

STUDY OF USABILITY OF ORTHOPHOTO AND HIGH RESOLUTION SATELLITE IMAGES IN CADASTRE RENEWAL WORKS IN TURKEY

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EXTRACT

The fact that cadastre is a living phenomenon and it needs to be updated constantly has become even more apparent with recent technological developments. If the usability of especially orthophoto and high resolution satellite images in cadastre renewal works is ensured, the state cadastre can be maintained constantly updated.

For this purpose, 3 pilot areas in Konya, Adana and Şanlıurfa were selected. In these areas detail acquisition was made with Cors method by using GPS. The coordinates were obtained by using orthophotos of 1/1000 and 1/2000 scale in Konya, orthophotos of 1/5000 scale in Adana and WorldView-2 high resolution satellite images of 1/5000 scale in Şanlıurfa in Erdas program.

The positional accuracy of the data obtained from digital orthophoto and area accuracy in comparison with cadastral areas were attempted to be established by presuming that geodesic coordinates were accurate. Moreover, cost analyses of all three methods were carried out.

In light of the discovered results, comments on the usability of orthophoto and high definiton satellite images in renewal cadastre were made.

Keywords: Cadastre, renewal, orthophoto, high definiton satellite images

1.INTRODUCTION

Cadastre, in its simplest sense, is the establishment and demonstration of the geometric and legal status of real estates.

International Cadastre Association (FIG) defines cadastre as; “The information system which has a key function in the fulfillment of societal, cultural and economic development, guarantees the constitutional security of land and realty property rights, ensures the protection of various information on land and buildings.” (Anonymous, 2006).

In the 2014 cadastral report which has been adapted by all countries, the explanation “Cadastre is systematically organized public inventories of proprietary data of a state or an area boundaries of which have been established based on a scale. Legal land objects are systematically established with different indication meanings. This land object is defined by public or private law. The outlines of the real estate, meaning the properties, size, value and legal rights of each descriptive land object, are demonstrated by special data and limitations associated with land objects” was given as a definition (Yomralıoğlu et. al, 2003).

The amendment made in Law no. 5304 has not been implemented in accordance with the purpose aimed in 22-a implementations. With the amendment to the “a” clause of the 22th article, in this section which starts with the word “However” the fact that provision of the first subclause shall not be applied in registered and cadastral places to eliminate errors arising from limitation measurements, illustrations and calculations on “land registration” cadastre or amendment process, with the purpose of re-arranging and ensuring the necessary corrections are made in land registry of cadastral maps which have lost the implementation characteristics, are insufficient due to technical reasons, are deemed to be lacking and have been established to be inaccurate in terms of ground boundaries has been stated and an exceptional case has been indicated (Sarı, 2009).

The aim of the thesis is to put forth whether orthophoto and high resolution satellite images can be used in cadastre renewal works or not. With this purpose and purpose of comparing cost and area data, test areas were created. The details of test areas, Adana / Karataş/ Çakırören and Gökçeli districts (villages), Şanlıurfa/Akçakale/Deniz ve Aydınli districts (villages) and Konya /Selçuklu/ Dokuz and Aşağıpınarbaşı districts (villages) were measured with GPS (CORS method).

As the cadastre works in Turkey are generally done in rural areas, selected areas are also of rural nature. The lands selected in Adana / Karataş / Gökçeli and Çakırören are partially orange groves. Moreover, they are wetlands and have changed shape due to drainage works. The districts of Konya /Selçuklu/ Dokuz and Aşağıpınarbaşı are near to Selçuk University campus and are in a zone which is open to the influence of urbanization. Whereas Şanlıurfa /Akçakale / Deniz and Aydınli are in a zone which borders on Syria and of which agricultural activities and land values have increased, along with its irrigation activities, with Southeastern Anatolia Project (GAP).

Cadastral sheets of 1/1000, 1/2000 and 1/5000 scales were digitized, geodesic ground measurement was made, orthophoto vector data of 1/5000 scale and 1/5000 orthophoto 50 cm resolution satellite images (worldwiev -2) were worked with. Analyses were made by presuming geodesic measurements as accurate, comparing the data obtained with this method and data obtained from other methods and taking cadastre renewal and Large Scale Map and Map Information Production Regulation.

