A Spatial Decision Support System Design for Land Consolidation Projects

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Key words: Land consolidation, SDSS, system design, reallocation

SUMMARY

Land consolidation (LC) has been defined broader social and economic reforms from the time of its earliest applications in Western Europe. The first consolidation initiatives of Denmark in the 1750s were part of a profound social reform to free people from obligations to noble landlords by establishing privately-owned family farms. The consolidation of fragmented holdings did result in improved agricultural productivity but this was not the only objective of these reforms. This chapter illustrates the wide range of rural development objectives, ranging from agricultural improvement to village renewal and landscape development and protection, which can be addressed through land consolidation projects. It describes various land consolidation approaches and concludes with an overview of conditions that should be put in place before land consolidation projects can be undertaken.

Increasing of the agricultural manufacturing and development of agricultural sector is defined as splitting of agricultural lands and combining seperately splitted agricultural areas according to the modern administrating services, styling and land arranging.

Land consolidation projects are a multiple criteria problem including location of parcels, redistribution, appointment steps. There is not a unique solution to solve this problems. For reallocation processes, generally computer calculations are not much considered. Because for the required criterias and limitations in the splitting step a computer calculation is unable to give all necessary answers at all. For a fast and efficient progress of the project studies, usage of the computer technology has been an essentiality.

Spatial Decision Support Systems (SDSS) consist of multiple chose criterias and a managing system that produces the most efficient solution for managing these criterias. In this study design step of SDSS is dealed for helping planning and decision making in land consolidation studies. It will be able to help an easier decision making by analysing datas required by database which is created in Geographic Information System (GIS) style. Also the best visual design is aimed to be served to the user with an efficient interface.

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1. INTRODUCTION

Agriculture has been accepted as the basic of nations' political and social stability since ancient times. Agriculture sector plays an important role in large scaled employing of people. In most countries of the world, agriculture is still the most responsible sector for employment and maintaining a large percentage of society.

Land degradation is the biggest obscure for the sustainable agriculture. Primary way of preventing this negativity is making legal arrangements for preventing more breaking up and healing the breakages, disorders already existing. These studies which aim rearranging of the agricultural areas are called as land consolidation.

Land consolidation can be described as rearranging and taking all precautions for a more fruitful working of land areas according to the developing agriculture technology of today (Çay, 2001).

In the study of land consolidation, reallocation step is accepted as core of consolidation. This is a tool which rearranges proprietary rights. The pleasure of consolidation is accepted as "pass grade" of land consolidation in a way. Because problems in the step of reallocation are the main reasons of rejections in the end of the project. In the basis, wishes of the landholdings for the reallocation are asked and assessed in the beginning. In this step, wishes of the landholdings should be considered carefully and necessary studies should be done for convincing them.

In this study we proposed a methodology about the land reallocation of the farm areas' parcels, along with a software which we have created. This system which is called as SDSS is a computer based system for the spatial reallocation decision problems, and gives great achievement in solving them. Experts of the matter thinks that this software will ease and fasten the land consolidation studies. This system which we have created in GIS style will be able to analyse the data which we required from database and will help to fasten the process and fastening the decision making. Also best visual design is aimed with an efficient interface. The created system data includes input, stocking, handling, analysing, calculating, reporting and geographically referenced datas visualition processes.

And data for the project area and coordinates can not be shared within the commercial softwares for the land consolidation. So, when we transfer the datas which we use for a commercial software to another software, there is a lot of loss of data. This process does not supply us so much choices. In the created software, these datas are kept in a database which enable us to use it in a lot of softwares.

Armstrong and Densham (1990) offered 5 key modules which is necessary for a SDSS :

1. Database management system
2. Analysis processes in a model based data management system.
3. A graphic producer
4. A report producer
5. User interface

We will explain our study on these five main modules.

2. A DATABASE MANAGEMENT SYSTEM DESIGN FOR LAND CONSOLIDATION

Cartographic views of a database for spatial decision support system,can support spatial questionings and analitical models. We have used MS Access for creating database in our study.

For using in land consolidation studies, cadastral parcels, block records, land degrees, application limitations, farmer choices, an easy to use database is designed (Figure1). Spatial datas are generally information related spatially. In general meaning spatial data has three types: point, line and polygon (Yomralıoglu, 2000). In our study spatial datas are classified according to the specification of the data.

