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Determination of Parcel Value Number with Detailed Method in the Land Consolidation

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Authors' contributions

This work was carried out in collaboration between all authors. Authors AT, KB and ŞTAA designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors AT and KB managed the analyses of the study. Author AT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: In this study, it was aimed to determine parcel value numbers used in land consolidation studies in more detailed.
Study Design: 14 different questions were created considering properties of the study area. Parcel value numbers of the study area were determined according to these detailed questions.
Place and Duration of Study: The study was carried out in 3 districts located in the Aksu province in Antalya in 2017.
Methodology: Generally, parcel value numbers were determined according to the parcel index. The current parcel index equation cannot perform a detailed calculation because it uses just three parameters such as soil index, productivity score and location score. However, in the new detailed equation created in this study, parcel index values were determined by using soil index and land quality index, which consisted of 14 different questions taking into account the properties of the region applied. In addition, proportions of parameters used in the current equation were revised in

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the new equation created. Results obtained with new detailed equation were compared with the results obtained by the institution that performs land consolidation with the current method in the region.
Results: As a result, the total parcel value numbers of the two districts were calculated higher in the new equation than the current equation. The total parcel value number in just one of the districts was determined lower in the new equation than the current equation.
Conclusion: According to results obtained in the study, the new equation can be used in the land consolidation studies instead of the current equation because the new equation has provided a much more detailed and fair land distribution.

Keywords: Current equation; detailed equation; land consolidation; land quality index.

1. INTRODUCTION

It is not possible to increase agricultural land proportionally with population growth. Therefore, the search for ways to get more yields from limited lands has been identified as the only solution that can meet the food needs of the growing population. Experts have specified that in the 21st century, land will be one of the most important production factors of the earth by regarding food production to meet the nutritional needs of the growing world population. For this reason, they declared that it is necessary to determine the capabilities and qualities of the land and to implement land use planning [1].

Increasing efficiency taken from the unit area is closely related to the agricultural structure as well as the quality and quantity of technology level, the seed used in production, fertilizer, medicine, irrigation etc. Structural disturbances in the agricultural structure prevent an increase in yield. Structural disturbances in agricultural structures can be fixed by land consolidation studies [2].

The most important agricultural infrastructure problems in Turkey are that in a large majority of agricultural enterprises, the lands are scattered in small parcels, their shapes are irregular and they are lack of transportation networks. In this case, farmers' families make production in smaller and more scattered agricultural land, and this causes that agricultural development is inadequate [3]. The aim of land consolidation (LC) is that to help raise national income at the national level. For this purpose, LC allows to consolidate the scattered land parts owned by the farmers, to correct the land saving system and to expand the small farming enterprises [4].

The most difficult, most critical and most time-spent steps of land consolidation studies are the land evaluation process and determination of parcel index [5]. In the current method, parcel indexes are determined according to the principles set out in the Technical Instruction of Land and Classification Standards and Land Consolidation Technical Instructions prepared by the General Directorate of Agricultural Reform according to Article 17 of Law No. 5403. Today, the calculation of parcel index is made according to the Storie Index method by using three parameters which are soil index, productivity score and location score in land consolidation studies [6]. The parcel index is determined by taking seventy percent of the index obtained from soil surveys and adding the productivity and location index. Ratings map is created by evaluating parcel index obtained at specific group intervals. The parcel value number is calculated by multiplying the parcel area with parcel index determined according to soil index, productivity score and location score [7]. Calculation of parcel value number and the redistribution of parcels in land consolidation are generally determined by using the rating map [8].

However, the land consolidation method in Turkey has been changed 6 times since the beginning of the land consolidation works and a compatible method for all projects, regions, etc. has not been determined yet. For this purpose, a much more detailed new method that will adapt to each condition of the project area, will give fair and equal results for the farmers' families and will relieve the engineers of the project should be developed. Some researchers [9-11] carried out relatively similar studies to determine the parcel value in more detail, however, these studies neither was completely similar with this study nor carried out in Turkey.