2. MATERIAL METHOD

Implementation zones in 3 different areas were selected to put forth whether orthophoto and high resolution satellite images can be used in cadastre renewal works.

These zones;

- 1- Adana province Karataş county Çakırören and Gökçeli districts
 - 2- Şanlıurfa province Akçakale county Deniz and Aydınli districts
 - 3- Konya province center county Dokuz and Aşağı Pınarbaşı districts
- areas in the size of blocks were selected.

About these zones:

- 1- Cadastral map sheets and scientific files were procured from Adana, Şanlıurfa and Konya Land Registry and Cadastre Directorates..
- 2- Orthophoto images of 1/5000 scale and vector maps of Adana-Karataş Area obtained from photogrammetric flights, orthophoto images of both 1/1000 and 1/2000 scale and vector map data of Konya-Selçuklu Area obtained from photogrammetric flights and orthophoto images of 1/5000 scale and vector map data of Şanlıurfa-Akçakale obtained from satellite images were used.

2.1 ADANA – KARATAŞ - GÖKÇELİ AND ÇAKIRÖREN DISTRICT STUDY AREA

Gökçeli and Çakırören villages are residential areas which have been transformed into district status in the boundaries of Karataş municipality with the metropolitan Law no. 6360 while they were formerly villages of Karataş county in Adana.

These villages are located on the highway of Adana-Karataş. Cadastral sheets no. MERSİN O34-c-13-D and MERSİN O34-c-02-b (in 1/5000 scale) and scientific files of our study area Adana province Karataş county were procured from Adana Cadastre Directorate. The cadastral works in the aforementioned villages were carried out photogrammetrically in 1970 by the General Directorate of Land Registry and Cadastre.

The selected area in Çakırören village is located on the west of Adana-Karataş highway. The land is used as a field. As the ground water level is high, many drainage works have been carried out and drainage channels have been opened.

Gökçeli village is also located on Adana-Karataş highway. This highway divides our study area. The land is used more as an orange grove and partially as a field. A big channel runs through our study area and drainage channels were also installed in this area.

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Vector data and orthophoto images of 1/5000 scale which contain Çakırören and Gökçeli Districts were procured from General Directorate of Agricultural Reform.

2.2 ŞANLIURFA – AKÇAKALE - AYDINLI and DENİZ DISTRICT STUDY AREA

Şanlıurfa province, Akçakale county, Aydınli and Deniz Districts are in a zone which is very close to the Syrian border. Uğurtaş village became Deniz village by being divided later on. It is an area to be irrigated in the scope of GAP project and irrigation facility constructions by General Directorate of State Hydraulic Works still continue.

Again cadastral sheets no. SURUÇ O41-a-14-b, SURUÇ O41-a-14-C, SURUÇ O41-a-08-d and scientific files of Şanlıurfa province Akçakale County was procured. The cadastral works in the aforementioned villages were carried out photogrammetrically in 1973 by the General Directorate of Land Registry and Cadastre.

Orthophoto images and vector data of O41-a-14 -b, O41-a-14-c and O41-a-08-d 1/5000 scale were procured from General Directorate of Agricultural Reform.

2.3 KONYA – SELÇUKLU - DOKUZ AND AŞAĞI PINARBAŞI DISTRICT STUDY AREA

Dokuz and Aşağıpınarbaşı Districts are residential areas within the boundaries of Selçuklu county in Konya Metropolitan region. These villages are located on the 25th kilometer of Konya-Ankara highway. Transportation is provided by public transport buses of Konya Metropolitan Municipality. The villages are generally dominated by farming and animal husbandry is also the main source of income in the villages. Residential units in the villages largely consist of single-storey mudbrick buildings. The farm lands of the village have a flat geography and agricultural irrigation is ensured with the wells located on land. Facility cadastre of the village was completed in 1952 for the village and in 1957 for the agricultural area.

Cadastral sheets of Konya Province Selçuklu County Dokuz District was procured from Konya Cadastre Directorate.

Scientific files of Dokuz and Aşağıpınarbaşı villages were procured from Konya Cadastre Directorate.

Orthophoto images and vector data of L29-d-21-a-2-c, L29-d-21-a-3-b, L29-d-21-a-3-c, L29-d-21-a-1-d, L29-d-21-a-4-a and L29-d-21-a-4-d, 1/1000 scale were procured from Konya Metropolitan Municipality.

