

Full Length Research Paper

The effects of different land reallocation models applied in land consolidation projects on parcel transposition: Example of Karatepe village, Turkey

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It is known that in agricultural countries, problems related to agricultural structure significantly affect agricultural production. One of the most serious of these problems involves the farming of fragmented, scattered and irregular shaped agricultural parcels. Land consolidation projects are one of the most important studies for the elimination of these problems. Enhancing the sustainability of land consolidation projects and applying the projects to larger areas will make these projects successful. Two different land reallocation models (Model A and Model B) were used in this study for Konya-Sarayönü-Karatepe Village land consolidation project. The study attempted to determine the extent to which the parcellation plans obtained after the application affected the success of the project. Data indicated that while the number of parcels was 351 before the consolidation, it became 143 in Model A and 141 in Model B. In addition, in Model A, 59.1% of the total areas were allocated to their previous locations, on behalf of their owners; while in Model B, 55.9% of the total areas were allocated to their previous locations, on behalf of their owners. A statistical analysis was conducted by determining the areas of the landholdings in a block, before and after the project. Statistical analyses indicated that the correlation coefficient (r) was 0.672 for Model A and 0.615 for Model B. According to these results, Model B yielded more successful results than Model A in terms of re-allocating the parcels in their previous locations.

Key words: Land consolidation, land reallocation, landholding, parcel non-transposition, correlation coefficient.

INTRODUCTION

Land consolidation means the reallocation of a rural area generally concerning agricultural or forest properties with fragmented ownership structure. The general objectives of land consolidation are to improving the production and working conditions in agriculture and forestry as well as promoting the general use and development of land and rural areas by re-arrangement of agricultural land (Thomas, 2005). These objectives are pursued by land exchanges between real estates generally without changes of ownership. In addition to actual land exchanges, improvement of the road and drainage network, different building, landscaping, environmental management and conservation projects, and other functions necessary for the objectives may be implemented (Viitanen and Vitikainen, 2005). Research attempting an objective evaluation of Land Consolidation has largely centred on specific cases or aspects such as

social or economic effects (Monke et al., 1992; Goodale and Sky, 1998; Lusho and Papa, 1998; Van Dijk, 2000; Miranda et al., 2006; Cay et al., 2010).

The objectives and methodology of land consolidation are influenced by the specific conditions in different countries and regions, by their historical circumstances, political and social development and also by the natural conditions (Bonfanti et al., 1997; Borec, 2000; Crecente et al., 2002; Eichenauer and Joeris, 1994; Gorton and White, 2003). Land consolidation projects generally include the initiation phase of the project, the design of the project, an inventory of existing land rights and land values, detailed consolidation plans showing the new parcel layout (reallocation), implementation of the plan, and finally, a concluding phase in which final records are produced (FAO 2003).

Land consolidation projects in Turkey are implemented

within the scope of rural development policies (Yomralioglu et al., 2009). In Turkey, Land consolidation projects are being carried out by the Agricultural Services Directorate of Country Private Administration and the Agrarian Reform General Directorate; both are units of the Agricultural Ministry and both have their own laws (acts numbered 3083 and 1757). Land consolidation regulations are compulsory in the regions that are under the responsibility of the Agrarian Reform General Directorate. In other regions, Land consolidation projects must be approved by two out of three of the farmers within the land consolidation region (Ayranci, 2009).

The success of land consolidation projects is evaluated from various perspectives by comparison with the conditions before the project. Cay et al. (2010) analyzed the success of land consolidation projects by applying different land reallocation models. As evaluation criteria, they used the number of parcels and shares, average parcel size, average number of parcels per landholding, production times of the new parcellation plans, project cost, the relations between the landholdings and their close relatives (spouse, father, mother, siblings and other landholdings whose field he/she uses) and to what extent the expectations of the landholdings, as stated during the interview stage of the project were satisfied.

One of the most important factors for successful land consolidation and for the sustainability of future applications involves satisfying the farmers involved in the project. In rural areas, land ownership is attached as a great importance. Therefore, when land reallocation is applied, it is of great importance to keep the landowners in their previous locations, wherever is possible. However, since the land consolidation involves combination of the fragmented land parcels, it is not possible to allocate all parcels of the farmers to their previous locations. Therefore, the farmers generally want to have the new parcels conveniently located around the largest parcel allocated to them.

Avcı (1999) introduced a new model which was developed to determine the new parcel reallocation plan for land consolidation projects. This model was applied within the Salihli-Yılmaz Village land consolidation project. The model is based on the maximization of the land amount that is re-allocated to the same landholding before the consolidation. The model uses a linear programming technique. The results (obtained from the model) showed that, compared to the situation prior to the consolidation project, the model allocated 68.2% of land area within the same block. In a study by Ayranci (2000), two different models were applied in Tokat-Erbaa-Yukarı Çandır Village land consolidation area. The researcher identified land parcels within the project area that were allocated to their previous locations on behalf of their owners. According to the results, 22.18% of the total parcels were left in their previous locations in the first model; and 18.31% of the total parcels were left in their previous locations using the second model. For both models, the total area of all landholdings within a block and the area

allocated to each specific landholding within the block were calculated and the relationships between these areas were determined. It was found that the correlation coefficient (r) was 0.735 for Model A and 0.664 for Model B.