In this study, it was aimed to compare the parcel value numbers determined according to the current method with parcel value numbers determined according to the new method which is more detailed. For this, firstly the parcel index of each parcel in the study area was determined

by new method as more detailed, then parcel value number of each parcel was determined by using parcel index. Lastly, parcel value numbers determined by new and detailed method compared with the parcel value number of current method.

2. MATERIALS AND METHODS

2.1 The Study Area

Three different districts were selected from different zones within the study area in order to ensure that regional conditions did not affect the results of the study. Solak district is located to the 20 km, Abdurrahmanlar district is located to the 26 km and Çatallar district is located to the 61 km east of Antalya city center. Study area is also located between 36°56' 00" – 37° 7' 50" North latitudes and 30°50' 50" – 30° 56' 30" East longitudes (Fig. 1). In addition, some physical properties of three districts were given in Table 1 [12-14].

2.2 Topography and Soil Properties

When the lands of the project area are examined, it can be said that they are geologically young, having high lime content on sedimentary rocks such as Limestone and Marn [15]. Soil maps used in land consolidation studies were created by using the soil survey maps. Soil index used in the calculation of parcel indexes in land consolidation studies is determined by using soil maps which are created from the soil survey maps with Stroie Index method (Fig. 2).

Table 1. Physical properties of three districts

Properties	Districts in study area		
	Solak	Abdurrahmanlar	Çatallar
Population	623	1676	321
Total area (ha)	1539.49	1122.87	659.32
Agricultural area (ha)	1391.31	622.86	558.41
Altitude (m)	16.11	11.81	45.40
Number of parcels (pieces)	645	377	727
Average parcel size (ha)	2.15	1.65	0.77
Number of parcel per enterprises (pieces)	0.45	0.36	1.52

