General Evaluation of Cadastre of Turkey in the Framework of Cadastre 2034 Vision: Sarioglan District/Konya

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Key words: Cadastre, Cadastre 2014, Cadastre 2034 Vision, Land Management, Land Management/Administration Systems.

SUMMARY

The "Cadastre 2014 Report" (Cadastre 2014, A Vision for a Future Cadastral System), published by the International Federation of Surveyors (FIG – Fédération Internationale des Géométres) between 1994 and 1998, which was designed to forecast a projection of 20 years' cadastral survey, pioneered the re-evaluation of the cadastral system of many countries. In the year of 2014, a report titled "Cadastre 2014 and Beyond" is published by the FIG, which evaluates both the present and the future situation and gives suggestions. At the same time, it was stated that this report was part of sustainable development by highlighting the impact and importance of land management/administration systems. In the 2010 Congress of the FIG, Sydney (Australia), Bennett and his colleagues introduced six principles (Cadastre 2034 Vision), with regard to the role of the cadastre in the future, titled as "Cadastral Futures: Building a New Vision for the Nature and Role of Cadastres". However, as a result of studies with respect to the future cadastral design, carried out by scientists and various countries (related institutions), the Cadastre 2034 Vision has begun to be recognised and these principles have become more prominent.

The cadastral studies, which started with the Law on Land Registry and Cadastre in 1912 in Turkey, continue with the Cadastre Law No. 3402 and 99,10 % of the cadastral survey has been completed as of today. However; it is clear that a cadastral structure, which has been built since 1912, with missing coordinate data and with different coordinate systems, produced with different measurement methods, cannot meet all expectations expected from the cadastre. Land Registry and Cadastre General Directorate has been carrying out renovation works in villages and districts that cannot respond to the needs of the age with projects such as digitization projects and cadastral map and information updating projects within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402. The cadastre has been completed at this point in Turkey, but it is difficult to overcome the existing problems without the transition from the classical cadastral concept to the land management/administration system.

This paper will make a general evaluation of the Cadastre of Turkey in the framework of Cadastre 2034 Vision and principles and emphasize the current situation. The cadastral structure of Konya, Bozkir and Sarioglan Districts will be taken as case study and the work area will be examined with its past and present problems, detections and suggestions will be explained.

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1. INTRODUCTION

Land has been the basis of ownership since the beginning of the existence of mankind. No piece of land has lost its importance in any period in history and it has always been so significant that it caused wars. For this reason, the concept of cadastre which arises from the need of ownership over time has passed through various stages up to day. Today, the importance of cadastre is increasing day by day as being the primary data in many occupational disciplines, depending on the increasing importance of land use, the creation and implementation of policies for sustainable development related to the use and conservation of land.

In the Cadastre Report published by the FIG in 1995, the definition of cadastre is as follows: ”A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection.”

According to Enemark (2012), the concept of cadastre is difficult to identify. It may be designed in many different ways, depending on the origin, history and cultural development of the region or country. Basically, a cadastre as such is just a record that identifies the individual land parcels/properties. The purpose of this identification may be taxation (as was the reason for establishing the European cadastres) or it may be security of land rights (as was the case when establishing the Torrens systems in the new world such as Australia). Today, most cadastral registers around the world are linked to both the land value/taxation area and the area of securing legal rights in land.

The first cadastral works in Turkey began with the purpose of taxation during the Ottoman Empire period. The cadastral works which were made in the technical sense started with the Law on Land Registry and Cadastre in 1912 and continued with various methods until today. Nowadays, Turkey Cadastre of 99.10 % completed by the General Directorate of Land Registry and Cadastre (GDLRC) and it has been carrying out projects such as digitization projects and cadastral map and information updating projects within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402 (GDLRC, 2017).

In Turkey and all over the world, the view and the conception on land and cadastre has changed dramatically over the last few centuries. As it can be seen in figure 1, the land, which was a means of wealth first, then gained the properties of being a commodity, then a scarce resource, and now a social scarce resource; has turned into financial instruments from simple property registers and has become the cornerstone of planning with immovable property markets (Cagdas and Gur, 2003). After the 1990's, since modern cadastral theories such as multipurpose cadastre have begun to be discussed due to the increase of cadastral anticipations, nowadays cadastre has left its place to land management/administration systems.

