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Research Article

DETERMINING AND FINDING SOLUTIONS TO THE SECTORAL PROBLEMS OF CADASTRE IN TURKEY

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ABSTRACT

Up to date, it was produced in Turkey different type of cadastral bases based applications in 2D. When evaluated in terms of modern cadastre, Turkish cadastre must enrich its scope and contents. With this article, it was investigated that current situation of Turkish cadastre, the suitability of the existing cadastral structure for multi-purpose cadastre in technical and legal terms via questionnaire. The following results were obtained for the Turkish cadastre. It is insufficient in terms of multipurpose cadastre, doesn't include land value for immovable property, 3D location data, land value maps, data for urban and rural land use. In addition to them, it also doesn't cover some rights and restrictions on the immovable property. The current cadastral system doesn't permit to registry for some area which are pasture, grassland, rocky terrain, swamp and marine areas etc. It is recommended that the content and scope of the cadastre should be developed according to the identified deficiencies in the study.
Keywords: *Multipurpose cadastre, content and scope of cadastre,* questionnaire.

1. INTRODUCTION

Ever since cadastre first appeared in the world its targets have been changing according to the period under question. Over time, the notion of cadastre which appeared for economical reasons has transformed into systems in which immovable properties are registered and taken under legal assurance. With the transformation of land which is the focal point of cadastre into a scarce societal resource the expectations from cadastre have changed.

The increase in the population of the world, free market economy and globalisation have made security much more important in the land market. The security of ownership rights cannot be guaranteed any longer with the traditional cadastre system. The performance of the traditional cadastre system is not sufficient either. These systems neither provide reliable and appropriate information related to a piece of land nor offer services which are effective and cheap. Therefore;

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in the future, cadastral s ystems are expected to meet expectations such as cadastral data in accord with our age of informatics, the dynamic contribution of the private sector and sufficiency in production. On the other hand, the whole of the legal status of the land including public rights and limitations will be represented with the expansion of the contents and scope of cadastre [1]. In another foresight the cadastre of the future offers elevated locational sensitivity, an object based approach in which all rights, limitations and responsibilities are represented, the ability of 3 dimensional visualisation and storage, up-to-date data, standardised data on a national and international scale and an environment centered approach [2]. Currently, most locational data is presented in 2D. Because all the rights, restrictions and responsibilities related to the land overlap, the current 2D cadastre systems are insufficient in some situations. As a result of the fast increase in population, in urban areas where the perpendicular dimension of the land is used intensely [3], various ownership units overlap or intercept and even more complicated structures come about [4, 5]. In the future, the 3D presentation of this information will be even more necessary [6]. The International Cartographers Union (FIG) gave place to the following while describing modern cadastre: It is established for the purposes of; (1) taxation (valuation and legal taxation), (2) legal purposes (land market), (3) the assistance of land and land usage management (planning and other management means), (4) sustainable development and (5) protection of the environment [7].

Currently, more information is needed to make the most of land which has become a scarce resource, to preserve clean water resources and agricultural land which are gaining more importance day by day and to hand public properties, forests and coasts over to future generations. All plans and projects related to land will be successful only if we have sufficient information related to the area we are in. However; cadastral bases which have so far been produced in Turkey are limited in scope and consist only of border cadastre an deven these technically insufficient works haven't been spread throughout the country [8]. The contents of Turkish cadastre must be enriched in order for it to meet the needs of today becuse the current understanding of immovable property ownership has acquired different dimensions compared to the past. In times when production depended mainly on agriculture, the productivity and size of land were more important. In those days, areas in which today there are rich oil reservoirs may not have been deemed valuable at all. However; today there exists different criteria to determine the value of immovable properties and maybe in the future new and different criteria will come to being. The primary principle for a country is to maket he most of immovable properties. The current capacity must be known very well in order to plan this principle and an important amount of this data can be obtained durin cadastral works. Cadastre is expected to cover all land and include all information which mechanics, economy, social life, statistics and science may need [9-11].

2. MATERIALS AND METHOD

In this study the ideas and evaluations of cadastre workers who are in the center of cadastral works about the Turkish Cadastral System will be put forward. The determination of sectoral problems, the sufficiency of the applications applied for their solution and the determination of ideas related to what kind of data must be included in the scope and contents of modern cadastre will be provided in this way. Valid and trustable data collection means are necessary in reaching wide sample groups in a short time for this to be possible. One of the most important of these means are surveys.

A survey is a data collection method used to collect data and reach as many people as possible in a short time [12,13]. With this means of data collection, data is collected from a wide sample group by asking people questions directly related to data about the topic being researched. It is possible to reveal the current situation by reaching many people in a short time via surveys [13].

To this end, the opin ions of qualified personnel carrying out activities related to immovable properties and who have recieved surveying training at graduate or under-graduate level, who are working for the General Directorate of Cadastre and Land Registry and holding the titles of engineer, control engineer, expert assistant, manager, and technician have been consulted. The survey form has been applied on 105 samples working in a total of 41 official institutions throughout Turkey (Table 1 and Figure 1).