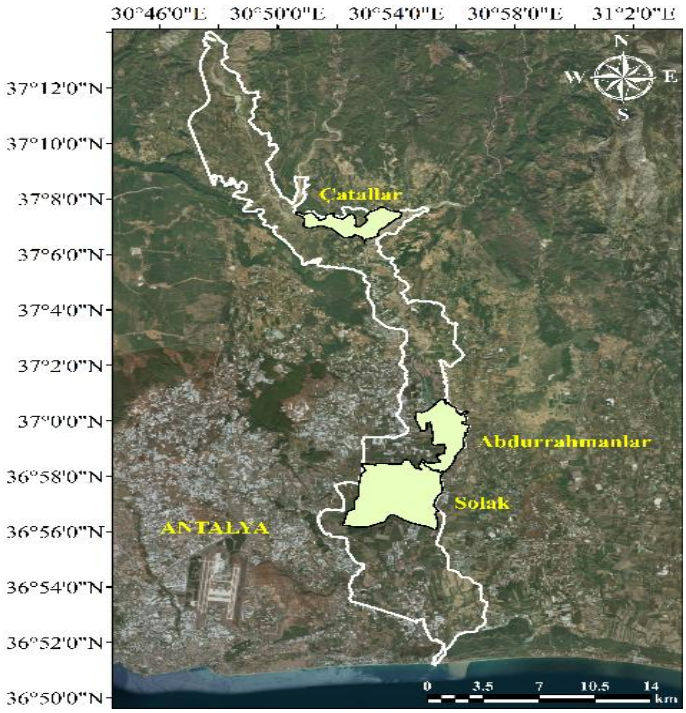

Fig. 1. Location of the study area

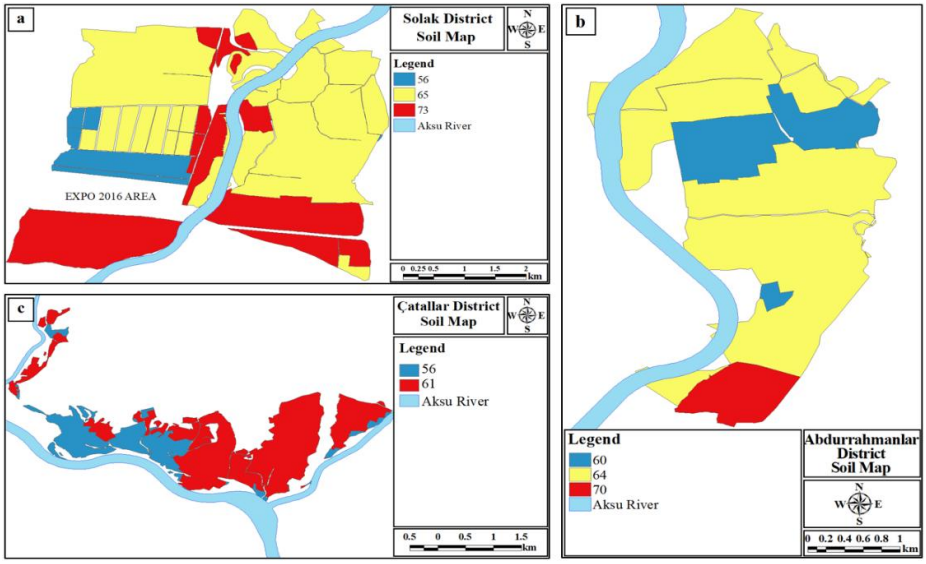

Fig. 2. Soil maps of the districts where the study was conducted

2.3 Data Related to Land Consolidation in the Study Area

Current map, cadastral situations, parcel information, land registry records showing landowners, property and parcel information, information on landowners, parcel number, parcel area and share information and parcel index of each parcel in the study area were taken from the General Directorate of State Hydraulic Works (SHW) 13th Regional Directorate.

2.4 Parcel Index Calculations in Land Consolidation Studies

In the current method, parcel indexes are determined by using Equation 1 according to the principles set out in the Technical Instruction of Land and Classification Standards and Land Consolidation Technical Instructions prepared by the General Directorate of Agricultural Reform according to Article 17 of Law No. 5403.

In the land consolidation study conducted in three districts, parcel indexes calculated by the new method (Eq. 2) are determined more detailed and effects on the parcel value number of the result are investigated. Thus, the method that determines the value of the parcel more accurately is proposed. The reason why we chosen the proportions of Equation 2 as 40% of soil index and 60% of land quality index is that soil is important for the cultivation so this value must not be decreased more. However, the proportion of soil index must not be increased more than 40% because land quality index contains a lot of parameters which are important for the land value. That's why proportions of parameters of the new equation were determined as they are in the Eq. 2.

$$P.I.= S.I. (70\%) + P. (10P) + L.S. (0\text{-}20P) \quad (1)$$

$$P.I.= S.I. (40\%) + L.Q.I. (60\%) \quad (2)$$

where the P.I. is parcel index, S.I. is soil index, P is productivity score, L.S. is location score and L.Q.I. is land quality index.

The questions set used in the study were determined by inspiration of (USDA, 2011) [16]. However, the questions used in (USDA, 2011) are targeted to soil grading according to the Land Evaluation and Site Assessment (LESA) method. In this study, questions were revised and changed to determine the parcel index. In addition, new questions that can be used to determine parcel index in detail according to regional needs have been added. The question set that constitutes the evaluation criteria used for determining land quality index and scores given to the questions were determined with a preliminary study. In the preliminary study, according to the needs of the region, the opinions of the engineering's working in the project, academic experts on land consolidation and landowners were taken. In this preliminary study, it was interviewed 137 people. With the interview, we were asked about which questions

would be more appropriate, whether there were questions that need to be added or subtracted, and we were also asked which answer is more important in each question to determine the importance level of answers. Finally, questions and scores given to questions were shaped according to answers given by the relevant engineers, experts and landowners.

Questions belong to the land quality index in the new equation were given in Table 2. 14 different questions determined as a result of preliminary study are in Table 2. Since each question has a maximum of 10 points, a total of 140 points are obtained. The obtained 140 points need to be converted to 100 points. This conversion was given in Table 2 and its below.