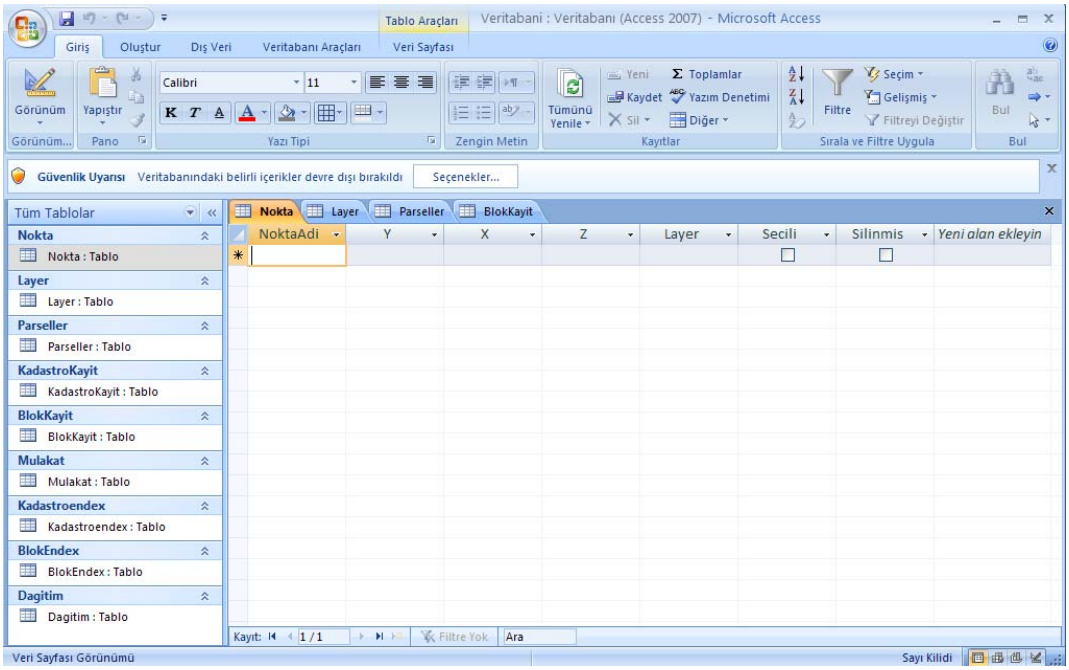


Figure 1. Database created by MS Access

Most effective method of the spatial data management is to use layer. For this aim we have used a ”layer table” in our study (Figure2). KADASTRO_PARSEL (cadastral parcel), KADASTRO_ADA (cadastral blocks), BLOK_PARSEL (new parcels), BLOK_ADA (new blocks), TOPRAK_DERECESİ (soil degrees) and GENEL_SINIR (project border) that shows limits of the study area are the basic layers that we use. In the questionings about the figures SQL, which is a sublanguage used in database questionings, preferred instead of MS Access.

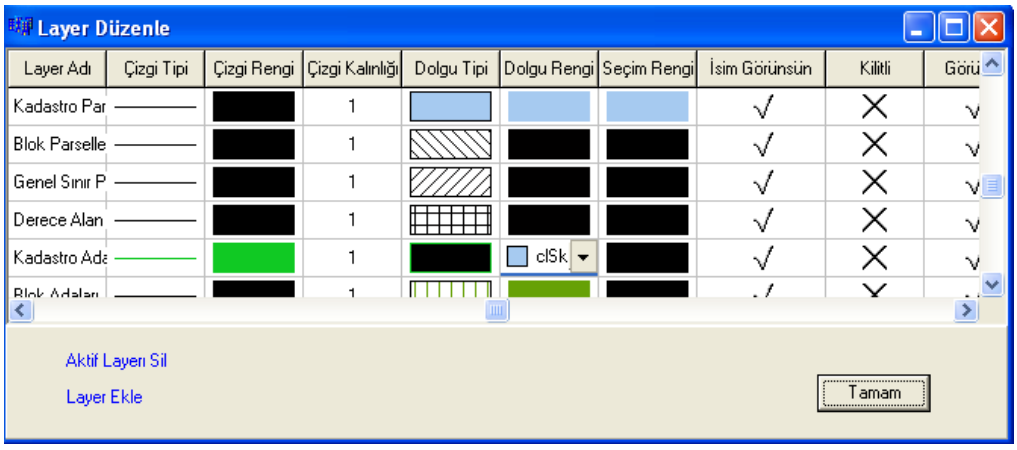
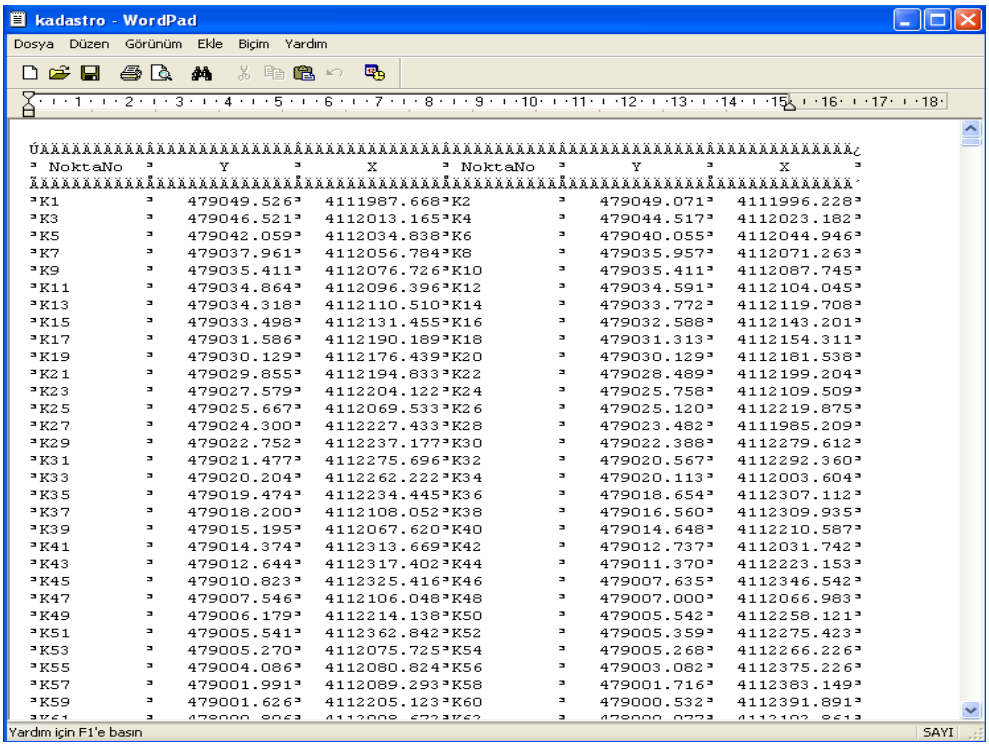