Table 1. The Number of Directorates and Sample Groups on which the Survey has been conducted

Name of Organizations	Number of Organizations	Sample
GDLRC(Local Organizations)	39	81
GDLRC (Central Organization)	1	19
Others	1	5
Total	**41**	**105**

Table 2. The Primary Stages of the Survey

Section	Number of Questions	Subject
1	8 Questions	Demographic features of the sample group
2	4 questions, 11 sub variables	The sufficiency of the land registry training they recieved at university
3	4 questions, 21 sub variables	Occupational knowledge and experience in their professional life
4	6 questions, 26 sub variables	Their views on the contents and scope of land registry
5	2 questions, 19 sub variables	The problems they come across during land registry works
6	5 questions, 22 sub variables	Ideas about the sufficiency in land registry
7	3 questions, 7 sub variables	The importance of private sector
8	3 questions, 27 sub variables	The place and importance of spatial data systems in land registry works
9	3 questions, 11 sub variables	The cadastral situation of the land registry Office they are working in
10	1 question, 3 sub variables	Ideas about training programs

The four page survey consists of 31 questions with a total of 146 sub-variables. The survey has been divided into ten main groups depending on the purpose of the study (Table 2) [14].

A total of 102 surveys were evaluated in the study. The results were statistically analysed. During the analysis, the variables obtained from the surveys were coded and a database was established. With this database, the analysis of each of the questions in the survey was made.

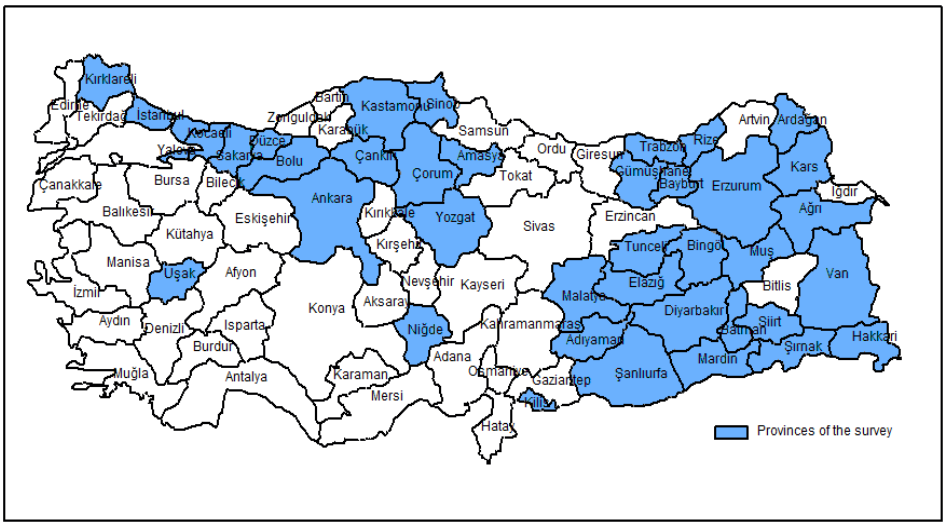


Figure 1. The Land Registry Offices in which the Survey has been conducted throughout Turkey

2.1. Validity and Reliability Analysis

Making a validity and reliability analysis of the survey reveals how practicable the data obtained at the end of the study is. Validity is a term used to tell how much the findings which are obtained cover the subject being researched. The most important point in a survey in terms of validity is that the survey provides content validity [13]. Content validity is also called scope validity. The important point in content validity is that the survey serves its purpose and that the questions in the survey are in accord with the purpose of the study [15]. After validity analysis, reliability analysis was made for the data on the basis of deductional statistics. Reliability analysis measures the consistency among the items on a scale and presents information about the relationship between these items [16].

The participation of 105 experienced GDLRC workers was provided for the application of the survey and were named as the sample group. The survey consisting of 31 questions was conducted on the sample group. Open ended questions were also asked to the sample group in case they couldn't find answers reflecting their opinions. The questions in the survey were prepared according to the Likert Type Attitude Scale.

In the Likert Type Attitude Scale, it is considered that the score distribution obtained from an item is constantly variable. In addition the option of answers are more than two and there is no single correct answer among the options. Apart from this, one of the primary assumptions of this scale is that each item in the survey is in a monotonic relationship with the attitude being measured. This means each item measures the same attitude. Therefore; it is accepted convenient to use the “Cronbach Alpha” cosufficient which was developed by Cronbach as a measure of consistency to determine the level of reliability in a Likert Type Attitude Scale [17]. Therefore; the reliability of the scale being used was determined by calculating the Cronbach Alpha Cosufficient for Reliability Analysis.

