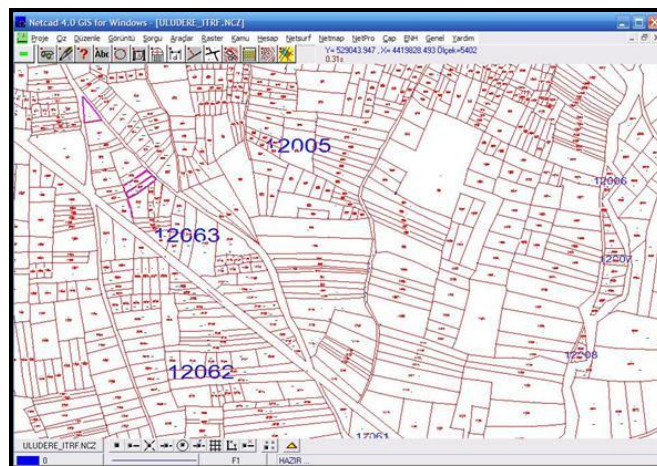


Figure 12. Ground measurement of the study area

Although the sheets were accurate in form, during the cadastre as a result of digitization and ground measurements, it was found that they were slanted and rotated as a coordinate and error was generally caused by drawing error. In addition, it was observed that tachometric measurements conducted in rural areas were performed at grad minute sensitivity using Wild T1 device and surveyor’s rod; while the

distance was measured at sensitivity of meter. Following the completion of necessary controls about performing procedures, orthophoto map obtained from the images taken in 2010 and measurements on the ground was superimposed (Figure 13). It was observed that there were certain differences in certain locations. It was found that these differences were between (0.3-1.5) m; however, these differences were not caused by errors in measurements in orthophoto maps or ground measurements. These types of differences were identified in boundaries made by plowing marks in field boundaries with no fixed boundary.

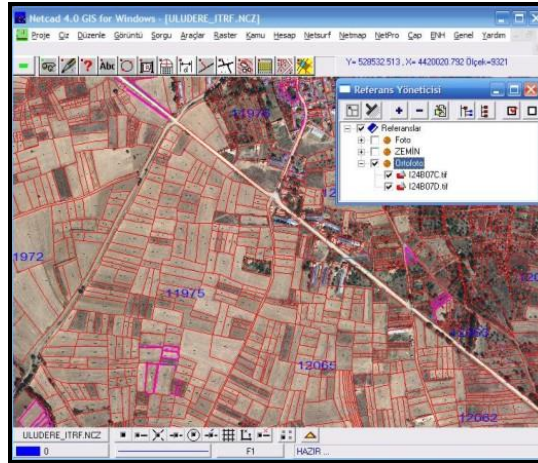


Figure 13. Superimposition of orthophoto map and ground measurement in study area

After this stage, the evaluation works started. Expert specifications, technical documents produced in cadastre and orthophoto maps were used in evaluation works. Analysis showed that field boundaries changed due to long years of plowing for agricultural purposes by the villagers in rural area. However, as field owners rejected the decreases particularly in title deed areas due to the differences in areas and to the changing boundaries which can be considered as “a valid boundary”, cadastral maps were renewed without using boundary type that can be valid for the study area [3].

7. RESULTS AND SUGGESTIONS

Cadastral works in Turkey are at the stage of completion. Following the completion of cadastre, it was understood that cadastral maps, which lost their quality of application; which are inadequate for technical reasons and which failed to show the boundaries in the ground accurately should be renewed. Cadastral maps produced in the past failed to address to the needs of today due to inadequate technical equipment, low number of trained personnel, long years of zoning plan applications and rapid urbanization.

Firstly, Renewal Law no 2859 and then article 22a of Cadastral Law no 3402 were implemented to renew outdated cadastral maps. Current studies are carried out as per article 3402/22.a. Both regulations which were enacted and implemented for the renewal of cadastral maps, in fact envisaged only technical corrections. In other words, they did not envisage corrections on ownership. Therefore, these arrangements fail to meet the needs. The evaluations for both arrangements are listed below:

- The principle aim of renewal works is to update cadastral maps and to eliminate unconformity.
- In renewal works, by entering the Republic of Turkey identity data, material errors like share errors will be corrected. In addition, it will be appropriate to make an arrangement that allows for inheritance to heirs.
- In renewal works, if the buildings and facilities registered in title deed records are present on the ground, detection is made according to actual situation.
- Measurement of the elevations of all points within the scope of renewal works, the need of other institutions for his data will be met.

In conclusion, it is inevitable to conduct cadastral works that contain the mentioned technical studies and envisage registration of underground and ground facilities. Comprehensive works envisaging the cadastre of all areas, which were left outside of detection in previous cadastral works, should be carried out and these works should be supported by a legal arrangement in such a way to form the infrastructure of spatial information systems.

8. REFERENCES

1. Erkan, H., 2001, “Kadastro Teknigi”, Chamber of Survey and Cadastre Engineers, Ankara (in Turkish).
2. Koen, L.A., 1987, “Conceptual and Legal Aspects of Cadastral Renovation. Ecole Polytechnique Federe de Lausanne”, Ecublens.
3. Caglar, O.S., 2013, “Cadastral maps types used in Turkey and renovation of this maps”, Master thesis, Afyon Kocatepe University (in Turkish).
4. Rossi, T.A., 2004, “Application of digital photogrammetric methods in the of land cover change on the coastal dunes of warren dunes state park”, Master thesis, The Michigan State University.
5. Smimard, P.G., 1997, “Accuracy of digital orthophotos”, Master thesis, The University of New Brunswick.