Figure 2. Created layer table.

3. ANALYSIS AND NUMERICAL CALCULATIONS IN A MODEL BASED DATA MANAGEMENT SYSTEM

We have used automotic data input in SDSS as manual data input process will take a long time. In order to be able to start land consolidation studies,cadastral records of the study area should be recorded in system.

Data collection for the spatial studies comprises nearly 2/3 of the total business cost. For this reason, creation of the data by the first hand and by the related institute,it is more advantegous to have related data from other sources related with the area. A software is prepared for the standardization of the datas.In the system, graphical values of the cadastral datas about the related area, is required by a commercial CAD software called as NETCAD (Figure3). But we will use our own software in our study, coordinate values of all datas are converted into required system with *.cks extended report files and transferred into MS Access database (Figure4).



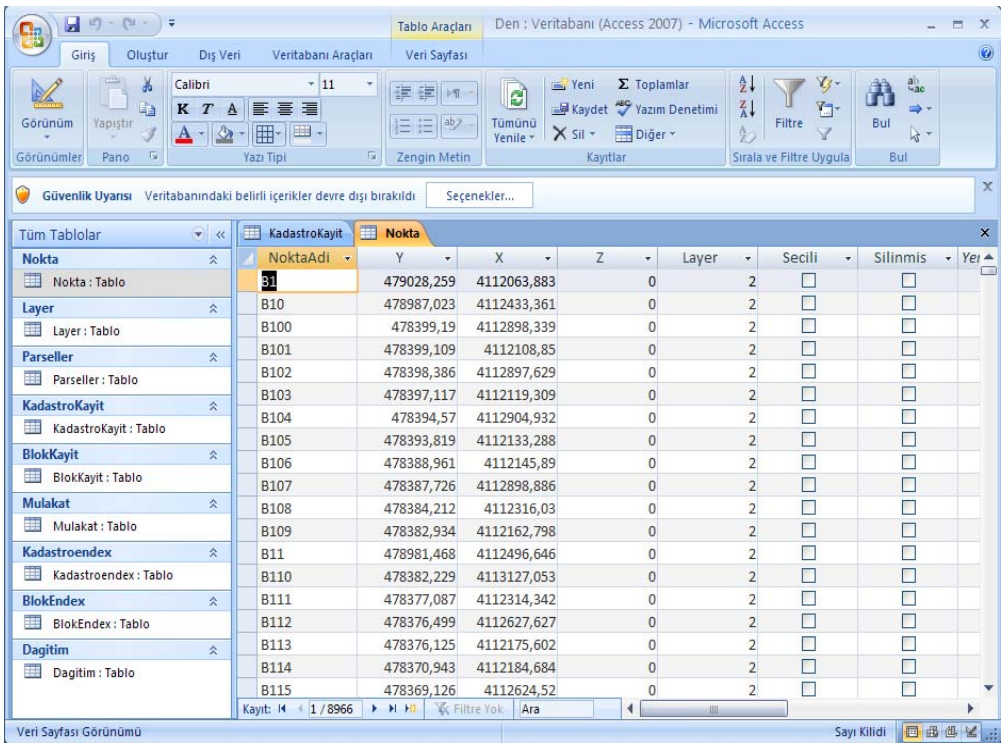
kadastro - WordPad

Dosya Düzen Görünüm Ekle Biçim Yardım

NoktaNo	Y	X	NoktaNo	Y	X
K1	479049.526	4111987.668	K2	479049.071	4111996.228
K3	479046.521	4112013.165	K4	479044.517	4112023.182
K5	479042.059	4112034.838	K6	479040.055	4112044.946
K7	479037.961	4112056.784	K8	479035.957	4112071.263
K9	479035.411	4112076.726	K10	479035.411	4112087.745
K11	479034.864	4112096.396	K12	479034.591	4112104.045
K13	479034.318	4112110.510	K14	479033.772	4112119.708
K15	479033.498	4112131.455	K16	479032.588	4112143.201
K17	479031.586	4112190.189	K18	479031.313	4112154.311
K19	479030.129	4112176.439	K20	479030.129	4112181.538
K21	479029.855	4112194.833	K22	479028.489	4112199.204
K23	479027.579	4112204.122	K24	479025.758	4112109.509
K25	479025.667	4112069.533	K26	479025.120	4112219.875
K27	479024.300	4112227.433	K28	479023.482	4111985.209
K29	479022.752	4112237.177	K30	479022.388	4112279.612
K31	479021.477	4112275.696	K32	479020.567	4112292.360
K33	479020.204	4112262.222	K34	479020.113	4112003.604
K35	479019.474	4112234.445	K36	479018.654	4112307.112
K37	479018.200	4112108.052	K38	479016.560	4112309.935
K39	479015.195	4112067.620	K40	479014.648	4112210.587
K41	479014.374	4112313.669	K42	479012.737	4112031.742
K43	479012.644	4112317.402	K44	479011.370	4112223.153
K45	479010.823	4112325.416	K46	479007.635	4112346.542
K47	479007.546	4112106.048	K48	479007.000	4112066.983
K49	479006.179	4112214.138	K50	479005.542	4112258.121
K51	479005.541	4112362.842	K52	479005.359	4112275.423
K53	479005.270	4112075.725	K54	479005.268	4112266.226
K55	479004.086	4112080.824	K56	479003.082	4112375.226
K57	479001.991	4112089.293	K58	479001.716	4112383.149