The evaluation criteria adapted in the evaluation of the alpha cosufficient is as follows [18]:

If it is between $0.00 < \alpha \leq 0.40$ the scale is not reliable.
If it is between $0.40 < \alpha \leq 0.60$ its reliability is low.
If it is between $0.60 < \alpha \leq 0.80$ it is rather reliable.
If it is between $0.80 < \alpha \leq 1.00$ it is a highly reliable scale.

As a result of the Alpha Cronbach Cosufficient reliability analysis, the alpha cosufficient was determined as 0.94 (Table 3). This result shows that the scale is highly reliable.

Table 3. The Calculation of the Cronbach Alpha Cosufficient

Reliability Statistics	
Cronbach's Alpha Cosufficient	The Number of Items Based on Statistics
0.94	146

3. FINDINGS

The answers given to the survey questions by the sample group have been presented by eing enriched with the use of graphics and charts.

3.1. The General Demographic Features of the Sample Group

When the professional experience and qualifications of the sample group are taken into account it is seen that 99% of them possess a degree of Survey and Land Register Engineering training it is also seen that 34% of them have expertised within the related institution (Table 4). When the age range of the sample group is taken into consideration it is seen that a large proportion of them, namely 79%, are between the ages 26-40 (Figure 2). It is also understood that the Professional experience of the majority of them (72%) is under ten years (Figure 3).

Table 4. Titles of the Sample Group in the Units They Work

Title	**Frequency (f)**	**%**
Engineer	67	65.7
Controlling Engineer	27	26.5
Assistant Expert	4	3.9
Technician	1	1
Departmental Manager	3	2.9
Total	**102**	**100**

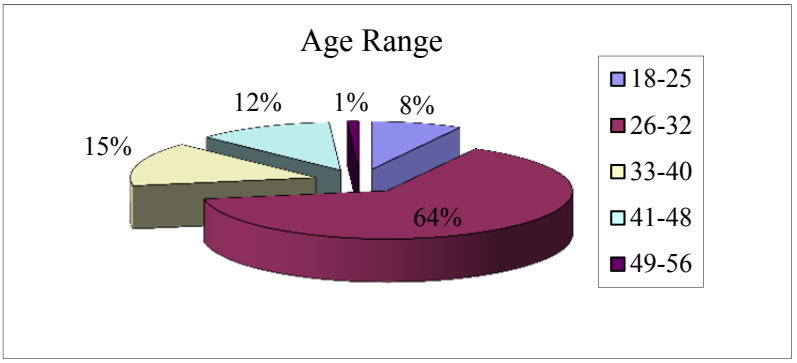


Figure 2. The Age Range Figure of the Sample Group

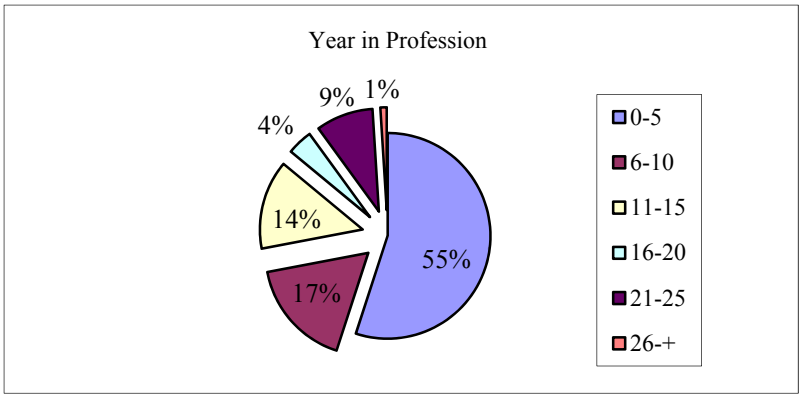


Figure 3. Figure Showing Experience in Profession

3.2. The Knowledge and Experience of the Sample Group in the Professional Sphere

With the questions asked under this title what kind of applications they carried out, technological developments, and their ideas about cadastre systems in developed countries and their operation were attempted to be evaluated with 21 sub variables. According to this, it was seen that among cadastral works the sample group focused mainly on the digitisation of cadastral maps, classical cadastre and the correction of post-cadastre technical mistakes (Table 4).

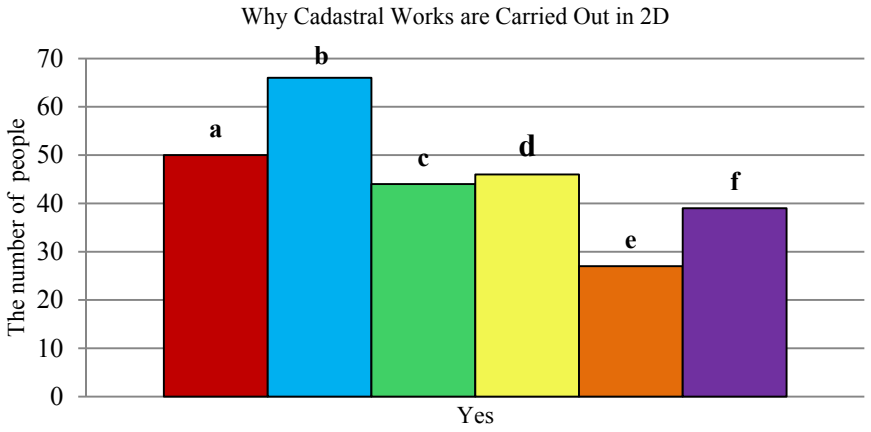
Table 4. Analysis of applications carried out by the sample group throghout their working life