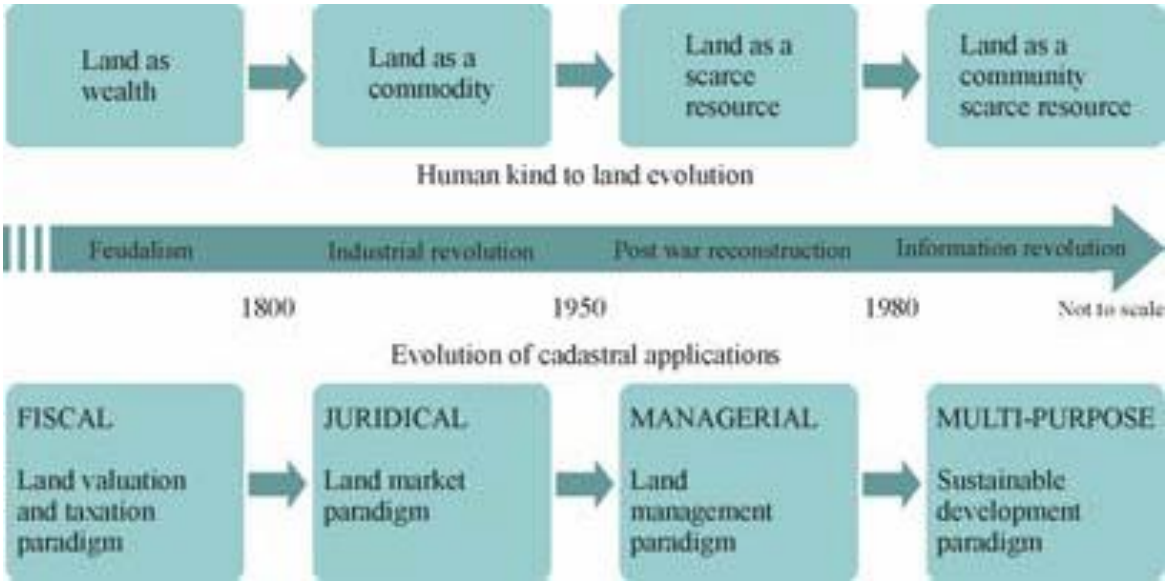

Figure 1. Development of cadastre in the world and Turkey (Enemark, 2001)

Several studies have been carried out cadastre and land management systems by the FIG. Cadastre 2014 A Vision For A Future Cadastral System (Kaufmann and Steudler, 1998), which the FIG began in 1994 at its 20th congress in Australia and completed in 1998, sets the standards for cadastral systems in 20 years. When it comes to 2014, in the 25th Congress of the FIG in 2014 in Malaysia is published the Cadastre 2014 and Beyond Report (Steudler, 2014), consequence the re-evaluation of the subject. In addition to this, there are many studies published by the FIG as Land Information Management for Sustainable Development of Cities (FIG Publication No: 31; FIG, 2002), Capacity Assessment in Land Administration (FIG Publication No. 41; Enemark and van der Molen, 2008), Fit-For-Purpose Land Administration (FIG Publication No. 60; Enemark et al., 2014) on cadastre and land management/administration systems.

In the congress organized by FIG in 2010 in Sydney (Australia), Bennett and his colleagues presented Cadastral Futures: Building a New Vision for the Nature and Role of the Cadastres (Bennett et al., 2010) and the work has put forward six elements regarding the role of cadastre

in the future (Cadastre 2034 Vision). However, as a result of studies like Cadastral Reform and Innovation for Australia - A National Strategy (A Vision for Cadastre 2034) Report (ICSM, 2015) published by Australia Intergovernmental Committee on Surveying and Mapping, Cadastre 2034 A 10-20 Year Strategy for Developing the Cadastral System: Knowing the Where of Land-Related Rights (LINZ, 2014) Report published by Land Information New Zealand on future cadastral design and the work done by related scientists, Cadastre 2034 Vision and principles have begun to be clarified.

