

APPLICATION OF GEOGRAPHICAL INFORMATION SYSTEMS IN LAND CONSOLIDATION PLANNING STUDIES

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Geographical information systems have very wide range of application, its usage has become inevitable particularly when land resources which need intensive database and complicated queries are considered. Graphical data analysis needed for any process is achieved by GIS readily.

In order to apply land consolidation works appropriately and develop efficient projects, there is a need to have a lot of data, their organisation and reuse. Information system in a land consolidation work consists of organised data and it is organisation of relationship among man, computer, data and programme to meet the users demands.

In this study, it was studies on data organisation of ARTOP system which has been developed by University of Uludağ, Faculty of Agriculture, Agricultural Engineering Department and inquires and analysis carried out by this data system was considered.

1. INTRODUCTION

Planning is defined as arranged thinks of a project during main goal defined and evaluation of alternatives to make the final decisions[Tülücü, 1997]. Planning works consists of several activities such as goal definition, data collection, alternative plan production, socio-economic analysis of plans and selection of the must suitable plan[Balaban, 1986].

Phases during planning of land consolidation projects are determined as examination of existing situation, problem definition, alternative plans suggestion, evaluation and application of plans. At the first phase of planning process, existing situation is defined by evaluation of agriculture, nature, landscape, recreation and etc. and necessary analyses are made. With Geographical Information System and/or the other mapping methods, conflicts between different sectors are determined and alternative plans are developed[Huylenbroek, 1992].

There are several reasons to need project related to planning and development of rural area. The most important reason is low productivity due to scattered field structure. In this structure, Farmers have small parcels and time and money loss are occurred due to long distance among parcels. In order to have an efficient agricultural production system, the roads must be readily accessible for the farmers and the dimension of roads must be wide enough to provide access for vehicle traffic[Sleeking 1992].

At the land consolidation works in Germany, the subjects which are taken into consideration in preparing land consolidation works are development target of region, type and volume of necessary measurements in existing conditions, road and irrigation system necessity, village renewal, protection of village natural structure, farm improvement. In this context, planning of common and public utilities, renovation and improvement of road, irrigation systems and protection structures are realized[Arıcı and Korukçu, 1990].

Function of planning information system is creation and analysis of planning data which is the basis of land consolidation project. Main feature of land consolidation projects is its ability to relate planning

and reallocation. Therefore, data for planning and reallocation must be ready and planning information system must be integrated to land consolidation information system[Stark, 1991].

GIS technology provides functional tools in determination of strategies, planning, management and decision making. It also establishes relationship between different institutions. Institutions have a great opportunity to realize and solve the problems. The problems can be solved by horizontal and vertical integration of spatial data[Dangermond, 1989]. Land use, plant cover, geology, slope and aspect, infrastructure and land use ability maps can readily be accessible to planners by GIS[Dungkar and Penjor, 1997].

In this study, it is aimed to create an information system which will have several function to facilitate planning and decision making process to extend land consolidation works on large area, to provide quick data entering, data relation and evaluation. For that reason, a model was created to provide spatial data, integrate data with other information and make analysis and inquiries by GIS.

2. MATERIAL AND METHOD

2.1 Material

In this study, ArcInfo Ver 7.1.2. program and computers having several functions were used as computer software and hardware. Graphical data which were obtained from several institutions was transferred to computer environment by A0 scanner and digitizer.

2.2 Method

Land consolidation works in Turkey are initially realized in DSI irrigation project area. Planning works are generally carried out in village basis. However, planning works are hard to carry out due to large volume of data and difficulty in evaluation. In the near future, land consolidation works will be enlarged to basin level so that planning will be much more complicated. For that reason, a model for main information system so called ARTOP was initially developed.

Information system structure for planning was realized in 6 phase;

- Determination of planning data and its contents
- Classification of planning data
- Organization of planning data
- Establishment of relationship between data
- Determination of planning analysis
- Design(Flowchart creation)

3. RESULTS AND DISCUSSION

3.1 Planning Data and Its Content

Information system has following components; ownership data, topographical data, soil map data, rural settlement data, road system data, irrigation and drainage network data, land use data. After determination of all data in information system, attribute features of graphical and non-graphical data were determined so that all data can be used and evaluated in a GIS based system.

Geometrical components which are separate coverages has specific features. Information so-called attribute defines geometrical components and details(e.g. parcel size, crop pattern etc.).