K59	479001.626	4112205.123	K60	479000.532	4112391.891

Yardım için F1'e basın SAYI

Figure 3. Coordinate report file presented by Netcad software.



Den : Veritabanı (Access 2007) - Microsoft Access

Güvenlik Uyarısı Veritabanındaki belirli içerikler devre dışı bırakıldı Seçenekler...

Tüm Tablolar

Nokta: Nokta : Tablo

Layer: Layer : Tablo

Parseller: Parseller : Tablo

KadastroKayit: KadastroKayit : Tablo

BlokKayit: BlokKayit : Tablo

Mulakat: Mulakat : Tablo

Kadastroendex: Kadastroendex : Tablo

BlokEndex: BlokEndex : Tablo

Dagitim: Dagitim : Tablo

KadastroKayit | Nokta

NoktaAdi	Y	X	Z	Layer	Secili	Silinmis
B1	479028,259	4112063,883	0	2		
B10	478987,023	4112433,361	0	2		
B100	478399,19	4112898,339	0	2		
B101	478399,109	4112108,85	0	2		
B102	478398,386	4112897,629	0	2		
B103	478397,117	4112119,309	0	2		
B104	478394,57	4112904,932	0	2		
B105	478393,819	4112133,288	0	2		
B106	478388,961	4112145,89	0	2		
B107	478387,726	4112898,886	0	2		
B108	478384,212	4112316,03	0	2		
B109	478382,934	4112162,798	0	2		
B11	478981,468	4112496,646	0	2		
B110	478382,229	4113127,053	0	2		
B111	478377,087	4112314,342	0	2		
B112	478376,499	4112627,627	0	2		
B113	478376,125	4112175,602	0	2		
B114	478370,943	4112184,684	0	2		
B115	478369,126	4112624,52	0	2		

Kayıt: 1 / 8966 Filtre Yok Ara

Veri Sayfası Görünümü Sayı Kilidi

Figure 4. Transfer of converted coordinate values to the database.

All geographical data objects have geometrical structure like point, polygon or line (Tsou, Buttenfield, 1996). By starting from this point, after the coordinates and parcels are transferred into database, parcels are drawn in vector data format as polygons (Figure5).

As non-spatial datas was provided from the cadastre foundation, process of transfering datas to the system is shown in Figure 6. Also in the same figure, index calculations of each parcel to be able to make the studies and overlay calculations, are required from degree areas and intersections of the parcel areas. At the end of this process,values of each parcel in the same degree values;

$$\text{Parcel Unit Value (PBD)} = \text{Share} \times \text{Index} \qquad \text{.....(1)}$$

calculated by system by using the above formula.

After that,by keeping the same degree value;

$$\text{Deduction} = \frac{\sum \text{cadastral parcel area} - \sum \text{block area}}{\sum \text{cadastral parcel area}} \qquad \text{.....(2)}$$

With this formula exact values are calculated which will be recorded with deduction values. After obtaining the necessary values, we can progress to the reallocation process which is accepted as the most important step for the land consolidation projects.