APPLICATION	Frequency (f)	Percentage (%)
Digitisation of Cadastral Maps	82	80
Renewal of Cadastral Maps	39	38
In the Control of Projects Based on the Arrangement of Rural and Urban Areas (Land Consolidation,Parcel and Land Arrangement)	38	37
In Expertise Works Related to Land Management Problems	38	37
The Correction of Post-Cadastre Technical Mistakes	70	69
In Classical Cadastre Works	52	51
Application, Land Amalgamation, Setting Marks and Land Use Conversion	94	92
In Land Registry and Cadastre Information Systems Applications	29	28

3.3. The Ideas of the Sample Group about the Scope and Contents of Turkish Cadastre

"Our current cadastral works must legally be carried out in 3D. However; it is seen in practice that the works are carried out in 2D. "Which of the following do you think can be the most important reason/reasons for this?"

An evaluation was made in the analsis of the answers given by the sample group to this question by considering the average scores of the answers (Figure 4).



a) The understanding that it is not necessary to produce cadastre bases in 3D,and that it is sufficient to position borders in 2D.
b) Political and bureaucratic pressure to finish cadastre works as soon as possible make 2D measurements obligatory
c) The deficiency of the cadastre crew in 3D cadastre works
d) The time of finishing work in primary cadastre being short for 3D land purchase
e) The deficiency of the technology used in cadastral works
f) The deficiency of most of the cadastre bases produced so far and the idea that the countries cadastre will be made in 3D in terms of modern cadastre in the future

Figure 4. The opinions of the sample group as to why cadastral works are carried out in 2D

"Do you find the current cadstre system sufficient in terms of its scope (the areas included in registry)?"

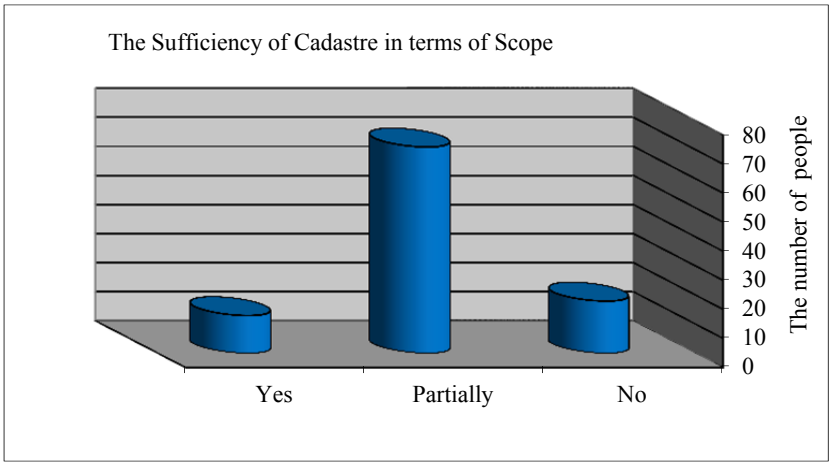
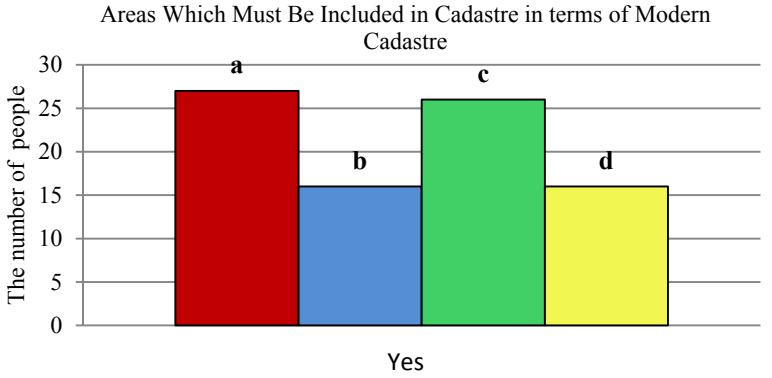


Figure 5. The sufficiency of the current cadastral system in terms of scope



a) That the term area exempt from registry must be changed in our laws and all areas consisting of land and water must be registered must be provided in terms of scope
b) Snow waters must be registered including their beds
c) Areas such as rocky places, stoney places and hills must be included in scope
d) Shores and sea areas must be included

Figure 6. Areas whose inclusion are suitable within the scope of cadastre

"*Do you find the current cadstre system sufficient in terms of its content*?*"* The analysis of the answers which the sample group gave to this question are presented in Figures 7 and 8.

