ALGORITHM DEVELOPING FOR LAND CONSOLIDATION SOFTWARE

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ABSTRACT:

Although increasing population in Turkey agricultural lands have not been expanded, thus, agricultural lands should be used more effectively. Therefore, Land consolidation is the most important work, which has to be done. Land consolidation takes time to execute project because of large application area and extensive. Therefore, using computer is extremely significant to conclude the land consolidation projects in a short period of time and in a right and justice principles and in a suitable productivity.

Nowadays in Turkey, Land consolidation application softwares are very limited and far away to serve. Sufficient steps have not been taken in order to cope with these problems. Because, Land consolidation projects are managed by two different associations and laws in turkey. Therefore, developing standard software have some difficulties.

In this research, necessary algorithms for standard software to be used for the applications of General Directorate of Rural Service were developed and their capacities were then investigated.

1. INTRODUCTION

Land consolidation for agricultural purposes is an activity or an instrument that is implemented in order to consolidate fragmented agricultural holdings or, in other words, to unite the scattered parcels of the distinct farms. Land consolidation is carried out by means of projects in clearly bordered parts of the rural area. For each project a project management will be appointed. Land consolidation may also include the improvement of the road system and of the water management system, as well as of the landscape and the conditions of nature in such a project area(Sonnenberg, 2002).

In the whole countries, land consolidation is applied to improve the rural areas. Because rural areas comprise substantial parts of the regions and are subject to a range of pressures including water shortage, land degradation, failing commodity prices and depopulation. Land consolidation means to unite and reregister the lands, which were divided because of heritage, sales or irrigation canals. In Turkey, the application of land consolidation officially commenced in 1961 in Konya region. Turkish Land Consolidation Regulations is based on 3083 and 1757 numbered acts and provides for landscape renovation within land consolidation areas, which focuses, among other things, on the planting of shrubs and trees, the creation of small parks/recreation/areas, in non-agricultural land and the protection/conservation of the cultural heritage and physical environment within land consolidation areas, such as the restoration of traditional fountains, old watermills and railway lines. Consolidation works are carried out by General Directorate of Rural Service (Köy Hizmetleri Genel Müdürlüğü - KHGM) and Directorate General of Agricultural Reform (Tarım Reformu Genel Müdürlüğü - TRGM) in Turkey (Banger and Sisman, 2001).

Land consolidation Process is important to obtain, in order to manipulate and control the raw data in short time, easily and also to present the results as numeric, alphanumeric and graphically means.

All these studies are carry out speedily and correctly in data processing. However, it is not sufficient to have only a computer. Because, it is necessary to have application softwares and its algorithms that data will be processing and its results will be given output. Manpower is necessary to write such software and to do their application.

Nowadays in Turkey, Land Consolidation softwares are not sufficient except for few softwares. Technological level reached in a country, Applications of one or some persons or institutions cannot survey and it is not sufficient to solve country-based problems. Performed studies with this opinion, Algorithms have developed for Land Consolidation studies which General Directorate of Rural Service carries out.

2. SOFTWARE DEVELOPMENT

Computers are utilized in solving a wide range of problems, which arise in such diverse fields as science, engineering, business, management and administration
A programmer's task is solving problems by the computer Which involves several steps such as problem definition, problem analysis, formulation of a method of solution, flowchart preparation, program coding, debugging and running (Figure 1).

The first step in the process of problem solving by a compute is the problem definition. Problem definition is precise and

well-defined statement of the problem in terms, which can be understood clearly by people involved in the problem area. Problem analysis and formulation of a method of solution is the most difficult and crucial step. To obtain a correct and efficient solution to a problem, existing mathematical and other pertinent techniques and tools relevant to the problem area must be used and whenever necessary new techniques must be developed. At this step, the type and organization of the data to be handled, the mathematical procedures are determined. The method of solution is expressed as a sequence of precisely described logical steps. Such a description of method of solution is called am algorithm.

Once a method of solution formulated, the logical steps and the sequence of operations to be performed at each step are next represented in a pictorial form, which is called a flowchart.

A flowchart is just a visual aid, but a computer cannot understand it. The method of solution must be expressed in a computer language to be understood by it. Many languages have been developed in order to communicate with the computers. Expressing the method of solution in terms of a computer language is called programming.