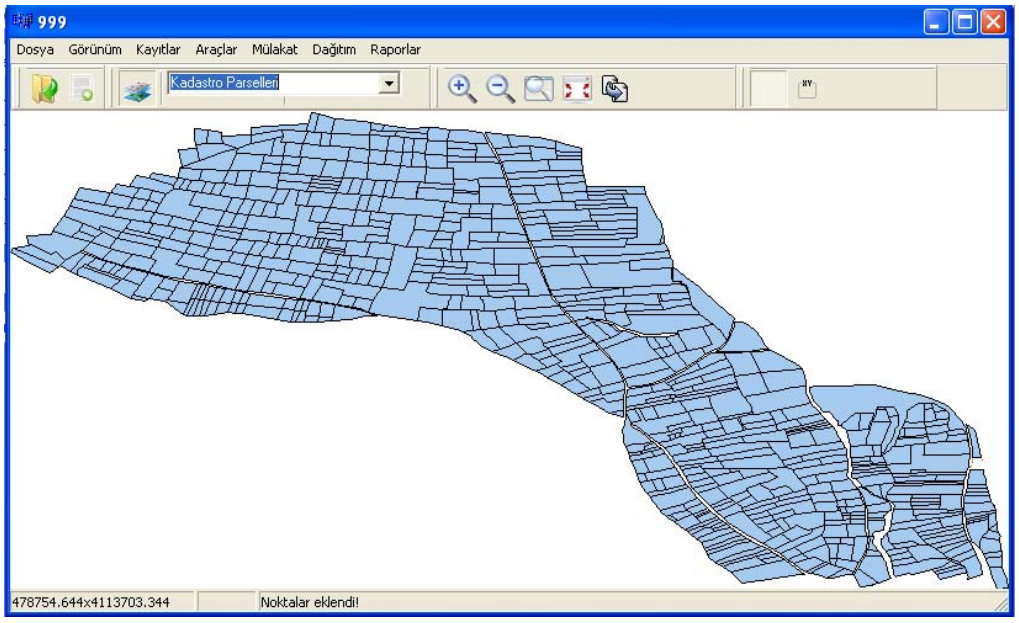


Figure 5. Drawing of the cadastral datas and parcels in vector data format which are added to database.

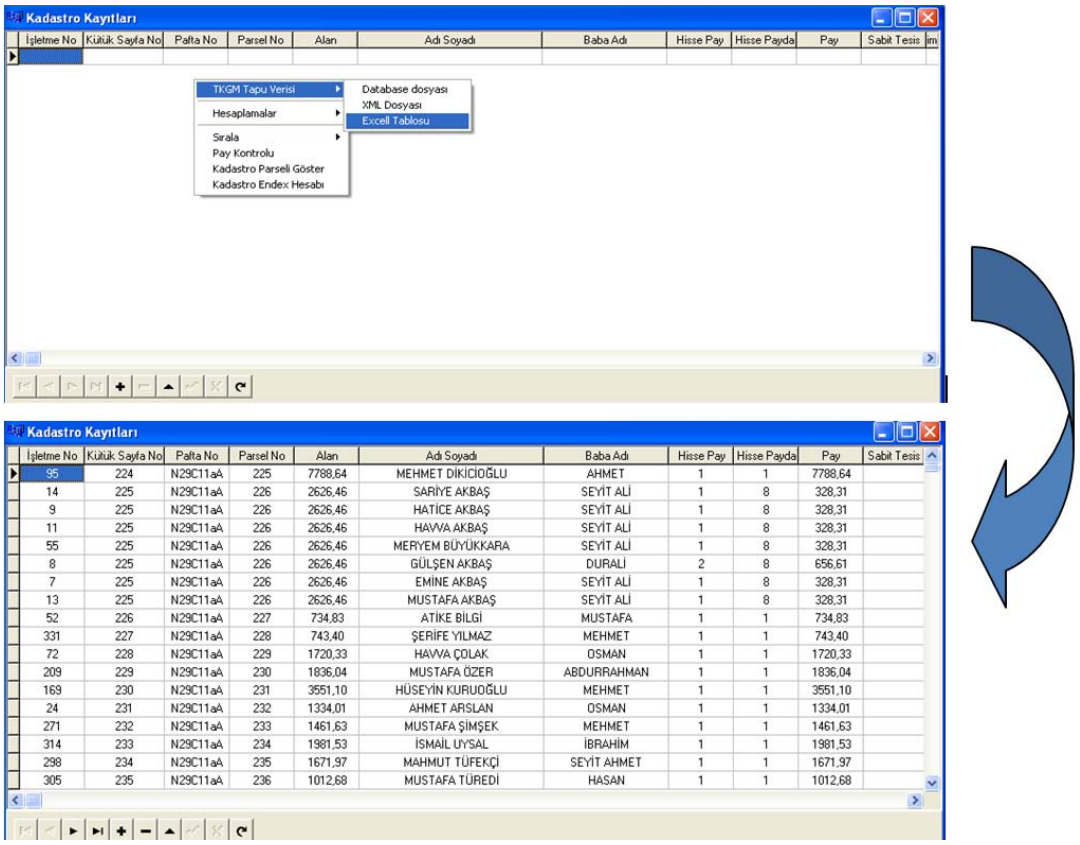


Figure 6. Transfer of non-spatial datas to the system.