Orthophoto images belonging to sheets no. L29-D-21-B-1 ve L29-D21-B-4 of 1/2000 scale were produced as Ground Sampling Interval = 20 cm from Leica Photogrammetric System (CPS) software.

3. IMPLEMENTATION

Areas in the size of blocks in Adana province Karataş county Çakırören and Gökçeli villages, Şanlıurfa province Akçakale county Deniz and Geldiğen villages, and Konya province center county Dokuz and Aşağıpınarbaşı villages were selected as implementation sites.

Detail measurements of our study areas were carried out with TUSAGA active system by utilizing Cors TR reference stations. Utilized TUSAGA active points are **ADAN** station for Adana Karataş, **SURF** station for Şanlıurfa Akçakale and **KNYA** station for Konya.

In detail measurements, a mobile receiver GNSS of SOUTH brand was used. In mobile receiver, data collection interval was at 1 sec. and satellite elevation angle was set at 10°.

3.1 ADANA –KARATAŞ- ÇAKIRÖREN AND GÖKÇELİ DISTRICTS STUDY AREA

Transformation of the cadastral sheets no. MERSİN O34-c-13-d and MERSİN O34-c-02-b of our Study Area Çakırören and Gökçeli districts was made in NETCAD program. As the result of affine transformation, root mean square error was obtained as 0.29 m for O34-c-13-d sheet and as 0.29 for O34-c-02-b sheet. Vector data was obtained from the transformed sheets.

An area of one block consisting of 166 to 207 parcels and 231 to 256 parcels selected in Çakırören village was measured with cors method with South 582 GNSS Rover GPS device. For utilized TUSAGA active points Adana Karataş, **ADAN** station was used.

44, 45, 48, 57, 58, 62, 64, 65, 117 to 121 and 137 to 165 parcels, and their sub-parcels selected in the determined Study Area of Gökçeli village were measured with cors method with South 582 GNSS Rover GPS device.

Cadastral sheet was digitized. Transformation to ITRF system was made by using the transformation parameters.

Parcel amalgamations were made with the help of Netcad program by transferring land measurement values obtained from GPS measuring device. After the transformation of the cadastral sheets, of which vector maps were made, to ITRF DATUM, they were superposed with land data. Cadastral sheet and ground measurement were superposed (Figure 3.1).

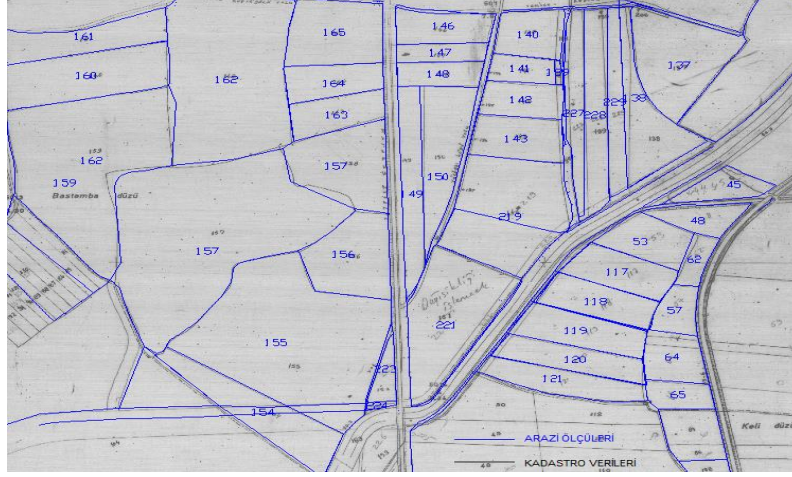


Figure 3.1 : Adana Province Karataş County Gökçeli District land and cadastral status

Area measurements of parcels no. 160, 166, 167, 168, 169, 174, 207, 219, 229, 231, 232, 243, 244, 245, 246, 257, 258, 259, 260, 262 in O34-c-13-d sheet of Çakırören District were made by using NETCAD software.

Area measurement was made by digitizing the cadastral sheet no. O34-c-13-d obtained from Adana Cadastre Directorate.