The last step is to run the program on a computer to get the desired answers, to correct the mistakes made in formulating the method of solution and/or programming until valid results are obtained and to document all the work done so that the same program can be used over and over again by different people to solve the same problem with different data values (Arkun and Gungor, 1977).
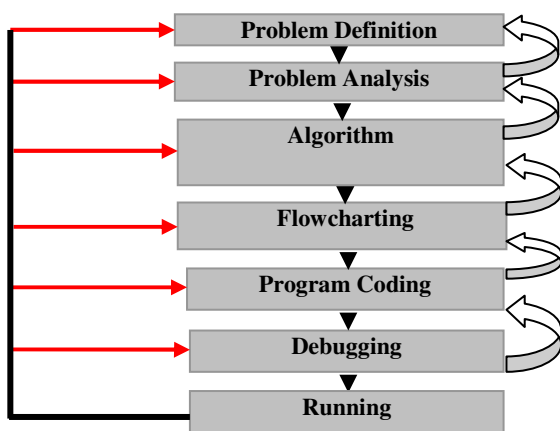

Figure 1. Steps in software development

3.   IMPLEMENTATION

3.1. Material and Method

Land Consolidation Project is carried out according to instructions of both General Directorate of Rural Service and Directorate General of Agricultural Reform. Therefore, This study aimed at algorithm developing benefit from Land Consolidation flow chart of General Directorate of Rural Service and flow chart symbols for algorithm preparing (Iscan, 2003).

Figure 2 shows the flow chart prepared by General Directorate of Rural Service applications.

3.2. Calculate of Sharing Ratio of Common Area and Land Area Given Back to Owner

All parcels are necessary to benefit from canal and road network. Therefore, Project area is planed with suitable and enough canal and road system. After this planning, canal and road areas are calculate.

This calculated area is given from registration external lands. Latter, area is reduced proportional land value given back to owner. Remaining area is registered in the name of Village Legal Personality.

Equation (1) is used to compute sharing ratio of common area.

$$(OTKPO) = \frac{h - r - a}{h} \qquad (1)$$

Where;
OTKPO= sharing ratio of common area,
   h = total area of cadastre parcels ,
   r = total area of blocks,
   a = registration external lands,

According to OTKPO, Cadastre parcels are necessary to read and gather from formed database. Latter, total areas of blocks are necessary to calculate from block corner coordinate. All data for Equation (1) are ensuring to calculate and computer entering registration external lands.

   Terms shows below is used in the Algorithm 1;
   h = total area of cadastre parcels,
   r = total area of blocks,
   a = registration external lands,
   I = loop,
   K = block number,
   M = number of block corner,
   X, Y = block corner coordinates,
   T = block area,
   F = area of cadastre parcel,
   N = number of cadastre parcel,
   OTKPO = sharing ratio of common area,
   OTKP = sharing of common area,
   GF = land area given back to owner,

Algorithm 1: Calculate of Sharing Ratio of Common Area and Land Area Given Back to Owner

1-   START
2-   Open Database
3-   Input N
4-   h = 0
5-   I → 1, N
6-   Read F(I)
7-   Calculate h = h + F(I)
8-   Read K
9-   r = 0
10- I → 1, K
11- Input M
12- I → 1, M

13- Input X(I), Y(I)
14- T = 0, T(M+1) = Y(1), Y(0) = Y(M)
15- I → 1, M
16- Calculate T = T + X(I) * [Y(I +1) – Y(I – 1)]
17- Calculate A = T/2
18- A→ BN and Save
19- Calculate r = r + A
20- Input a