A land consolidation project consists of various steps. Among these steps, reallocation of the parcels is a process which requires various criterias and considering a lot of limitations (Semlali, 2001).

In the devoloped software, most important criteria for the reallocation is the wishes of the landholdings. In this aim three choices are asked to all landholdings and recorded in system. Figure 7 shows the system that we created for reallocation process. There is two options are given for the reallocation.

First technique is to make reallocation process manually (Figure8). In this situation, authorised person finished the process by following the wish of each landholding on the screen and graphical situation of the blocks.

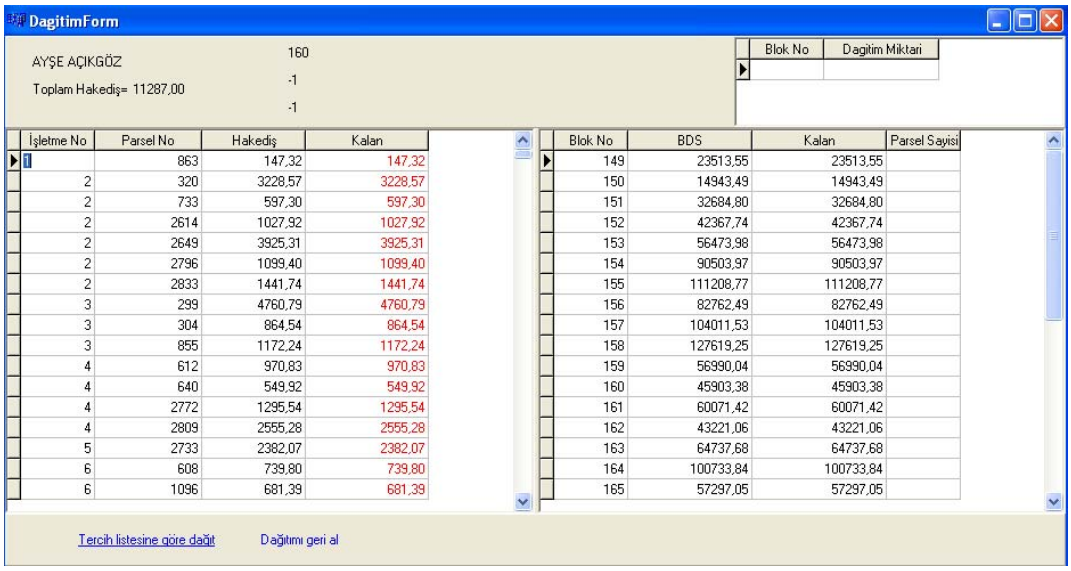


Figure 7. Created table for reallocation.

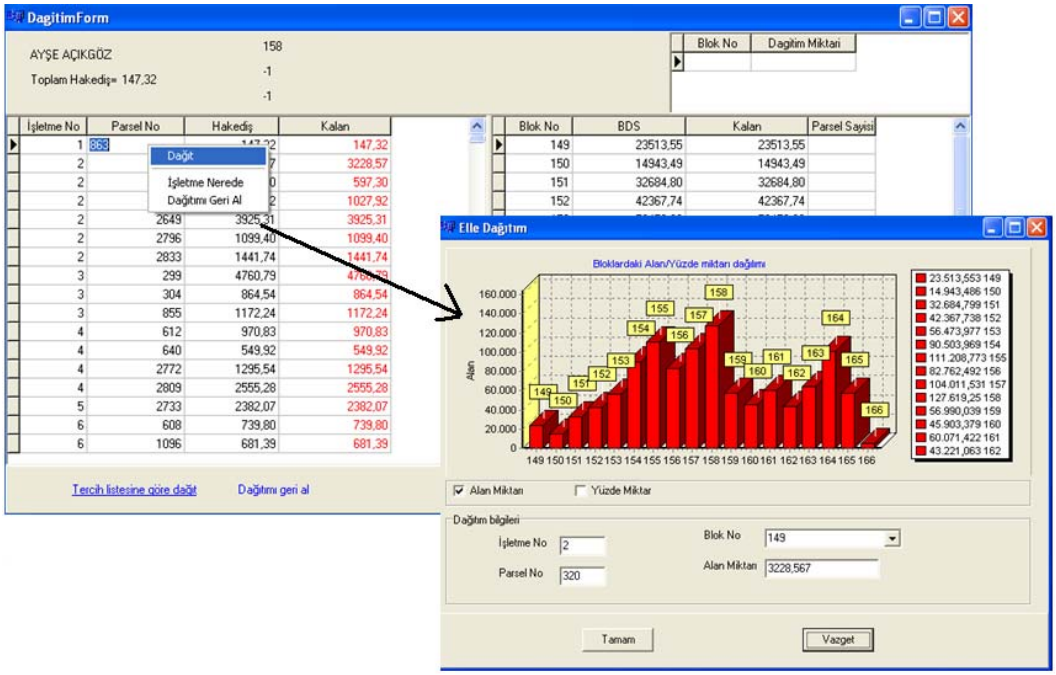


Figure 8. Manually reallocation.