In this paper a general evaluation of the Cadastre of Turkey in the framework of Cadastre 2034 Vision and principles is made and the current situation is emphasized. The cadastral structure of Konya, Bozkir and Sarioglan District is selected as case study and examined from past to present problems, detections and suggestions are explained.

2. CADASTRE 2034 VISION

After 1980's the requirements for land management, on the axis of sustainable development, and technological, social and economic changes emerged in the world, necessitated the restructuring of the traditional cadastre towards the land administration and the discussion of the modern cadastre concepts (Cagdas and Gur, 2003).

Many studies have been done by scientists in this framework. One of the first studies that pioneered these studies is the work by Bennett and his colleagues to study Cadastral Futures: building a New Vision for the Nature and Role of the Cadastre, presented at the 2010 FIG Congress in Sydney (Australia). However, Don Grant, General Director of the Land Information New Zealand Authority until February of 2014 and his colleagues presented A New Zealand Strategy for Cadastre 2034 at the FIG Congress in 2014 in Kuala Lumpur (Malaysia), said that the principles and the actions to be taken in order to implement these principles in New Zealand are explained. An article by Mathias Lemmens, compiled by international experts on this subject and consisting of two parts named Toward Cadastre 2034, was published in the GIM International magazine (Lemmens, 2010; Lemmens, 2010a).

2.1. Principles of Cadastre 2034 Vision

2.1.1. Survey-Accurate Cadastre

It means that land boundaries are measured at high accuracy (sub-centimeter accuracy) to ensure compatibility of land and cadastral maps. Many applications of the cadastre will require survey accuracy: building management, utility administration, infrastructure organization, precision farming, some navigation applications and sea-level rise response all require such accuracy. Moreover, not only will ownership parcels need survey-accuracy, the hundreds of new property objects require measurement and representation. Only survey-accuracy will enable the complex layering of property interests to be accurately understood. (Figure 2) (Bennett et al., 2010).

Figure 2. Accurate measurement and display of the cadastre.

2.1.2. Object-Oriented Cadastre

The development of an object-oriented cadastral understanding should be adopted instead of a parcel-based cadastre in order to re-define and legally define all rights, restrictions and responsibilities of land use to meet today's needs (Polat and Alkan, 2015). Parcels will continue to be an important people-land organization tool, however, many new interests exhibit vastly different spatial footprints (Figure 3) (Bennet et al., 2010).

Figure 3. Not all property interests fit in the parcel framework: object-oriented design is required.

2.1.3. 3D/4D Cadastre

Incorporating height and time into cadastral frameworks will be essential: proliferation of property interests and sustainability analysis require modelling and visualisation of the third and fourth dimensions (Figure 4). Technological advancements will enable traditional 2D cadastres to be extended to the new dimensions. Administrative friction caused by misinformation and poor understandings of property interests will be dramatically reduced. Consequently, planning and development times will be greatly reduced (Bennet et al., 2010).

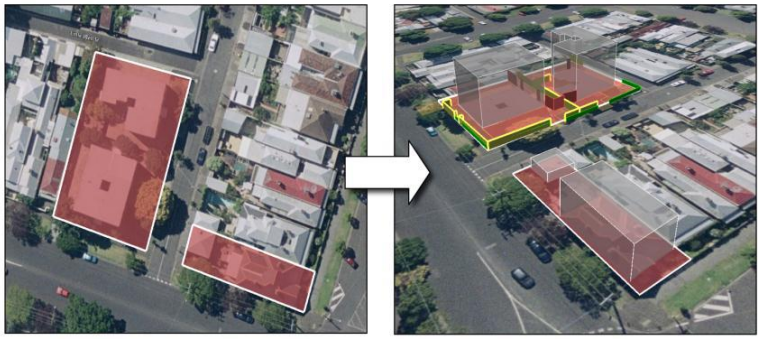

Figure 4. 2D approaches do not enable the complete legal situation on land to be easily understood, for this, need 3D/4D cadastre.

2.1.4. Real-Time Cadastre

Future cadastres will be updated and accessed in real-time. Emergency management, property market management and navigation tools require cadastral information to exhibit this quality. Currently, cadastral and owner information update processes may take weeks or months. However, soon technology will enable surveyors to measure and update the cadastre in the field in real-time. Robust checking processes will continue to ensure the integrity of the cadastre (Bennet et al., 2010).