Column 1 lists the questions set of land quality index. Column 2 shows the maximum points assigned for each factor. Column 3 shows the weight assigned to each factor. The weights foresaw for each question in this column are determined according to the importance level of 14 different questions identified for the project area. Full points which is 10 have been assigned to most important questions for the project area and other questions have been scored by the importance level. For instance, factors 1, 2, 7, 8 and 10 were judged to be the most important; thus, 10 points were assigned to them in Table 2. Other factors were rated according to their relative importance. Column 4 shows the multiplication of the points per factor (column 2) and times assigned weight to each factor (column 3). In the example in Table 2, total maximum points are 1000 as a result of the sum of these values. The maximum relative value for the land quality index is 100. Thus, an adjustment is required to be 100 point in total. The adjustment coefficient were found 0.1 (100/1000) for this study. Column 5 shows the adjusted weights needed to produce a maximum point total of 100. The adjusted weights are determined as 100:1000 to produce an adjustment factor of 0.1. Then multiplying the original assigned weight of each question by 0.1; e.g., 0.1 x 7 = 0.7 for factors 3, 5 and 12. The adjusted weight values show the relative importance assigned to each factor, but limit the maximum points to 100 for the land quality index. Column 6 shows the adjusted maximum points for each factor when the maximum number of points per factor (column 2) is multiplied by the adjusted weight (column 5). The total adjusted maximum points for this system now becomes 100.

Table 2. Determination of land quality index

Factor	Max. Point per factor	Times assigned weight	Weight assigned points	Adjust weight	Adjust max. point
1	**2**	**3**	**4**	**5**	**6**
1) Parcel area	10	10	100	1.0	10
2) Share situation	10	10	100	1.0	10
3) Lands adjacent to agricultural areas	10	7	70	0.7	7
4) Land use status	10	5	50	0.5	5
5) Fixed facility (greenhouse, garden, etc.) situation within parcel	10	7	70	0.7	7
6) Zoning situation of agricultural area	10	4	40	0.4	4
7) Distance to the district center	10	10	100	1.0	10
8) Distance to the highway	10	10	100	1.0	10
9) The existence of agricultural drainage system	10	4	40	0.4	4
10) Distance to the natural resources such as river, lake, etc.	10	10	100	1.0	10
11) The existence of electricity on parcel	10	8	80	0.8	8
12) Closeness to forest and its facade of parcel	10	7	70	0.7	7
13) The existence of historical area on parcel	10	4	40	0.4	4
14) Status of receiving the state support of the parcel	10	4	40	0.4	4
Maximum total points	**140**		**1000**		**100**

2.5 Evaluation in Terms of Parcel Value Number

It is necessary to provide land equal to the amount of old land to landowners after land consolidation. This situation is important in terms of equality between the participants. In the study, the parcel value numbers determined by the new equation were compared with the parcel value numbers determined by the existing equation and the method which is advantageous was proposed. Parcel value numbers (PVN) were calculated using Equation 3 in the study.

$$\mathrm{PVN} = \frac{\mathrm{P.I.}}{100} * \mathrm{P.A.} \quad (3)$$

where PVN is parcel value number, P.I. is parcel index and P.A. is parcel area (m^2).

3. RESULTS AND DISCUSSION

Distribution of parcel value number groups according to methods used in the study for Solak, Abdurrahmanlar and Çatallar districts were given in Figs. 3, 4 and 5 respectively. The parcel value numbers determined by the new method were determined according to 14 different criteria in detail containing regional needs.