In order to establish relationship between data and make analyses and inquiries easier, different coverages have been created for each graphical data. Non-graphical data in system is as follows; project information data, village information data, ownership data, data on irrigation, drainage and road network and land use data. This data is characterized as character, integer, reel number and data. Info tables were also created for having relationship between numerical and alpha-numerical data, and its analyses and queries.

Since project area covers villages more than, village information tables which identify villages have been created in land consolidation projects on basin level. Cadastral maps and related title-deed information are one of the most important part of information system at land consolidation projects considering softwares which were developed for land consolidation works and Cadastral General Directorate's standards, ownership info table has been created. Irrigation network information such as canal name, water level, width, lining, capacity and discharge has been determined by considering State Hydraulic Works(DSI) criteria and attribute table has been created. Same processes have been followed in establishing road and drainage attribute tables.

3.2. Classification of Planning Data

All information in system has been classified according to obtaining methods of data, data type, data transfer method of system, attributes(numerical, alpha-numerical and graphical), use frequency, user level and data organization method. Some data which are used in model can be obtained from field survey, some data can be obtained from existing studies which were carried out by public and/or private agencies.

In order to evaluate the data in GIS-based environment, data must be transferred to computer. Transfer can be done by manually or automatically. All information has been stored as different coverages to carry out independent data inquiries from each other. Each coverage allows specific data processing in GIS-based environment so that possible complications will be prevented.

In land consolidation works, some information are frequently used and some are not. Frequently used information must be readily accessible to the user in information system. An algorithm has been created to make accessible the inquiry results to the user.

3.3. Organization of Planning Data

Information system has been designed to allow data transfer among different information systems. In order to achieve appropriate data transfer process, some standards must be followed in establishing information systems. Created model is able to read data from Arc/Info software, dxf format and ArcView Shape format to store them easily.

3.4. Establishment Relationship Between Data

After determination of coverages and info tables in information system, relationship between coverages and info tables have been established. Thus, when the user works on any coverage or any info table, he/she can make analyses and inquiries from coverage or info tables so that evaluation for planning works can be easily carried out and planning information can be ready to use. Those information become base data for land consolidation works.

Figure 1 shows the relationship between cadastre coverage and ownership data info table. When selecting parcel No: 3 from cadastre coverage, parcel ownership information can be obtained by the help of attribute table for cadastre coverage.

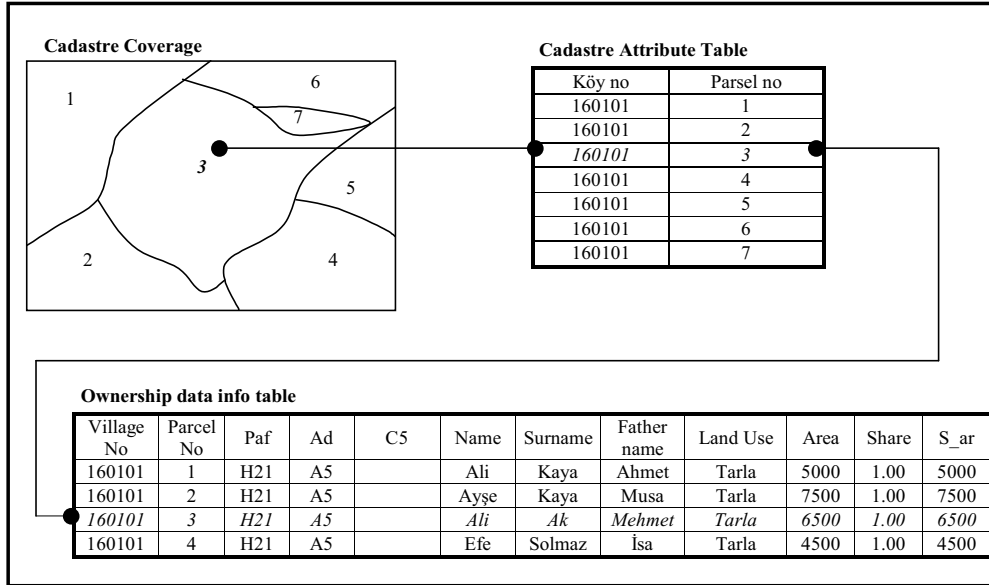


Figure 1: The Relationship Between Cadastre Coverage and Ownership Data Info Table

3.5. Planning Analyses

After transferring all planning data to information system and establishing the relationship between data, required analysis can be carried out by the help of newly provided data. Analysis can be done at village level or at village group or basin level.