2.1.5. Global Cadastre

Future cadastres will have the capacity to link into regional and global cadastral networks. Globalisation of economic systems and land markets (through mortgage backed certificates and other complex commodities) requires global systems of management. Interoperable cadastral systems appear to offer a method for integrating and better understanding the relationship between land markets (Figure 5). Environmental management also requires integration of cadastral systems at regional and global levels: environmental problems and concerns are often spread over multiple jurisdictions (Bennet et al., 2010; McDougall et al., 2013).

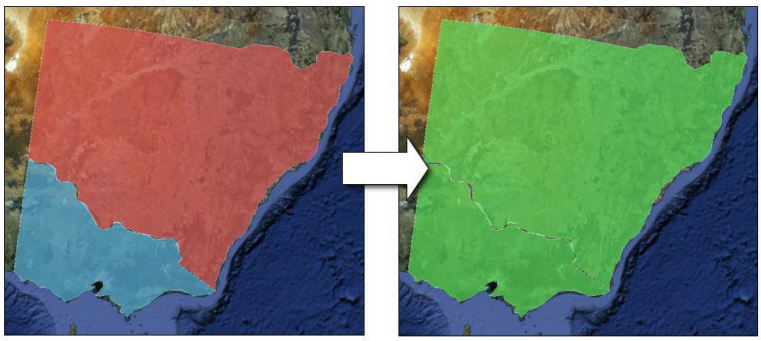

Figure 5. Cadastral systems will become interoperable allowing management of economic and environmental concerns at regional and international level.

2.1.6. Organic Cadastre

Cadastres will better model the organic natural environment (Figure 6). Many new property interests are designed around natural phenomena, rather than the strict bearings and distances or Cartesian coordinates found in traditional land parcels. For example, many interests in the marine environments exhibit fuzzy and changeable boundaries. Moreover, legal controls protecting flora and fauna or the land interests of indigenous communities (such as those found in developing countries) are often vague and require new tools for representation and management (Bennett et al., 2010; Grant et al., 2014).

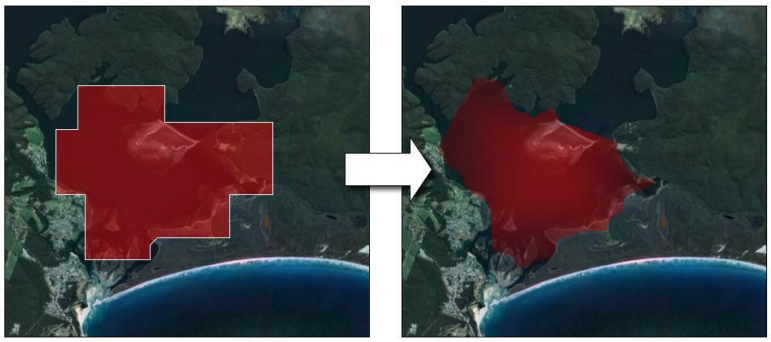

Figure 6. Future cadastres will better model the organic natural environment.

3. TURKEY CADASTRE

In Turkey, the first cadastral survey of the Ottoman Empire period in 1912 had begun with Law on Land Registry and Cadastre but was suspended because of war. After the proclamation of the Republic, Land in Artvin, Ardahan, Kars Provinces with Kulp, Iğdır, Hopa and Kemalpaşa Districts about Law No. 474 dated 1924 cadastral works had begun again. Today, cadastral surveys are carried out according to Cadastre Law No. 3402. At the

same time, by the GDLRC has been carrying out renovation works with projects such as digitization projects and cadastral map and information updating projects within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402 (Yurdakul, 2017). Turkey's first/basic cadastral works is seen in table 1.