Second technique is the main subject to be insisted. System makes the reallocation process automatically (Figure9). Here, some criterias are considered as the appointment process is done automatically. These criteria;

- Allocation process first starts with the landholding who has a statical facility on the land. Aim of this, is giving priority to the facility owners as stated in the laws.

- Secondly, allocation process of the farmers who haev more than three facilities will be completed. Reason of this, preventing splitting the land of the farmers who already have small pieces.
- And lastly,the farmers who are out of this conditions are set into their new blocks and finished.

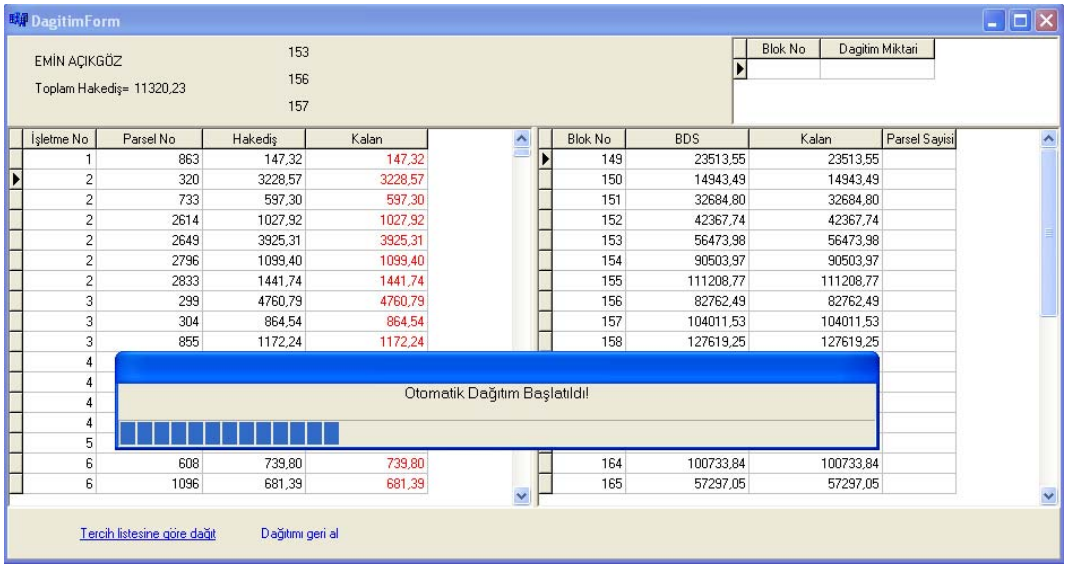


Figure 9. Process of automatic reallocation.

4. A GRAPHIC PRODUCER

The system that we created, is a information system that give us the opportunity of analysing graphical information like the cadastral, block, road, static facilitiy and ungraphical information about these values (like landholdings, areas) and assignment for each parcel and block. By representing the results with a software that we created, there is no need for a commercial software. System also includes most questionings done by commercial softwares (Figure10).

With the system we created, all reports and statistical results asked by the institute, which makes land consolidation, can be required as a print out by the system.

5. A USER INTERFACE

Components of the decision support systems (DSS); DSS database, DSS software system and user interface. Analysis qualification of these methods is depended on comprising it with a user interface which will ease the use of model (Çetinyokuş, Gökçen, 2002).

We have used an easy designed and extremely effective user interface in our study (Figure 11).