21- Calculate OTKPO = $\dfrac{h - r - a}{h}$

22- Save
23- I → 1, N
24- Read F(I)
25- Calculate OTKP(I) = F(I) * OTKPO
26- Calculate GF(I) = F(I) – OTKP(I)
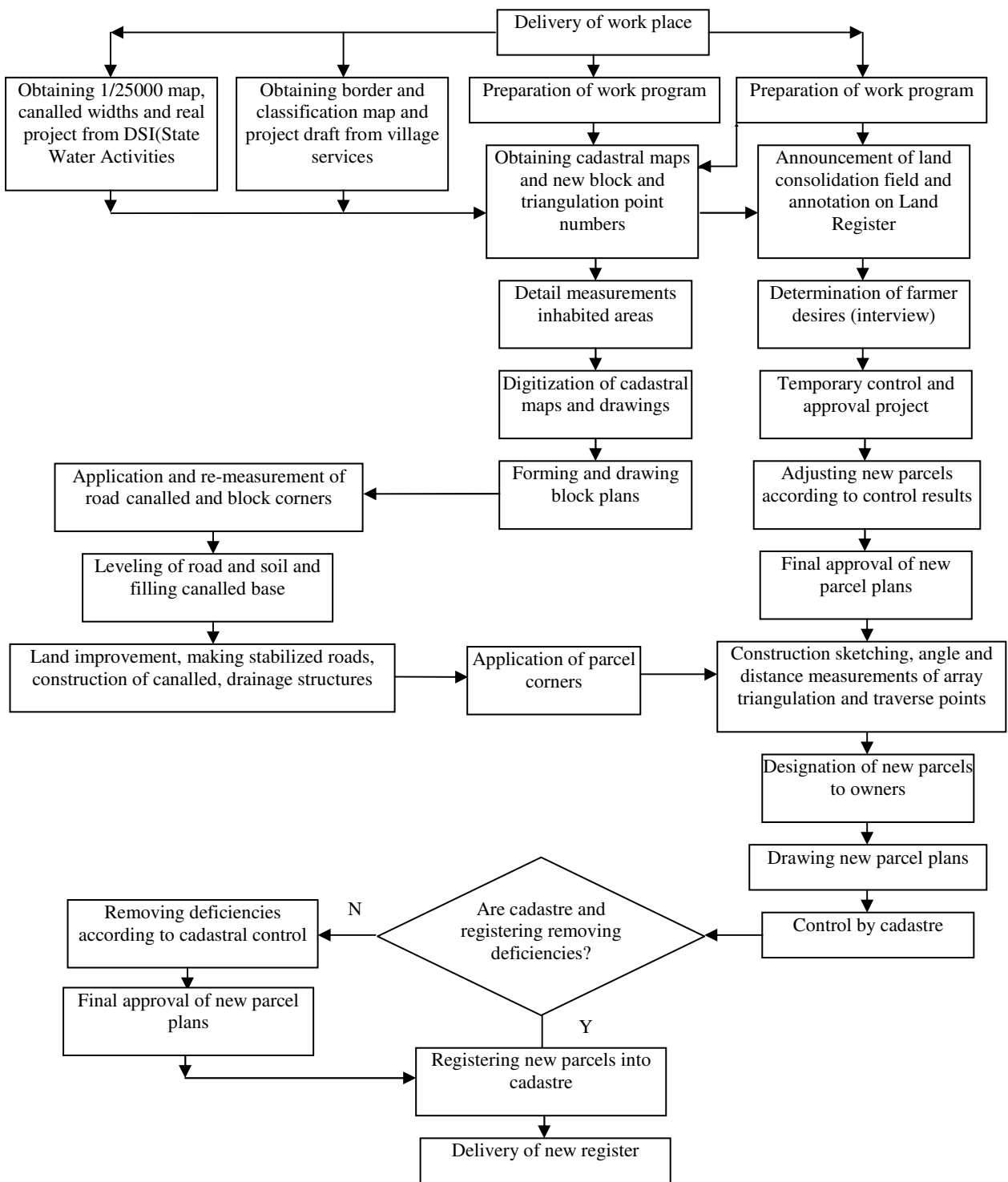27- Save Database
28- STOP