Table 1. Turkey's district and village current cadastral situation (GDLRC, 2017)

	District		**Village**		**Total (District + Village)**	
Total Number of Units	18784	Rate	33265	Rate	52049	Rate
Total Number of Finished Units	18721	% 99,66	32857	% 98,77	51578	**% 99,10**
Number of Ongoing Units	30	% 0,16	76	% 0,23	106	% 0,20
Number of Problematic Units	33	% 0,18	332	% 1,00	365	% 0,70

With the completion of the cadastre by GDLRC, it is carried out in various projects such as Land Registry and Cadastre Information System (LRCIS, TAKBIS: Tapu ve Kadastro Bilgi Sistemi), Spatial Property System (SPS, MEGSIS: Mekânsal Gayrimenkul Sistemi), Land Registry Archive Information System (LRAIS, TARBIS: Tapu Arşiv Bilgi Sistemi), Land Registry and Cadastre Modernization Project (LRCMP, TKMP: Tapu ve Kadastro Modernizasyon Projesi), Tusaga-Active System (Turkey Constant GNSS Network), Map Information Bank (MIB, HBB: Harita Bilgi Bankası) and Turkey National Geographical Information System (TNGIS, TUCBS: Türkiye Ulusal Coğrafi Bilgi Sistemi). At the beginning of these projects are TAKBIS and MEGSIS. TAKBIS; It is one of the most basic e-government projects aimed at transferring property information to the computer environment and conducting all kinds of inquiries throughout the country. Purposes, Turkey across the land registry and cadastral records transferred to computer environments and all activities carried out through the computer system, thus, it is necessary to provide effective monitoring and control of private, public immovable property. TAKBIS is an integrated information system that performs many operations in the logic of Geographical Information System/Land Information System (GIS/LIS). In May of 2012, all land registry directorates were transferred to TAKBIS. With TAKBIS project it is targeted that across Turkey land registry and cadastral services are analysed in the framework of GIS/LIS logic, problems are identified, solutions are found, standard and electronic fulfilment in this way, accurate, reliable and up-to-date information is provided to local administrations and public institutions (GDLRC, 2017a).

The MEGSIS project is designed to digitally collect data on the local computers of the cadastre directorates on a central system and map them to the land registry information and share it with the stakeholder institutions, organizations and municipalities that need this information and map services at international standards and to the citizens via the e-government portal is an open source application. Approximately 52 million cadastral parcels were installed in the system started in August 2011 (Figure 7). Approximately 50 million of these parcels have been harmonized with land registry data, and cadastre directorates are continuing their efforts to improve, update and finalize them (GDRLC, 2017b).

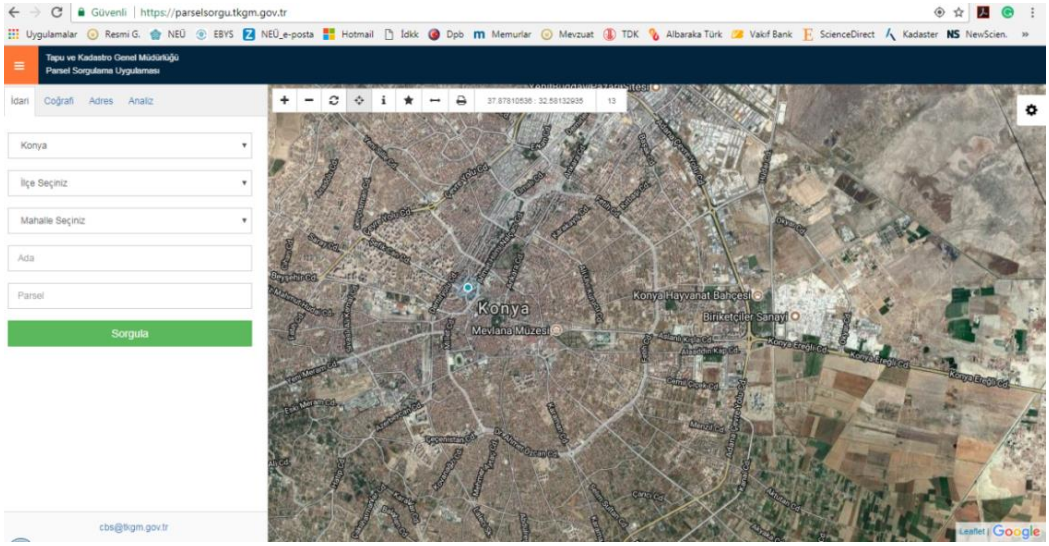

Figure 7. MEGSIS Project.