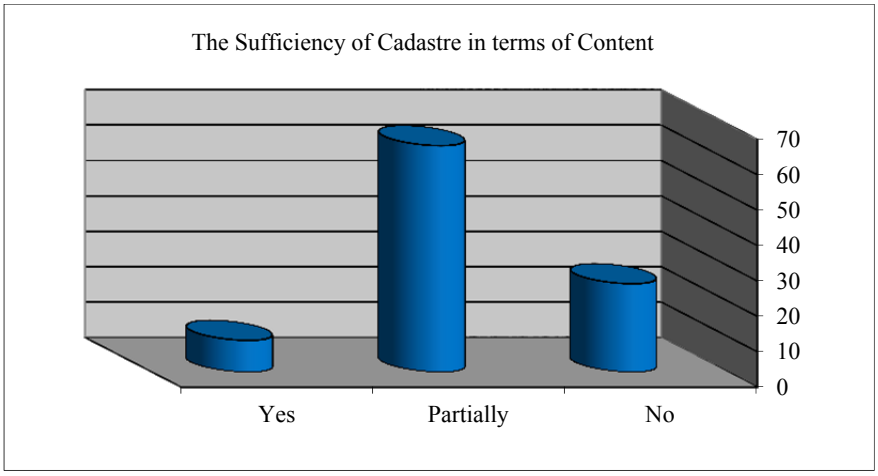
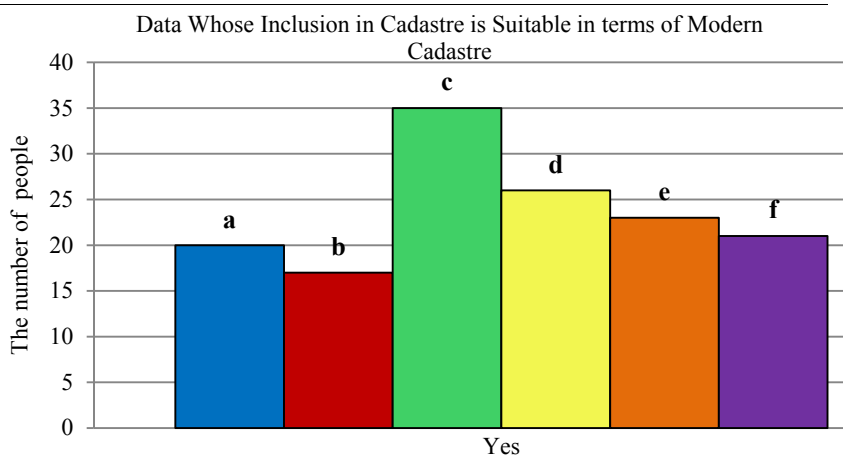


Figure 7. The sufficiency of the current cadastral system in terms of scope



a) The measurement of parcel boundaries and the facilities within them and the determination of the owner and area are not enough
b) It will be sufficient in terms of content for the current technical substructure facilities to be positioned in 3D and be registered by being shown on the parcel
c) In addition to the current system, the land usage situation on the parcel (agricultural usage boundaries, woodland, rocky land, archeological site, jeologically inconvenient areas) must also be measured and registered
d) Land value maps must be prepared together with cadastre and included within the content of cadastre
e) Via cadastre, the immovable value of immovable properties under the process of evaluation in urban and rural areas must be included within the content
f) All land objects which can affect the rights of ownership, usage and utilization of the surface, underneath or above of the immovable property positively or negatively should be included in the content of cadastre and registered

Figure 8. Data whose inclusion are suitable within the scope of cadastre

"When you evaluate the current cadastre system in terms of the deficiency of its contents and scope, what do you think about the renewal and the enrichment of only the content of cadastre in areas formed in the ITRF cadastre base system with cadastre works?

The analysis results of this question in which the ideas of the sample group related to the deficiency of the scope and content of the current cadastre system were evaluated are presented in Figure 9. In the analysis of the question which fourteen participants didn't answer, it was concluded that the participants believe that even in areas which cadastre documents are technically free of problems, a new and enriched cadastre program must be carried out.

After all these evaluations the ideas of the sample group related to the sufficiency of the current cadastral system were evaluated with the following question: *"Can you score the current cadastral system in terms of its sufficiency related to the following headings? (Order them from 1 to 5, 1 being the most important for you) (Figure 10).* As a result of the evaluations, while the measurement methods used in the current cadastral system were found to be sufficient, it was analysed that the organizational structure, current regulations and the technology used were found to be insufficient.