Figure 2. Technical steps of land consolidation for General Directorate of Rural Service (Cay, 1995)
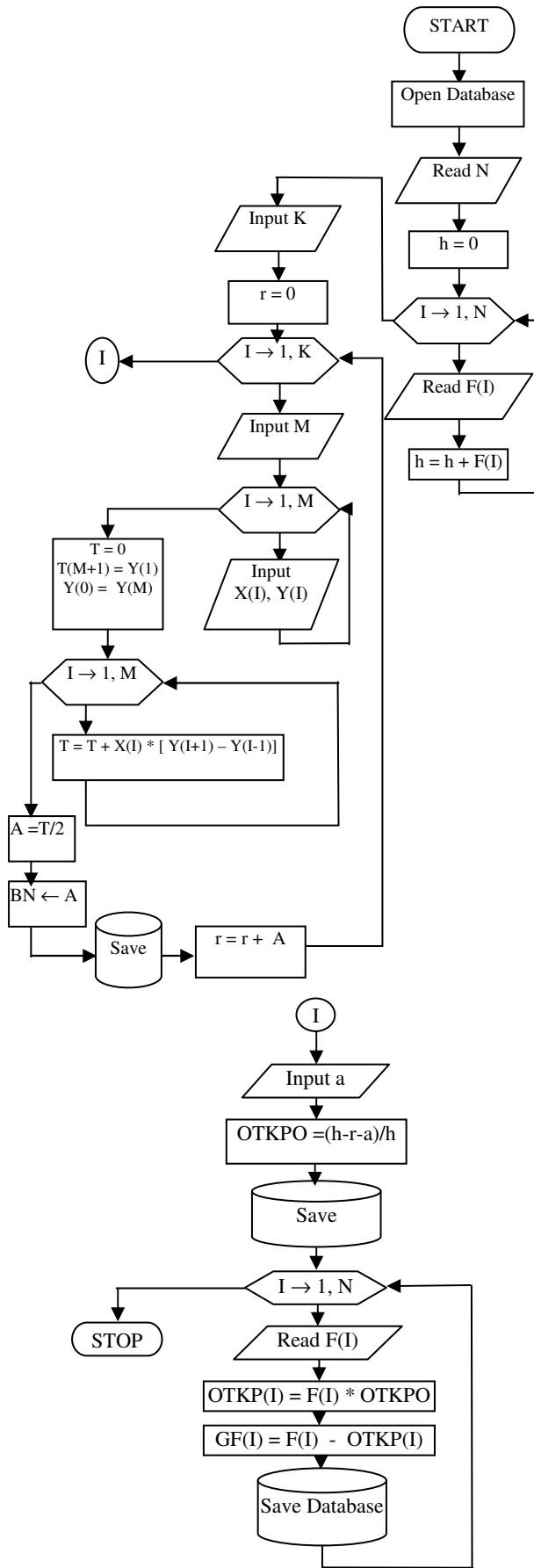
Figure 3. Flow chart prepared for calculate of sharing ratio of common area and land area given back to owner

3.3. Classification Study

Parcels that are located in consolidation areas are ranked for computed transformation values. Equation (2) is used to compute Land Index (PE)

$$PE = 0,70 * SI + P + L \qquad (2)$$

Where SI is defined soil index and derived from the soil profile, soil structure, and slopes of the land, salinity of the soil, pH, erosion, microroliyef and other soil qualifications and then marked as 100 point. P is referred productivity of the soil, and marked as 10 points. Where L is the location index of the parcel and marked as 20 points.

According to this law, agricultural lands are grade 10 degrees. Between 1-7 degree lands are arranged in a one group. Between 8-10 degree lands are not evaluated (Demir, et. al., 2002).

Unique index value is established depending on the index and areas of the index values which are inside the same degree scale. The ratio of these different degree index values between each other gives the transformation table. If different degree value apart from the participation degree is determined to the holdings; this table can be used for transformation between degree values (Demirel, 2003).

In application is used number of parcel value (**P**arsel **D**eğer **S**ayısı - **PDS**) instead of transformation value.

Equation (3) is used to compute number of parcel value

$$PDS = PE * (Area) / 100 \qquad (3)$$

The Algorithm 2 will need to be capable of performing two tasks. The first is the calculation of number of parcel value given back to owner. Second, The Algorithm 2 will calculate separately number of parcel value for each holding. This is showed us that which holdings will be given how many value.

There is all information of cadastre parcels in Database System. These thinking, terms shown below is used in the Algorithm 2.