The coordinate values of parcels no. 207, 219, 232, 231, 230, 229, 227, 262, 260, 259, 258, 257, 246, 245, 244, 243, 174, 160, 169, 168, 167, 166, 161, 196 in O34-c-13-d sheet of Çakırören District were obtained in Erdas 8.1 software and area measurement was made from orthophoto.

Area measurements were made after transferring the coordinates of points belonging to the parcels to NETCAD media and forming the shape of the parcel.

Area measurement was made by digitizing the cadastral sheet no. O34-c-13-d obtained from Adana Cadastre Directorate.

Areas which were measured in the land belonging to the parcels in the study area, were registered in land records, were obtained from orthophoto and vector drawing and areas which were obtained as the result of the digitization of cadastral sheet were compared. Tolerance margin quantity (df), M scaling denominator, F; an area in m² unit was calculated with:

$$df = 0,013 * (M.F)^{1/2} + 0,0003 * F \text{ (Table 3.1) .}$$

Table 3.1 : Adana Province Karataş County Gökçeli District Area Measurement

BÖLGE ADI	PARSEL NO	ARAZİ ALANI	TAPU ALANI	KADASTRO ALANI	ORTOFOTO ALANI	VEKTÖR ALANI	FARK	TECVİZ SINIRI	TECVİZİN 3 KATI	SONUÇ
Adana İli - Karataş İlçesi - Gökçeli Mahallesi	48	15605.79	14900	14666.87	15606.42	14934.88	705.79	116.68	350.04	RED
	53	23524.64	24200	20034.85	23525.58	26580.87	675.36	150.26	450.78	RED
	57	13265.48	17500	13642.63	13361.08	13786.33	4234.52	126.85	380.55	RED
	52	8369.18	8450	8391.09	9223.23	8229.45	80.82	87.04	261.12	KABUL
	64	20681.41	19400	21071.67	22357.58	22064.29	1281.41	133.86	401.58	RED
	65	12435.57	11400	13447.55	10878.33	10738.92	1035.57	101.57	304.71	RED
	117	25976.93	26990	26786.86	26359.79	26499.77	1013.07	159.12	477.36	RED
	118	27006.5	26990	26139.69	26915.46	30006.6	16.50	159.12	477.36	KABUL
	119	29662.45	26990	29841.61	30359.82	31361.83	2672.45	159.12	477.36	RED
	120	26368.13	26990	25099.43	26595.65	24440.84	621.87	159.12	477.36	RED
	121	27492.75	26990	25365.11	27493.85	27712.98	502.75	159.12	477.36	RED
	146	21829.04	21274.5	22903.53	20278.46	20721.96	554.55	140.46	421.38	RED
	147	11828.17	11741.9	12462.26	12005.87	12621.78	86.24	103.13	309.39	KABUL
	148	15209.89	14228.4	15265.72	16479.18	14768.85	981.52	113.92	341.76	RED
	155	164914.28	165200	155703.51	176267.57	171423.37	285.72	423.18	1269.54	KABUL
	156	43167.79	43500	43364.61	43169.51	42625.06	332.21	204.77	614.31	KABUL
	157	195402.83	199800	199681.04	196163.93	195357.3	4397.17	470.83	1412.49	RED
	158	47202.89	48400	48348.66	46578.13	48823.54	1197.11	216.75	650.25	RED
	163	23312.46	22300	22329.11	23617.94	20315.32	1012.46	143.96	431.88	RED
	164	22501.55	22300	23246.08	22202.22	23849.59	201.55	143.96	431.88	KABUL
165	43106.6	42760	42686.64	42796.27	41346.89	346.60	202.91	608.73	KABUL	

3.2. ŞANLIURFA-AKÇAKALE-DENİZ AND AYDINLI DISTRICTS STUDY AREA

Cadastral sheets no. SURUÇ O-41-a-14-b, SURUÇ O-41-a-14-C, SURUÇ O-41-a-08-d of Şanlıurfa province Akçakale County were obtained from Şanlıurfa Cadastre Directorate and digitized.

Akçakale county Aydınli district parcels of 137 to 180 and Deniz district parcels of 81, 127 to 129, 132 to 145 were measured with with cors method with South 582 GNSS Rover GPS device. For utilized TUSAGA active points Şanlıurfa Akçakale, **SURF** station was used.