These analyses are as follows;

- Ownership Analysis
- Irrigation System Analysis
- Drainage System Analysis
- Road System Analysis
- Settlement Area Analysis
- Other

In order to make analysis, coverages and attribute tables have been related with each other depending relationship and related flowcharts have been created. For example, figure 2 shows flowcharts for ownership analysis. Various analysis can be done by using only cadastre coverage and its attribute table. These analysis are; total parcel number in project area, parcel distribution pattern, total parcel number in each village, etc.

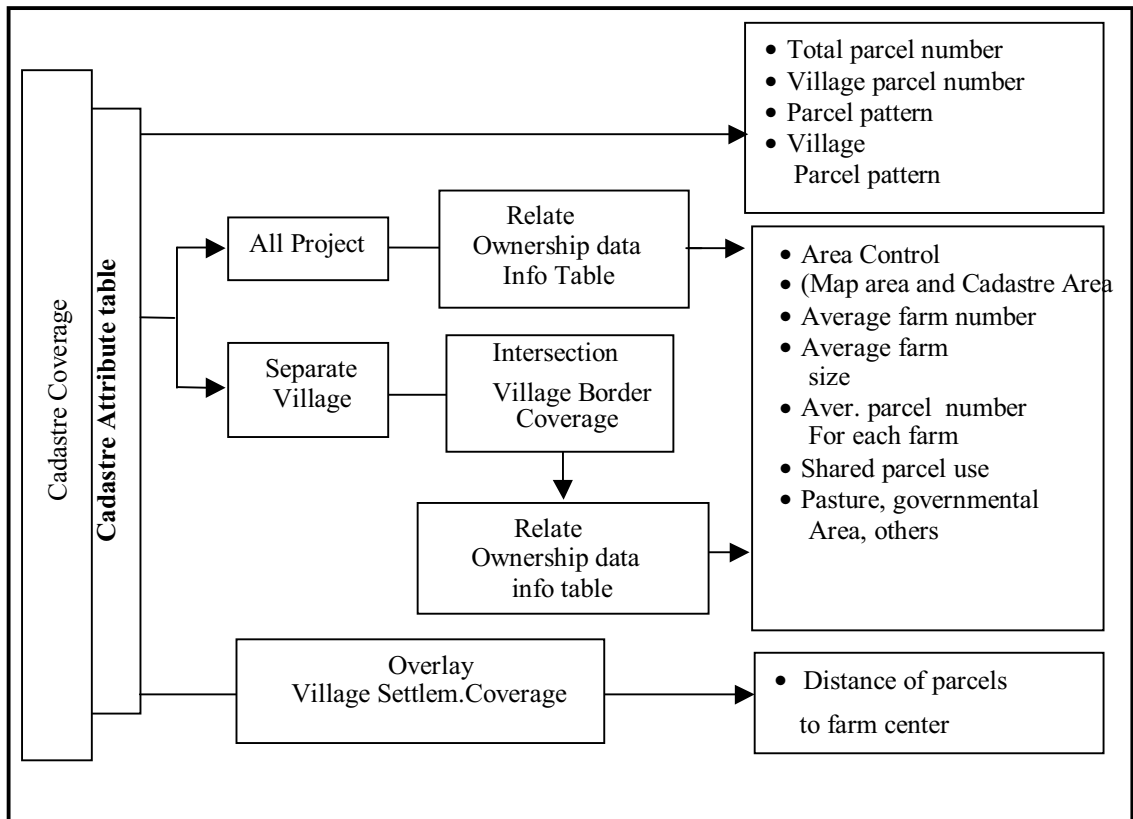


Figure 2: Flowcharts for Ownership Analysis

Another example about land use pattern was given in Figure 3. In this analysis, land use pattern and rural landscape structure can be determined by relating land use coverage and info table and land use pattern for villages and parcels can be analyzed by integrating some coverage with cadastral coverage.