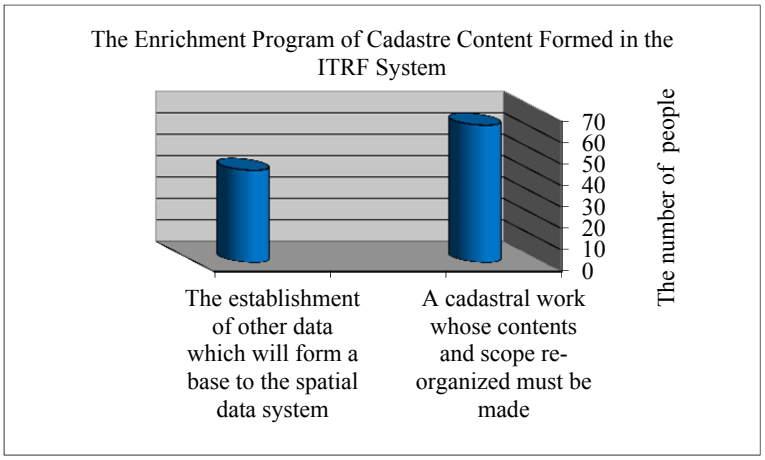


Figure 9. The Ideas of the Sample Group about Works Aiming to Enrich Cadastral Content

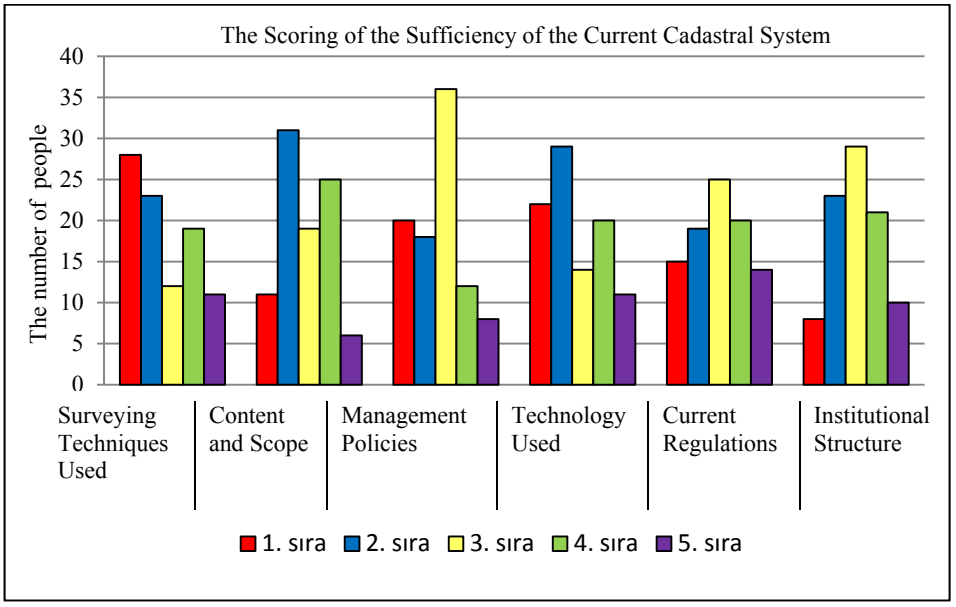


Figure 10. The ideas of the sample group about the sufficiency of the current cadastral system

3.4. The Chi-square Analysis of the Ideas of the Sample Group about the Content and Scope of the Turkish Cadastral System According to their Professional Eperience

As it can be seen in Figure 3, the sample group consists mainly of cadastre workers with a Professional experience between 0-5, 6-10 and 11-15 years. Therefore; the ideas of the sample group about the scope and content of the Turkish Cadastral System have statistically been obtained from the sample group consisting mainly of cadastre workers with a professional experience between these years. For example, while 61% of the sample group with professional experience between 6-10 years and 64% of the sample group with professional experience

between 10-15 years find the scope of the current cadastral system partially sufficient, 56% of the sample group with professional experience between 6-10 years and 64% of the sample group with professional experience between 10-15 years find the content of the current cadastral system partially sufficient

3.5. The Ideas of the Sample Group about the Place and Importance of the Spatial Data System in Cadastral Works

The ideas of the sample group about the place and importance of the spatial data system in cadastral works have been analysed with the two following questions: *"The clause saying the substructure of spatial data systems is established with cadastre has been added to the purpose section of our cadastre law. Do you produce positional or non-positional data from the current data substructure in cadastral works aimed at this?"* and *"Do you think that the substructure of spatial data systems can be established with cadastre in the current system?"*

The analysis of whether positional or non-positional data is produced differently from the current data substructure in cadastral works has been made in Figure 11. According to this, it was determined that 12,7% believe that positional or non-positional data is, 54,9% believe it isn't, and 26,5% believe that it is partially produced in cadastral works.