3.1. The Problems in Turkey Cadastre

Cadastral works in Turkey was completed with approximately 97 % in 2010 (GDRLC, 2017c). However, cadastral works, which have been produced since 1912, have been produced numerically since the 1970s. Some of the cadastral maps produced some uncoordinated graphic maps (produced linearly) and some of them are produced in the local coordinate system and for these reasons, there are some problems in it. Nowadays, it cannot be mentioned that the problems related to remedying these problems are completely eliminated in the application of projects such as cadastral maps and information updating projects and digitization projects within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402 by GDLRC. General problems experienced in Turkey Cadastre can be listed as follows:

- There is no altitude information. Therefore, the three-dimensional data associated with the data in the map is not easy and economical.
- Ground control points such as triangulation point, polygons which are the basis of their cadastral work have not been preserved and most of them have disappeared.
- Due to differences in scale, type of pads, production technique and coordinate systems, it is difficult for the stations to be associated with themselves and with other usage areas.
- There are deficiencies in the monitoring and updating of the post-cadastral changes in the places where the cadastre is over.
- Some buildings are no in the cadastral maps (Sari, 2006).
- It is observed that non-cadastral lands have been opened to agriculture and not registered.
- There are cases where there are no changes; the actual situation in the land has not been changed in terms of cadastre and land registry.
- The purchase and sale values of the immovable property do not reflect their real values in terms of land title. In this case, the State causes the tax loss.

- Owners were found during the basic cadastral works, but since there are no subsequent transfers when there are deaths, these are seen as proprietors. Or, external trades have been made, even if the owner changed; this situation is not reflected in the register. The actual owner became uncertain (Dikici and Inam, 2002).
- The cadastre is in expectation; urbanization in rural areas, environmental problems, despite the significant changes in the nature of the various investment related to land cadastre Turkey are continuing with the old content. There cannot be rich database needed for land-related investments. This prevents or reduces the realization of the expected benefit from the cadastre.
- The land registry and cadastre services, immovable property valuation process and the information cannot be produced. For this reason, expropriation, land readjustment of consolidation, valuation, determined realistically and collection of real estate taxes and charges cannot be the base in real terms (Adibelli, 2006).
- Land registry and cadastre information constitute the basis of all investment and engineering services related to land. However, since this information cannot be integrated with other information about the land and spatial information systems cannot be created, many areas cannot be used in these areas and resources are wasted due to the repetition of data on production activities made by various institutions throughout the country (Durduran et al., 2007).

3.2. Eveluation of Turkey Cadastre in the Framework of Cadastre 2034 Vision

With the survey-accurate cadastre direction, cadastral measurements should be made below the centimeter. Because this data is used as basic data in many professional disciplines. It can be stated that the present cadastral works are provided with satellite and GNSS technology and this measure is provided by a few centimeter accuracy measurements. However, it cannot be said that satellite and GNSS technology has achieved this measure of accuracy before its widespread use or in cadastral measurements made with local techniques.

With object-oriented cadastre direction, the objective is to define all rights, restrictions and responsibilities of cadastral parcels during and after cadastral construction in order to meet the needs of today and cadastral works are done in this concept light. The registration of all rights, restrictions and responsibilities above and below the cadastral parcels to land registers. It is observed that completed in cadastral works in Turkey in 2010 the measurement and registration of these rights is not completely done or is partially done.

With 3D/4D cadastre direction, although the task of establishing the infrastructure of the spatial information system of the country is within the GDLRC in accordance with the Cadastre Law No. 3402, the cadastral works are limited to two dimensions and the concepts of height and time in the third and fourth dimension seems to have been neglected.

With real-time cadastre direction, it is necessary to update the cadastre instantly and provide access in real time. With the MEGSIS project made by GDLRC, it is possible to access

instant cadastral data and as well as update studies are also carried out (GDRLC, 2017b). At the same time, these data should be made available on the internet by payment of legal fees and revolving fund fees.

With the global cadastre direction, integration of cadastral systems at regional and global level is required. In this respect, the coordinate system used in Turkey Cadastre (ITRF: International Terrestrial Reference Frame) can be integrated into international networks and cadastral system state. However, it is necessary to complete the renewal or conversion studies of the area that ED50 datum and in the local coordinate system.