Digitized cadastral sheet coordinates were transformed from UTM coordinates to ITRF coordinates. Area measurement was made by using Netcad program.

Area measurement was made by digitizing the cadastral sheets no. O41-a-08-d, O41-a-14-b and O41-a-14-c obtained from Şanlıurfa Cadastre Directorate.

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Area measurement was made from digitized satellite images. Area measurement was made from the vector map obtained from the General Directorate of Agricultural Reform. Land title area and land area, areas obtained from orthophoto, areas obtained from vector orthophoto and areas obtained from cadastral sheet were compared. Tolerance margin was measured according to scale of 1/5000 and parcels in and out of the tolerance margin were determined.

By taking the cadastral sheet scale of parcel areas into consideration with the purpose of control and measuring the surface areas with graphic method, the surface area in the land title and its usage status in the land, parcel areas digitized from orthophoto and parcel areas obtained from vector orthophoto were compared. Tolerance margin quantity (df), M scaling denominator, F; an area in m² unit was calculated with:

$$df = 0,013 * (M.F)^{1/2} + 0,0003 * F$$

3.3 KONYA- CENTER –DOKUZ AND A.PINARBAŞI DISTRICT STUDY AREA

Cadastral sheets of no. Konya L29-d-21-a-2-c, L29-d-21-a-3-b, L29-d-21-a-3-c, L29-d-21-b-1-d, L29-d-21-b-4-a, L29-d-21-b-4-d, L29-d-21-b-1, L29-d-21-b-4 belonging to Dokuz and Aşağıpınarbaşı districts, which were our implemetation areas, were digitized. These sheets are within the scope of 1/5000 L29-d-21-a ve L29-d-21-b cadastral sheet.

Cadastral sheets of 1/5000 scale were porduced by the General Directorate of Land Registry and Cadastre in 1978 with Aerial Photogrammetry method.

The aerial photos of this area were taken between 19.05.2005 and 30.05.2005. The photography was carried out analogously with ZEISS RMK TOP 30 aerial camera. Photography scale is 1/4000. Scanning process was conducted with işlemleri ZEISS SCAI Photogrammetry scanner. Pixel size directly from negative roll film was actualized as 14 micron and radiometric resolution was provided as 8 bit (256 gray scale).

In orthophoto of 1/1000 scale, ground sampling interval was produced to be 10 cm and in orthophoto of 1/2000 scale, ground sampling interval was produced to be 20 cm. Cadastral sheets which were digitized by using transformation data were transformed from ED_50 datum and ITRF datum.

Our study area was measured with cors method with South 582 GNSS Rover Gps device. For utilized TUSAGA active points Konya, **KNYA** station was used. Area measurement was carried out by using Nectad program.

Digitized cadastral sheets were superposed with land data after being transformed into ITRF. Area measurements of Konya province Selçuklu county Aşağıpınarbaşı district ve Dokuz district were made.

4. EVALUATION

4.1 EVALUATION OF PARCELS IN STUDY AREAS

4.1.1 Adana Province Karataş County Çakırören District



Figure 4.1: Adana Province Karataş County Çakırören District evaluation of parcel no. 207

Cadastral area of parcel no. 207 Adana province Karataş county Çakırören district (village) is 158050,74 m² while its land title area is 158000m². In the first cadastre, area measurement was carried out by encircling with planimeter. As the result of land measurement, area value was obtained as 155518,95 m². While in the area measurement carried out from orthophoto this value was 155796,07 m². Vector map area was obtained as 158570,04 m². Tolerance limit calculated according to 1/5000 sheet was calculated as 412,79 m². In this case, its divergence from land area was 2481,05 m² and 2203,93 m² from orthophoto. Orthophoto measurement and land measurement area values are excluded from tolerance limit. The reason why they are excluded from tolerance limits is the fact that parcel no. 207 is divided into 7 parcels in land usage. Area of 207/1 is 18958,11 m², area of 207/2 is 44421,50 m², area of 207/3 is 50932,15 m², area of 207/4 is 7246,56 m², area of 207/5 is 11391,80 m², area of 207/6 is 6198,34 m² and area of 207/7 is 16370,49 m². It was found that sections such as roads and channels were formed outside the parcel due to the land in use being wetlands and, moreover, there is a road on the north of the parcel while there is none on cadastre and this road was divided from the parcel.