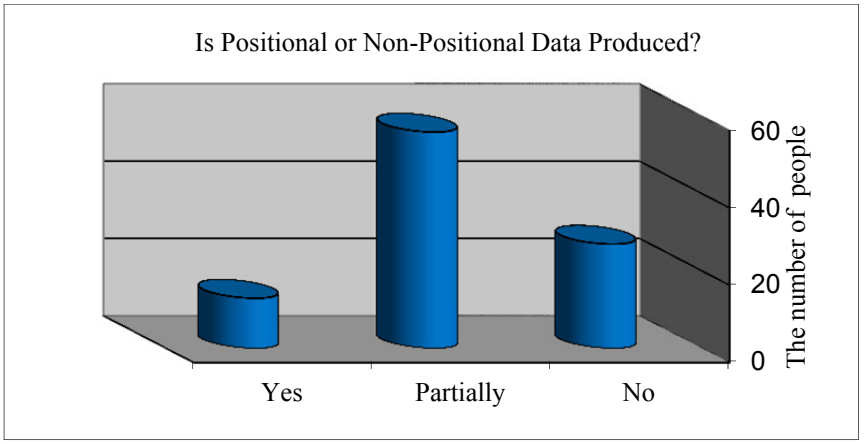


Figure 11. Producability of positional or non-positional data in cadastral works

The analysis of whether the substructure of spatial data systems can be established with the current cadastral Works in relation to an upper analysis has been made in Figure 12. It was determined that 33% of the participants believe that the data system can be established with the current system, 27% of the participants believe that it can't be established with the current system and 39% of the participants believe it can be partially established with the current system. Different answers at close rates were given to this question by the sample group.

The participants who answered that the Spatial Data System can be either totally or partially established with the current system were asked to indicate which spatial data types given in the question as multiple choices can be produced by which institution during cadastral works. As a result of the analysis it was determined that 3D positional data, the attribute data of land objects which can form a basis to measurement, all limitations and rights related to the parcel, the coordinate data of the boundaries of the parcel (3D and in the ITRF system), the owner of the parcel, the acreage of the parcel, the boundaries of geologically reserved areas, forests, pastureland, summer pastureland, villages, the 3D determination of protected areas, and other attributional and positional data can be produced by the GDLRC.

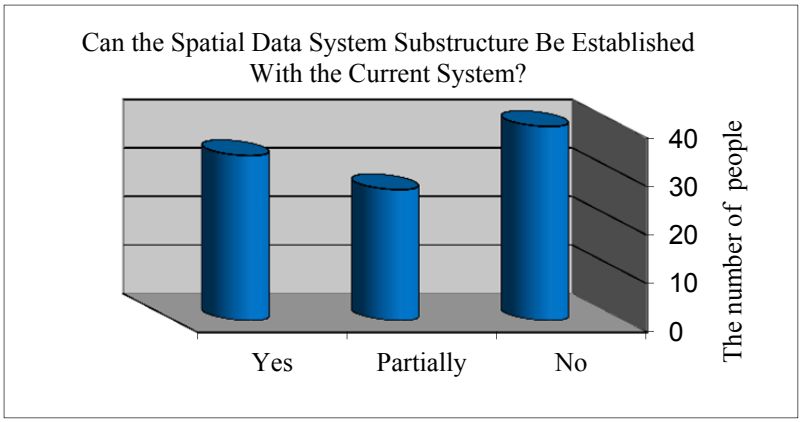


Figure 12. The possibility of establishing the Spatial Data System with cadastral works in the current system

4. DISCUSSION

So far, cadastral works in Turkey have been carried out by using various measurement methods in different coordinate systems, different bases and scales [19, 20]. Especially the development in technology and the increase in its contribution to cadastre in the years after the 1990's, digital cadastral works have been carried out in the ITRF coordinate system (International Terrestrial Reference Frame) [8]. Cadastral products have been produced in 2D in each system. After the involvement of the private sector in cadastral works in 2004, only parcels and the size of the details on them have been carried out in 3D [21, 22]. Up to this process, the establishment of cadastral bases with measurement methods low in positional sensitivity in city centers, urban development areas and adjacent areas of cities where land values are very high and engineering activities are intense has drawn attention as a very important cadastral problem [23]. After primary cadastre aiming to solve this problem, renewal cadastral works and digital cadastral works have been carried out for areas in which cadastral bases are deficient and currently Turkish cadastre has been 99% completed in rural and urban areas [24,25, 21, 26, 8]. Digital cadastral bases which are a very important legand for TAKBIS [27] and must be produced in the ITRF were produced in rural areas in especially which no cadastral work had been carried out before in the process of tendered cadastral works. However, the transformation of areas whose cadastre was carried out with the orthogonal measurement system in city centers between the years 1950-1980 into digital form and the establishment of the country's cadastre as a whole in the ITRF system stil remains as an important problem *[23, 28, 20]*. In addition to all these, with the addition made to the purpose of our cadastre law, its purpose has been enriched and its target has been set as not only to determine the boundaries and owners and to calculate the size of immovable properties in the ITRF system but also to establish the substructure of spatial data systems with cadastre. Therefore, with cadastral works the determination, measurement and registration of various data given within the scope of land object and the establishment of 3D or 4D land registers aiming at this is a very important duty given to cadastre. At the point reached, according to Cadastre Law numbered 3402, the country's cadastre has been completed and the cadastre law has fulfilled its duty. In spite of this, new fields have been created for cadastre and cadastral data which are of a dynamic nature. With new legislative arrangements, the working area of the surveying sector must be re-defined by re-designating the scope and content of cadastre and re-organizing the institutional structure and technical means aiming at this. With this study, what the new working areas of the surveying sector can be have been investigated. As a result of the study it is