With the organic/natural cadastre direction, it should contribute to the modelling of natural environments such as marine environments, flora and fauna. In this respect, cadastral data should be shared with relevant institutions in order to be basic data for all projects. GDLRC shares cadastral information with all relevant institutions.

Turkey Cadastre can be summarized as seen in table 2, the result of the general evaluation in the light of principles of Cadastre 2034 Vision described above details. Turkey Cadastre is above the average and 3 principles that are fully provided, the other three, they are in the well, middle and poor levels are evaluated.

Table 2. General evaluation of Turkey Cadastre in the framework of Cadastre 2034 Vision

Principles of Cadastre 2034 Vision		**Bad**	**Middle**	**Good**	**Very good**
1	Survey-Accurate Cadastre				✓
2	Object-Oriented Cadastre		✓		
3	3D/4D Cadastre	✓			
4	Real Time Cadastre			✓	
5	Global Cadastre				✓
6	Organic/Natural Cadastre				✓

4. CASE STUDY: SARIOGLAN DISTRICT

The first cadastral works in Konya, Bozkir, Sarioglan District (Figure 8) began in the 1930's, were finalized in 1934 and created the map in figure 9. These studies were carried out in accordance with Cadastre Law No. 658 dated 02.05.1925 and as a result of the studies 137 cadastral parcels were made measurement and registered. In 2017, a renewal project was implemented by GDLRC within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402 and the works were completed in January 2018. As a result, from the year 1934 to the present day, 137 parcels became 375 parcels with parcelling, expropriation and similar applications (Figure 10). However, it is seen that the number of parcels formed by the physical use of land, such as external sales, heritage and transfers between the people, reaches about 3600 and these changes cannot be reflected in the cadastral map and land registry. It is

obvious that despite the technical problems being solved due to the completion of 22/a project, existing property problems in Sarıoglan District cannot be resolved.

Figure 8. Study area Sarıoglan District.

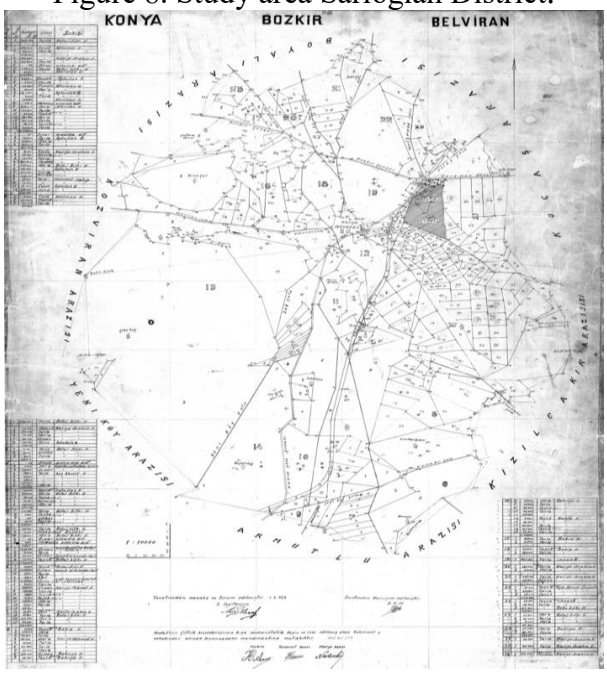

Figure 9. Cadastral map of Sarioglan District (1/10.000 scale) (1934).