Boundaries of which land measurement was detected to not have changed with Cadastral Sheet were established in accordance with the fixed boundary definition in renewal legislation.

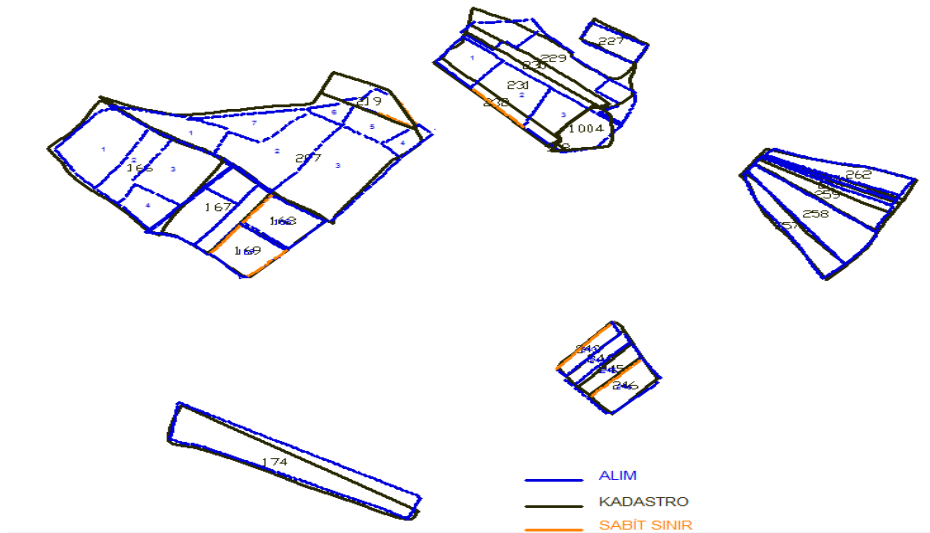


Figure 4.2 : Adana Province Karataş County Çakırören District Fixed boundaries

Digitized cadastral status in Adana Province Karataş County Çakırören District and land status was compared frontally. In this comparison, the least and most skewness quantities were established and presented in the table (Table 4.1)

Table 4.1 : Adana Province Karataş County Çakırören District skewness status

BÖLGE ADI	PARSEL NO	KAYIKLIK	
		EN AZ (m)	EN ÇOK (m)
ADANA İLİ - KARATAŞ İLÇESİ ÇAKIRÖREN MAHALLESİ	160	0.73	12.25
	166	1.86	16.59
	167	0.02	40.12
	168	0.3	6.88
	169	1.2	11.2
	174	4.5	45
	207	0.79	29.3
	219	0.97	101.91
	227	1	9.28
	229	1.7	31.4
	230	3.04	16.76
	231	4.24	113.24
	232	1.01	46.6
	243	1.22	11.77
	244	1.88	8.9
	245	0.65	8.21
	246	0.71	5.1
	257	0.67	8.77
258	1.03	11.18	
259	3.2	24.64	
260	0.85	24.64	
262	0.27	13.92	

4.2 COST ANALYSIS OF METHODS

Table 4.2 : Cost Analysis of Methods

Yöntemler	Maliyet (1 ha)	
	TL	₺
GZK GPS	26.28	11.58
1/5000 Kıymetlendirme ile Beraber Sayısal Ortofoto	2.94	1.29
1/5000 Sayısal Ortofoto	1.41	0.62
1/2000 Kıymetlendirme ile Beraber Sayısal Ortofoto	68.5	39.92
1/2000 Sayısal Ortofoto	19.98	11.35
Uzaktan Algılama (WORLDVIEW-2) Pankromatik Görüntü	3.92	1.73
Uzaktan Algılama (WORLDVIEW-2) Pan-Sharp Görüntü	3.37	1.48

5. CONCLUSION AND RECOMMENDATIONS

Adana Province Karataş County Çakırören and Gökçeli Districts, Şanlıurfa Province Akçakale County Aydınli and Deniz Districts and Konya Province Selçuklu County Dokuz and Aşağıpınarbaşı Districts were formed as test areas with the purpose of carrying out cadastre renewal works faster and more economically, and keeping the cadastre constantly updated by renewing it.