understood that all land objects which are necessary for the establishment of spatial data systems must be formed with the collobarative work of different disciplines. This necessity will establish the very important substructure for our future cadastral duties which will confront us in both e-state applications and the INSPIRE (Infrastructure for Spatial Information in the European Community) directives which are a part of the European Union adaptation process.

5. RESULT AND SUGGESTIONS

Within the transformation process of the Cadastre of Turkey into modern cadastre, it has been determined that a part of the current cadastre data is insufficient in terms of exact position sensitivity and capability of representing the estate. With the motive that it is necessary to transform and transfer digital cadastre bases having the desired exact position sensitivity and capability of representing the estate into the ITRF system throughout the country, the GDLRC has started works to complete most of primary cadastre and renewal. However, this is not enough for the substructure of modern cadastre because, first of all, the current cadastre bases must be established in a way that they contain 3 or 4 dimensional data. What is meant by 3D is not only to carry out land measurement in a way that includes the parcel corners. It is rather to establish the topography of the land in a digital form and with a dimensional drawing logic in a way that it can form a base for all engineering activities that will take place on it. In addition, all kinds of objects on, under or above the land which will directly effect the usage, benefitting and ownership rights must be determined and measured because with Cadastre 2014 a cadastre parcel has been defined as a cubic object as a land object. The surface of the parcel is somewhere within this land object, and the parcel doesn't consist only of the surface. However, in the current system this is how it is and this situation complies neither with Cadastre 2014 and INSPIRE directives nor with the targets trying to be reached by developed countries in their surveying sector and therefore with cadastral tendencies. For this reason, the establishment of data substructures aiming at the determination, measurement and registration of land objects based on parcels in Turkey and the legitimization of such land objects must be targeted. In order to realize this, the content and scope of the current cadastral system must be re-determined. Especially which data related to the land can be included into the system via cadastre must be put forward with its reasons. In order to determine this, according to the survey carried out with the sample group chosen from experts working in the surveying sector:

It has been concluded that there is a need; for the area which cadastre covers to be reorganized in a way that it covers the entire piece of land, for the ensurement of not leaving any land outside cadastre, and for the development of a system which will determine and register all the current areas throughout the country.

In addition to this, currently in the globalising world where great engineering projects have transitions between continents, the establishment of the substructure of intergrated coast management of sea areas via cadastre and the necessity of the inclusion of these areas in the cadastral system have been determined. The establishment of the substructure of data systems via cadastre has become the purpose function. However, what the data forming the substructure of spatial data systems is hasn't been clarified with laws or regulations. There is primarily a need to determine spatial information system data and the standards it must possess. At this point, with the survey carried out it has been concluded that; the establishment of value maps of the immovable property, land value maps belonging to agricultural areas, 3 or 4 dimensional spatial data, and positional and verbal data which may be related to the immovable property within the scope of land objects can be succeeded via cadastre. The necessity to update the content of cadastre for this purpose has been revealed. In addition to this, it has been concluded with this study that after the completion of cadastre which is of a dynamic nature throughout the country, cadastral works will not finish. In fact, it has also been understood that it is extremely necessary for all land objects which are necessary for the establishment of spatial data systems to be formed

with the collobarative work of different disciplines. In multi faceted studies carried out within GDLRC, a lot of problems including technical, legal, political and bureaucratic ones are encountered. The existence of many problems including problems arising from plot-base inconsistency, forest, pastureland, and plateau borders; the nonapplicability of old title deed registers; problems arising from administrative boundaries and the private surveying sector; administrative problems arising from the GDLRC organization, and problems arising from the lack of legislation has been understood. However, the fact that these haven't been solved yet, refrains the surveying sector from meeting the expectations of public institutions apart from the GDLRC, the private sector apart from the surveying sector and citizens. The most important of all is that these problems cause the system of our country not to come to the same level as the developments in Europe and on the universal scale.

Various surveying based applications are carried out for different land types by different institutions according to different standards. Because different standards and methods are used in forest, pastureland and de-forestration (de-forestration means that an area which was legally accepted as a forest or part of a forest via cadastral works, has after time lost this speciality, so this area both legally and technically may not be accepted as a forest anymore under certain, strict rules) processes, even in some technical points which are trying to be standardised by the GDLRC a unity cannot be provided. For this reason, another finding of the survey which has been carried out is that it is not correct in professional terms that cadastral works and works related to the surveying sector are carried out by different institutions and the only authorized institution must be the GDLRC.

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