When examining the parcel value numbers of Solak district (Fig. 3), it was shown that the number of parcels that parcel value number was calculated with the detailed method was bigger in groups of 5000-10000, 10000-20000, 20000-30000 and 40000-50000 than the current method. This shows that parcel value number calculated with the detailed method is bigger than parcel value number calculated with the current method. This is an advantage for landowners. Because increasing the parcel value number means that increasing the land amount to be given to the landowners after consolidation. There are only two groups in which the parcel value number calculated by the current method is bigger. These groups are 1000-5000 and 30000-40000. The reason why the parcels in the range of 1000-5000 in these groups have the smaller parcel value number in the current method is due to the small scale consolidation process has been done before in the Solak district and the parcels in this range have a small area.

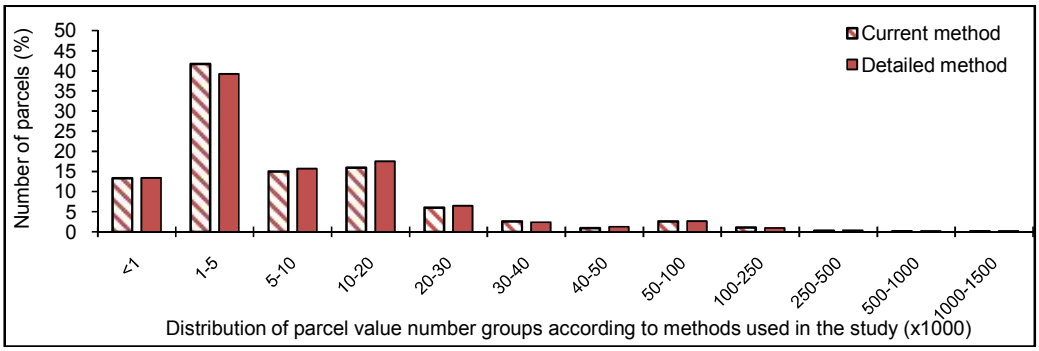

Fig. 3. Current and detailed parcel value number change of the Solak district

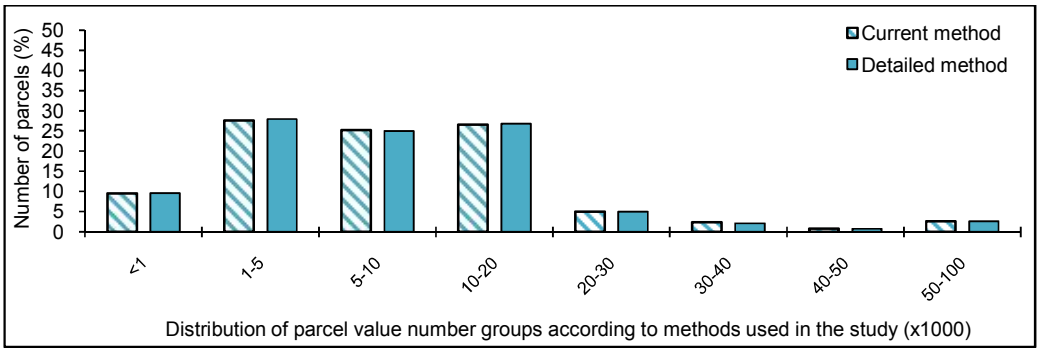

Fig. 4. Current and detailed parcel value number change of the Abdurrahmanlar district