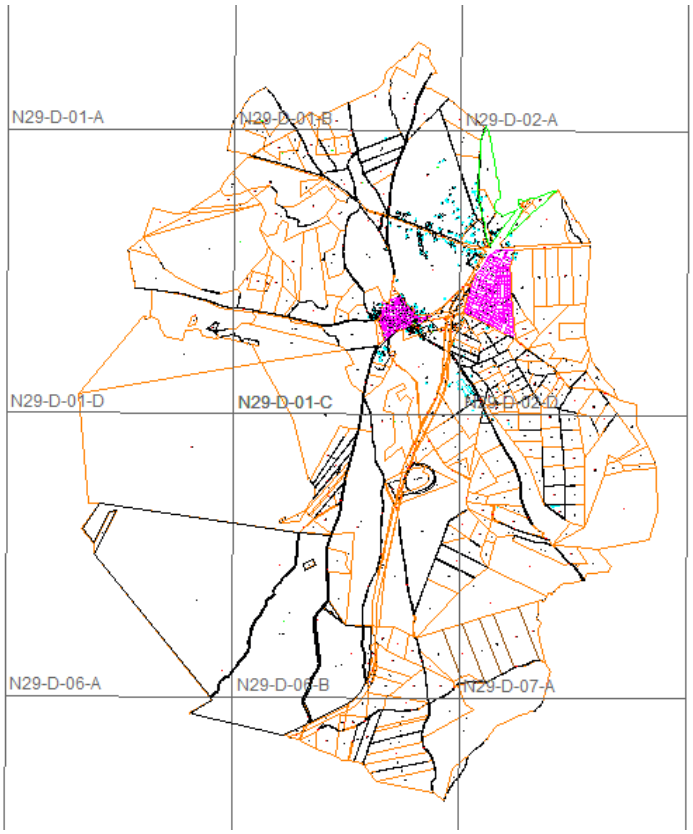

Figure 10. Cadastral map of Sarıoglan District after 22/a project (2018).

District and villages with similar problems to the Sarioglan District in Turkey there are located slightly. Legal arrangements should be specially prepared for these units to solve the problem, and different alternatives such as the second cadastre and the multipurpose cadastre should be considered.

4.1. What To Do In Terms of Principles of Cadastre 2034 Vision

The cadastral works of Sarioglan District completed in January 2018 are evaluated in terms of principles of Cadastre 2034 Vision, the following can be said:

- With today's GNSS technologies, land boundaries are measured in high accuracy and global coordinate systems, but these measurements are not evaluated to allow for 3D/4D modelling. The obtained measurements should be able to evaluate the digital terrain models (3D/4D terrain models) needed/required areas.
- It can be said that all the rights, restrictions and responsibilities that parcels have during recording are partly recorded. However, there is a special case here in Sarioglan District and the actual users of the land cannot be reflected in the land registry records. Resulting from the cadastral legislation in Turkey, in other words, because it does not allow the second cadastre of Law No. 3042, this problem cannot be

resolved. Consideration should be given to the enactment of the cadastral renewal and updating law concerning the resolution of these problems. In this case, the cadastral areas should be made cadastre again, changes in the ownership and property of the immovable (sale, donation, transfer by inheritance etc.) and must be taken into account that the changes in the geometry of the immovable (such as parcelling, combination of parcels, land use conversion), it should be possible to make cadastral surveys in possible non-registration areas and to collect new data on each immovable (Sari, 2013).

- The numerical and verbal data obtained as a result of the measurement are presented to the user via MEGSIS. At the same time, the changes made on the land and cadastral plans are uploaded to the system as soon as possible, shared with the institutions and organizations that need it, and the loss of duplicate labour, time and cost is prevented.

5. CONCLUSION AND RECOMMENDATIONS

In this study, by explaining the current situation of Turkey Cadastre and problems experienced, we make a general assessment in terms of principles of Cadastre 2034 Vision. We also put forward the deficiencies need to be fixed in cadastral surveys and observed in Turkey Cadastre above average in terms of principles of Cadastre 2034 Vision.

GDLRC has been currently carrying out projects such as digitization projects and cadastral map and information updating projects within the scope of sub-article (a) of article 22 of the Cadastre Law No. 3402. Taking into account the changes that the cadastre concept has undergone over the last two decades, it will be more useful to make the cadastre redefinition in the light of the principles of Cadastre 2034 Vision and to carry out future work in line with this vision.
The work to be done in order to make all the rights and restrictions on the land of cadastral works to be suitable for all information systems with a concept that uses geomatic technology and provides cost recovery should be evaluated within strategic planning (Durduran et al., 2007).

However, it should not be forgotten that cadastral systems of the future should be evaluated together with environmental, environmental management, land management/administration, technology, information systems, globalization, urbanization, good governance, climate change and, most importantly, sustainable development.

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