In the present study, two different land reallocation models were applied to determine the success of the Konya-Sarayönü-Karatepe Village land consolidation project. The parcellation plan obtained at the end of the application was compared in terms of number of parcel and shares, number of parcels per landholding and average parcel size. Furthermore, the parcel areas allocated to their previous locations on behalf of their owners were identified and a statistical analysis was made.

MATERIALS AND METHODS

Materials

The material of the study consisted of project data from the land consolidation area in Konya province, (Turkey) Sarayönü district Karatepe village (Section I). Netcad 5.0 software was used in the study. Land consolidation activities in the project area were carried out according to the Land Consolidation Regulation (1979), which was abolished by Special Provincial Administration. The new Land Consolidation Regulation entered into force on 24.07.2009. The application was implemented between the years 2008 - 2010.

Description of the project area

The project area is located in a plain in the north of Konya province. It is 58 km from Konya provincial center and 7 km from the district center. The area can be reached via asphalt road (Figure 1). The project area lacks an above ground water source that can be used for irrigation. There are a total of 9 boreholes, 3 of which were previously opened by the State Hydraulic Works. These boreholes supply a flow of 190 lt/sec. The boreholes were commissioned, 3 boreholes provide sprinkling irrigation. According to the 2007 census, there are 75 houses in the village, with a total population of 493 people. Within the village, 95% of the population earns their living from agriculture. An alternating planting system of fallow/cereal crops is employed within the project area. Beet, potato, beans, cereals and vegetables are grown in the section which is opened to irrigation after land consolidation.

The project area consists of two sections: irrigated agriculture lands (Section I) and non-irrigated agriculture lands (Section II). A cadastral land survey was conducted across the entire project area. According to the cadastral registry, the parcels are under the ownership of the Treasury, Pastures and Persons. Of 1770 parcels, 1691 were registered on behalf of the Persons; 19 were registered on behalf of the Treasury; 26 were registered on behalf of Turkish State Railways and 34 were registered on behalf of the Pastures. There are a total of 426 various landholdings within the study area.

Land consolidation in irrigated agriculture area (Section I) was evaluated in the present study. Karatepe Village (Section I) land consolidation project has a total area of 374.4 ha. The whole of the area is included in the arrangement. The cadastral survey indicates that the area is owned by persons. There are a total of 137 farmers (landholdings) within the consolidation area. There are a total of 351 cadastral parcels within the consolidation area (Figure 2). Of these cadastre parcels, 26 are shared parcels. The average size of the cadastre parcels was 11,025 m². There is one degree class (Parcel Index = 73) in the project area. The contribution share to the



Figure 1. Project area

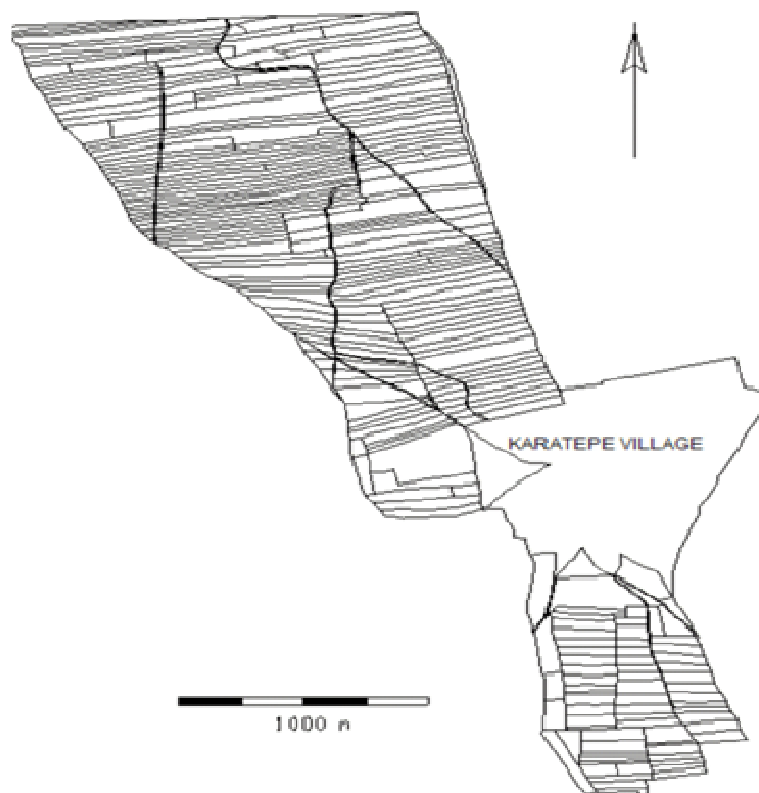


Figure 2. Cadastral Situation on Karatepe Village (Section I).

Table 1. Number of parcels before and after land consolidation.