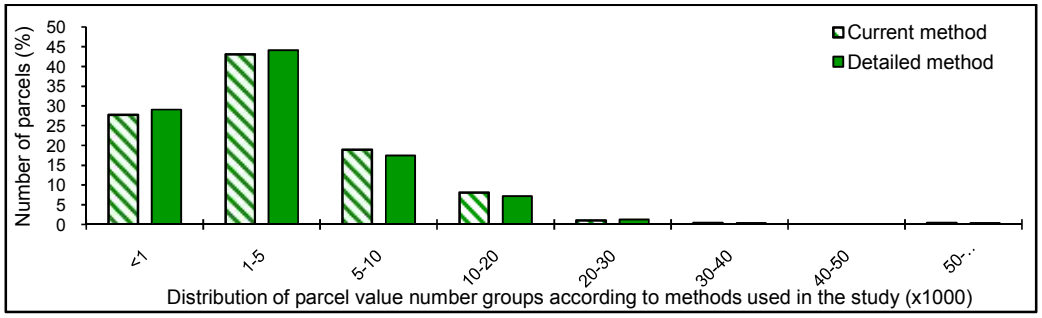

Fig. 5. Current and detailed parcel value number change of the Çatallar district

It is seen that the number of parcels that the parcel value number calculated by the detailed method in Abdurrahmanlar district is higher than the current method in 1000-5000 and 10000-20000 ranges (Fig. 4). The number of parcels that parcel value number calculated by both methods are equal in <1000, 20000-30000, 40000-50000, 50000-100000 groups. The number of parcels calculated by the current method is higher only in the 5000-10000 and 30000-40000 groups. Similarly, it is observed that the detailed method is more calculated in the <1000 and 1000-5000 groups, where the number of parcels is especially bigger in Çatallar district (Fig. 5). This indicates that the detailed method can be used in the land consolidation studies instead of the current method. In addition, change of total parcel value number for each district according to methods was given in Fig. 6.

The total parcel value numbers of the Solak and Abdurrahmanlar districts were calculated higher in the detailed method than the current method. This is partly because that the parcel index was calculated more detailed and included 14 different parameters according to regional needs. The situation that parcel value number is bigger is an advantage for the landowners. The reason why that parcel value number is lower in Çatallar district is caused by the district soil has low quality. This causes that parcel value number calculates lower. Comparison of parcel value numbers obtained with current and detailed methods was given in Fig. 7.

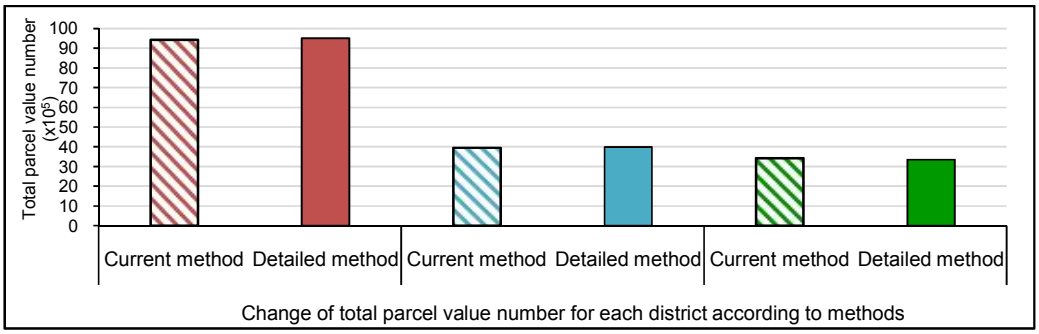

Fig. 6. Change of total parcel value number for each district according to methods

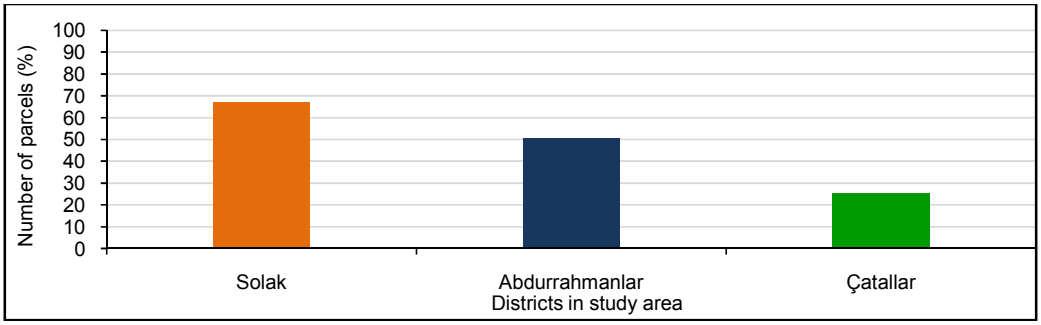

Fig. 7. Comparison of parcel value numbers obtained with current and detailed methods