Coordinates of the detail points within these test areas were measured with GZK GPS (Cors method). With these coordinates orthophoto and vector maps obtained from aerial photographs and satellite images, and areas obtained from land title and land measurements were compared.

In area comparison, rate of being within tolerance limits in Adana/ Karataş/ Çakırören and Gökçeli districts, and Şanlıurfa/Akçakale/Deniz and Aydınli districts of 1/500 scale is lower than that of Konya/Selçuklu/ Dokuz and Aşağıpınarbaşı districts of 1/2000 scale. In the sheet of 1/5000 scale, the rate of being within tolerance limits is between 15% and 43%. In the sheet of 1/2000 scale, the rate of being within tolerance limits is between 50% and 75%. It is observed that these rates are coherent with İnam 2005 data error limit rates (within error limits 24, not within them 76).

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While the rate of area values in land title (calculated with planimeter) and digitized cadastral area values being out of tolerance limits is 10% to 57% in Şanlıurfa/Akçakale/Deniz and Aydınli districts and Adana/ Karataş/ Çakırören and Gökçeli districts of 1/5000 scale, this rate is 25% in Konya/Selçuklu/ Dokuz and Aşağıpınarbaşı districts of 1/2000 scale.

In our study, cost of CORS GPS method and digital orthophoto cost produced from aerial photograph were compared with orthophoto cost produced from satellite image (panchromatic and pan-sharpen image). Finding of Cankurt et. al is coherent with our study as well. Orthophotos of Şanlıurfa region were obtained from Worldview -2 satellite. Orthophotos of Adana region were obtained from aerial photograph. While the cost of one sheet is 2473,10 tl in Adana region, cost of one sheet is 3037,10 tl in Şanlıurfa region.

While the cost of measurement made with CORS GPS method is lower than aerial photogrammetry and satellite imaging for small areas, this advantage lies with aerial photogrammetry and satellite imaging for large areas.

In light of the conclusions and evaluations stated above, the following points are recommended on orthophoto and high resolution satellite images in cadastre renewal works in Turkey:

- According to fixed (distinct) points; position accuracy in 1/5000 sheet works better in orthophoto than satellite image.
- Divergence in indistinct points is related to the fact that GPS receiver and mouse cursor could not be hit at the same place and not to a positional error.
- In the studies conducted, sub-parcels are determined according to first facility cadastre and this subject is lacking in renewal legislation.
- It was established that some boundaries do not change in land and cadastral sheet and fit the definition of fixed boundary stated in renewal legislation. Other boundaries can be evaluated as indefinite boundary. Therefore, they can be established over orthophoto and sheet with the skill and assistance of experts without going to the area.

In conclusion :

- Both photogrammetric vector maps and orthophoto maps were analyzed in different scales (1/1000, 1/2000, 1/5000). When area divergences were analyzed, orthophotos and vector maps of 1/5000 scale were observed to be sufficient in cadastre renewal works. It was again concluded that orthophotos and vector maps of 1/5000 scale obtained from high resolution satellite images can be used in cadastre renewal works.
- Land measurements, photogrammetric vector map and orthophoto map, orthophoto and vector maps obtained from high resolution satellite images were analyzed in terms of cost. As a significant difference was observed in terms of cadastre renewal works when areas which were obtained from vector maps and orthophoto were analyzed, opting for orthophoto maps with regard to cost will be appropriate.

Orthophotos of 1/5000 scale are recommended in cadastre renewal works in terms of having the ability to be archived, reanalyzed without necessitating extra costs and providing the opportunity to analyze parcels.

In line with requests from Cadastre Directorates, digital vector map and orthophoto of 1/5000 scale production is made or procured by the General Directorate of Land Registry and Cadastre for Cadastre facility, digitization, renewal and update works.

In all these studies; medium and small scale maps used with preliminary survey, investigation, planning purposes in digital vector photogrammetric maps of 1/5000 scale or digital colored orthophoto production works and necessitated by the units who need these maps to be used in pre-study planning and preliminary investigations and post-study integrity, completeness and quality controls with the purpose of General Directorate of Land Registry and Cadastre rendering its cadastre-based service in a healthy manner, are of vital importance.

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