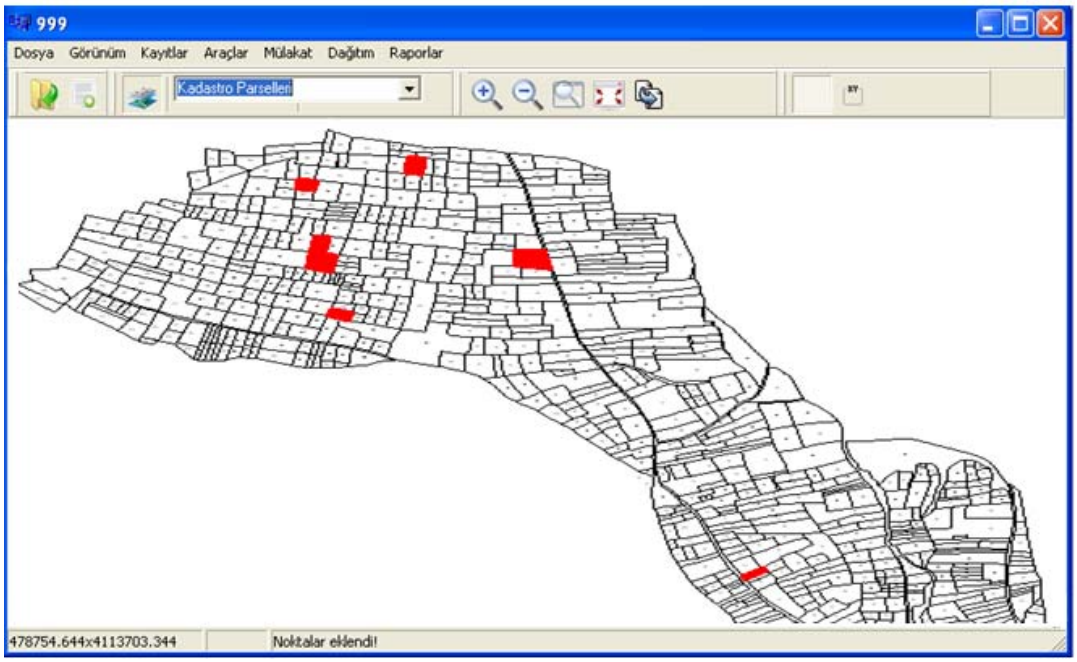


Figure10. Questioning the cadastral parcels of number 2 landholding.

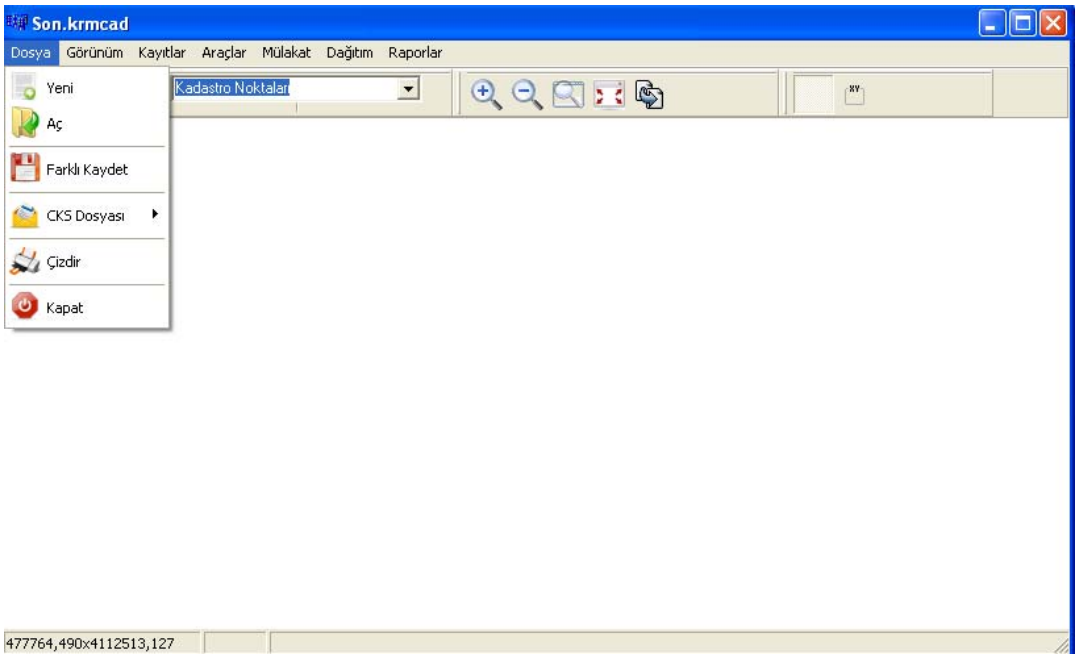


Figure 11. General view of the user interface.

6. CONCLUSION

This study is proposed a methodology about the land reallocation of the farm areas' parcels, along with a software which we have created. This system which is called as SDSS is a computer based system for the spatial reallocation decision problems, and gives great achievement in solving them. Experts of the matter thinks that this software will ease and fasten the land consolidation studies. As this is a thesis study and parcelation is not completed yet, we did not do application study and result investigation. But distribution step of the parcels is completed and distribution results are studied by experts and positive opinions are obtained.

SDSS software which we prepared with C++ programming language and includes a simple and easy interface with GIS functions, it will be a more economical solution for the usage instead of professional and commercial software packages.

In our study,we have planned to make a different study without necessity of any commercial software and with a design only for our study. Here, the aim is to automatisation of the distrubition studies and having an efficient and economical solution in the land regulation by obviating dependency for expensive systems like CAD and GIS.

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