When compare the parcel value numbers obtained with current and detailed methods, parcel value number of 67% of all parcels in Solak district was calculated higher in the detailed method than the current method. This value was 50.5% in Abdurrahmanlar district. A high calculation of the parcel value number is an advantage because it will increase the amount of land to be given to landowners after land consolidation. So, a detailed method is an advantage for these two districts. However, the parcel value number of 25% of parcels in Çatallar district was calculated higher in the detailed method than the current method. This means that 75% of parcels was calculated higher in the current method than the detailed method. So, this is a disadvantage for the landowners in Çatallar district because the amount of lands to be given them will decrease. The reason is that Çatallar district located in the north of the project area and it is relatively far away from the important centers. The points of the distance to the important centers in the question set of L.Q.I. parameter were assigned the highest. However, parcels of the Çatallar district did not benefit from these points because Çatallar is located in the north of the study area and far away from the important centers. This situation has caused the fall of the points of district parcels. This shows that detailed method can calculate with high accuracy the value of the places where values should be less.

Gündoğdu et al. [10] have tried to determine the parcel value numbers using the possibilities and capabilities of the geographical information system and to try it on a sample project. With the method they used, the parcel value numbers of the parcels in the field of land consolidation were able to determine very precisely and were able to determine the real values of the parcels of the participants. In this study, parcel value numbers were determined in a very detailed way using geographical information systems and similarly to the results of Gündoğdu et al. [10], the results of the study we did show that the detailed calculation of the parcel value numbers can be used to determine the real values of the parcels. Yomralioglu [9] identified 40 factors affecting land parcel value in the land redistribution process. In order to determine the land value in rural land consolidation, the topography, parcel shape, current available area, location and size of parcel, parcel surroundings, wind condition, soil quality and depth, taxes paid, current selling price of parcel, distance from important point in terms of location such as city center, ring road, railroad, water transportation way, recreation areas, existence of irrigation water source, existence of drainage system are the important factors that can be used to determine the parcel value in the same way. In this study, 14 different criteria were used to determine the parcel value and similar results were obtained with the [9]. Tomić et al. [11] conducted a study to determine land values in land consolidation work in Croatia. In the study, they investigated the priority areas for the implementation of land consolidation as a prerequisite for the development of rural areas and agricultural land. They reported that the criteria such as the share of the agricultural land in the land consolidation area, average agricultural parcel size, parcel shapes, fragmentation index of agricultural holdings, the share of agricultural lands belong to the state (treasury land), regional development index, number of agricultural holdings within the land consolidation area etc. have to be used in the determination of the values of the priority areas. The study done by us is similar with the results of Tomić et al. [11] because it is taking into account the similar parameters and determining the real value of parcels. Scarelli and Venzi [17] conducted a study to determine land values in land consolidation studies. Researchers have stated that special conditions must be set for the sale of land. In addition, they specified that the value of land should be determined not only by the farmer's subjective ability but also by considering the nature, productivity and richness of the adjacent neighboring parcels. In this study conducted, we proposed that land value should be determined according to more parameters belong to the region. So, the results of Scarelli and Venzi [17] were similar to our study.

4. CONCLUSION

In the study conducted, soil index was kept constant in both current and detailed methods which are being used to determine parcel index. For this reason, the differences between the methods are due to the other parameters used in the calculation. In the current method, the location score and the efficiency score are not in detail, and they are superficial. However, in the detailed method, since the land quality index is detailed, the parcel index was calculated in a detailed and more accurate way.

As a result, it was clearly understood that the detailed method is needed to use to determine the parcel index in land consolidation studies. The detailed method increases the initiative of the rating commission and makes their works easier. It is not standard for all regions, and it can be modified according to region and project. It calculated parcel values in more detail and real according to international criteria taking into consideration the geographical, physical, cultural and socio-economic structure of the region where the land consolidation is made. These parameters can be listed as the method used in the study and the innovations that the findings will bring to the land consolidation studies.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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