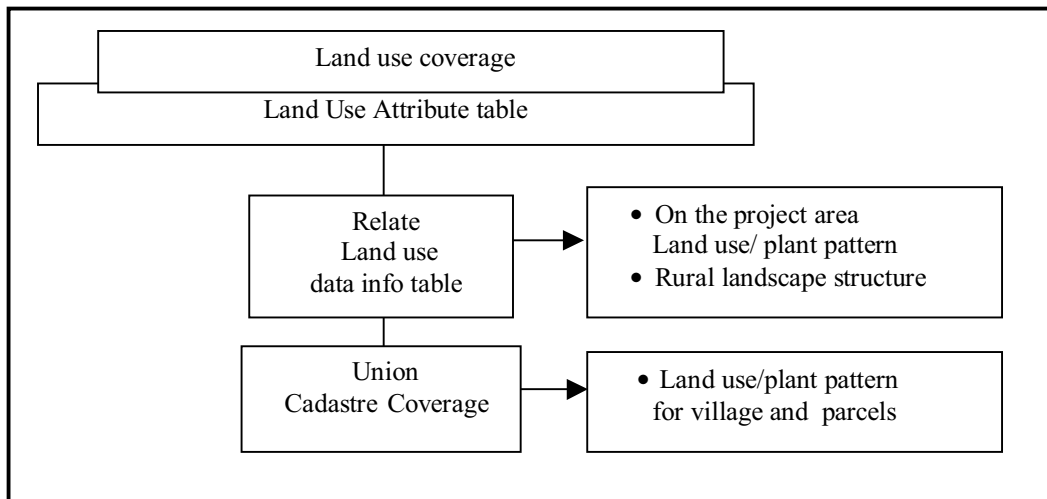


Figure 3: Flowchart Analysis of Land Use Situation

3.6. Information System Flowcharts

After determination of all graphical and non-graphical information, their relationships and required analyses, detailed system flowcharts have been created to make programming for land consolidation information system. A general flowchart for main information system was given in Figure 4. User will firstly choose project herewith. System allows to study on more than one project. Flowcharts of other components have been created depending on classical applications and standards and criteria of related institutions.

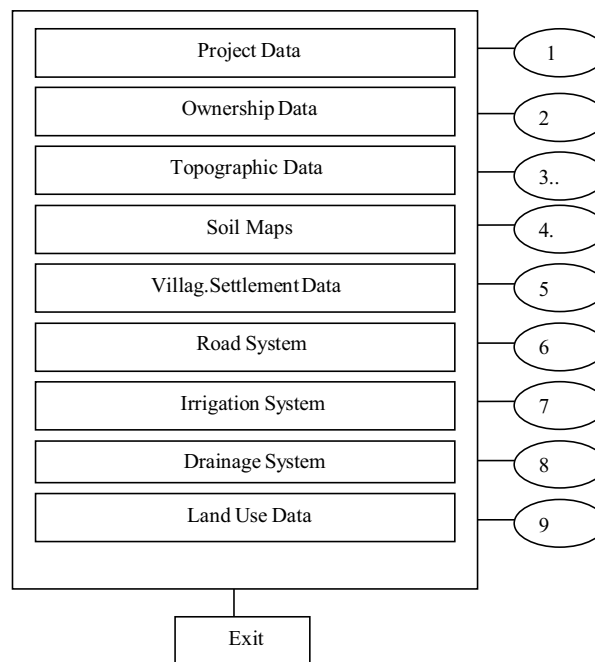


Figure 4: Main Information System Flowchart

4. RECOMMENDATIONS

In this study, It is aimed to develop an information system for planning of land consolidation works and to analyze planning data. An information system model has been created by GIS. Model so-called ARTOP allows to organize, relate, and evaluate data through GIS features. In developing model, the phases which are taken into consideration in studies of General Directorate of Rural Affairs and General Directorate of Soil Reform have been followed when model will be put into practice, land consolidation projects will be prepared in basin level or village groups level.

With this system:

- Planning studies of land consolidation projects will be extended to large areas.
- Land consolidation will be equitable in field level.
- Field conditions will be readily evaluated in planning, project efficiency will be increased.
- Use of technology will be increased, field surveys and controls will be easier.

- Projects can be prepared by private firms or engineering offices, and project operation will be faster.
- System will efficiency help planners in land consolidation projects. It will also provide classification and analysis of large volume of data according to planners.
- Land consolidation works can be included into rural area planning.
- Basin information system will be created so final information requirements of institutions can be met.

The unique negative aspect of the system is necessity to use Arc/Info GIS program. However, if a center is established and served to different region by on-line system, system can be used in very wide range of area, efficiency can be improved and cost can be reduced.

Model is suitable to be enlarged. Any deficiencies in the model during application can be eliminated by developed softwares and interventions. When cadastral renewal studies are finished and cadastral works are done by computers, and topographical maps and DEMs are transferred into digital environment, soil mapping works are finished onto converted into digital environment, data transfer to system will be much more easier and faster.

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