GF = land area given back to owner,
I and J = loop,
N = number of cadastre parcels,
S = number of holdings,
TPDS = total number of parcel value for a holding,

Algorithm 2. Calculation of Number of Parcel Value for Each Holding in General Directorate of Rural Service Applications

1- START
2- Open Database
3- Input N from Database
4- I → 1, N
5- Read PE(I) and GF(I)
6- Calculate $PDS(I) = \dfrac{PE(I) * GF(I)}{100}$
7- Save Database
8- Input S from Database
9- J → 1, S
10- TPDS = 0
11- I → 1, N
12- Calculate TPDS = TPDS + PDS (J, I)

13- TPDS (I) = TPDS
14- Save Database
15- STOP

3.4. Reallocation Study

Land reallocation is the most important activity in the process of land consolidation. In land consolidation, land planning and implementing is realized by land reallocation step. New parcels are settled by landowner wishes within blocks, which are constituted public facilities. In the other words, new agriculture parcels are constituted. Landowner wishes provide easiness in the reallocation. When wishes are accepted, it is watched out ownership lists, land using and constant foundations. According to General Directorate of Rural Service, reallocation study is implemented by reduced number of parcel value. First, number of parcel value is calculated separately for each block. Later, according to landowner wishes, holdings are settlement blocks. If there is remaining area, this area is registered in the name of Village Legal Personality.

After each holding is settlement blocks, parcellation is done. New parcels that will be settlement blocks are done with necessary iterasyon on map or computer screen.

In theory, the total land value of all the land parcels should be the same as the total value of the blocks. In practice it is impossible to have this result, because digitalizing errors (Essadiki and Ettarid, 2002)

Algorithm 3 has done all calculation for reallocation. Terms shown below are used in the Algorithm 3.

BN = block no,
BPDS = total value of the blocks,
D = number of parcel index in block,
DPE = parcel Index for a area in block,
DF = area of parcel index group,
PDS = number of parcel value of parcel index group,
S = number of farmer,
TPDS = total number of parcel value for a farmer,
M = landowner wishes,
GBPDS = remaining number of parcel value in block after reallocation,
KTK = remaining number of parcel value in the name of Village Legal Personality,
TKTK = remaining total number of parcel value in the name of Village Legal Personality,

Algorithm 3: Calculate Total Value of the Blocks and Reallocation

1- START
2- Input BN
3- BPDS = 0
4- Input D
5- I → 1, D
6- DPE(I)' yı gir
7- Input DF(I)
8- Calculate PDS(I) = $\dfrac{DPE(I) * DF(I)}{100}$
9- Calculate BPDS = BPDS + PDS(I)
10- BPDS → BN
11- Save
12- If there are new BN, GO TO 2
13- Open Database

14- Input S
15- J → 1, S
16- Read TPDS(J)
17- I = 1
18- Input M(I)
19- Read BN
20- Read BPDS
21- If BPDS = 0 , I = I + 1 and GO TO 18
22- If TPDS (J)>=BPDS, BPDS → BN
      Else GO TO 26
23- Save
24- Calculate TPDS (J) = TPDS (J) – BPDS
25- If TPDS (J) = 0, GO TO 5
      Else I = I + 1 and GO TO 18
26- Calculate GBPDS = BPDS – TPDS(J)
27- GBPDS → BPDS
28- BPDS → BN
      TPDS (J) → BN
29- Save and GO TO 5
30- TKTK = 0
31- Input BN
32- Read BPDS
33- Calculate TKTK = TKTK + BPDS
34- BPDS → KTK, KTK → BN
35- Save
36- If there are BN, GO TO 31
37- STOP

4. CONCLUSIONS

Algorithm preparation is the most important step in the process of software development. When programmer's are used to developed algorithms for land consolidation projects, they will be implemented easiness this algorithm on a programming language. With software will be developed by this algorithms will be provided great easiness for project.

With this software, damage, cost and manpower of land consolidation projects is reduced the least and efficient is also increased to maximum. To do standard land consolidation software, database system should be developed very good. However, production of standard data is not standard requested in Turkey since each institution has produced different condition. This case has prevented improvement of software sector.

Finally, necessary algorithms for land consolidation software (sharing ratio of common area, land area given back to owner, classification and reallocation) have been developed and persons related this subject will be used easily this algorithms for software development.

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