Parcel size (da)	Number of landholding	Cadastral situation		Model A		Model B	
		Number of parcel	%	Number of parcel	%	Number of parcel	%
0 - 5	11	93	8.5	9	0.8	6	0.5
5 - 10	19	79	4.2	15	0.8	18	1
10 - 20	48	138	2.9	47	1	54	1.1
20 - 30	23	33	1.4	30	1.3	24	1
30+	36	8	0.2	42	1.2	39	1.1
Total	137	351	2.6	143	1.04	141	1.03

common facilities was calculated as 1.0336%.

Methods

The study used an interview-based land reallocation model (Model A) and a block priority based land reallocation model (Model B) to obtain parcellation plans of the Karatepe Village Section I land consolidation project. Model A is based on interviews with the farmers. On the other hand, Model B does not involve the farmers in the allocation process. It is based on the principle of determining the first and second largest parcels owned by the landholdings and the reallocation of these parcels to the blocks. The following equation was used to calculate the parcel non-transposition ratios within the project area:

$$PTR = \left(1 - \frac{A_a - A_b}{A_a} \right) * 100 \dots\dots\dots 1$$

In Equation 1:

PTR: refers to Parcel Non-Transposition Ratio (%).

A_a: refers to Total Project area (da).

A_b: refers to the total area of non-transposed parcels (da).

The areas in each landholding before the project and the areas in parcellation plans after two different land reallocations were compared and the correlation coefficient and regression equation between the land areas before and after the project were determined according to Equations 2, 3, 4 and 5, given below:

Regression equation:

$$\sum y = an + b \sum x \dots\dots\dots 2$$

$$\sum xy = a \sum x + b \sum x^2 \dots\dots\dots 3$$

Equations 2 and 3 yield coefficients a and b. According to these coefficients, a linear regression equation is expressed with Equation 4.

$$y = a + b.x \dots\dots\dots 4$$

n: number of measures,

a: constant coefficient,

b: regression coefficient,

x: independent variable (landholding area before the project),

y: dependant variable (landholding areas after the project).

The correlation coefficient has a range between -1 and +1. When there is no interaction, the coefficient has a value of 0; when there is a full and strong interaction, it has a value of 1 and when there is a reverse and full interaction, the coefficient has a value of -1. Correlation coefficient is indicated by "r".

$$r = \frac{\sum xy - (\sum x)(\sum y) / n}{\sqrt{(\sum x^2 - (\sum x)^2 / n)(\sum y^2 - (\sum y)^2 / n)}} \dots\dots\dots 5$$

RESULTS AND DISCUSSION

Number of parcels and average parcel size

The most important factors in determining the success levels of land consolidation projects include the following: number of parcels and shares after the land reallocation, average number of parcels per landholding and average parcel size. The number of parcels and average number of parcels per landholding for the Karatepe village land consolidation project are shown in Table 1. Average parcel sizes are shown in Table 2. Parcellation plans obtained after applying Model A and Model B are shown in Figures 3 and 4, respectively.

As indicated in Table 1, before the consolidation, while there were a total of 351 previous cadastral parcels in Karatepe village consolidation area, the number of parcels in Model A and Model B were 143 and 141, respectively. While there were 26 shared parcels before the consolidation, the number of shared parcels was found to be 30 in Model A and 7 in Model B. Before the consolidation, the average number of parcels per landholding was 2.6, compared with 1.04 in Model A and 1.03 in Model B. This result indicates that, in terms of reducing the number of parcels, shared parcels and average number of parcels per landholding, Model B was a more successful model.

One of the important aims of land consolidation projects is to provide the landholdings with allocations of land of a size that are suitable for agriculture. In the study area, while the average parcel size was 11.025 da before the consolidation, average parcel size became 26.180 da

Table 2. Average parcel size before and after land consolidation.

Parcel size(da)	Cadastral situation	Model A	Model B
0 - 5	2.365	0.610	4.003
5 - 10	7.408	7.635	7.801
10 - 20	13.872	14.397	14.285
20 - 30	23.678	24.035	24.664
30+	46.075	53.004	56.819
Total	11.025	26.180	26.551

**Figure 3.** Parcellation plan after applying Model A.

in Model A and 26.551 da in Model B. As indicated in Table 2, except the land group of 10 - 20 da, in all groups, Model B gave more successful results. Average parcel size increased by 237% using Model A and 241% using Model B.

Scattered parcels of the landholdings

Table 3 shows numbers of parcel of the landholdings before and after the consolidation. As shown, 40.2% of the landholdings had one parcel before the consolidation. This percentage increased to 81% in Model A and 95% in Model B after the consolidation. After the consolidation, the landholdings were combined in one parcel as far as

possible. In terms of combining the landholdings in one parcel, Model B is observed to yield better results than Model A.

Non-transposed area

Within the study area, parcel areas that were allocated to their previous locations on behalf of their owners are shown in Table 4 according to parcel sizes. These areas were scanned on the parcellation plans obtained after the application of Model A and Model B, which are shown in Figures 5 and 6, respectively. As indicated in Table 4, a total of 200 parcels in Model A and a total of 195 parcels



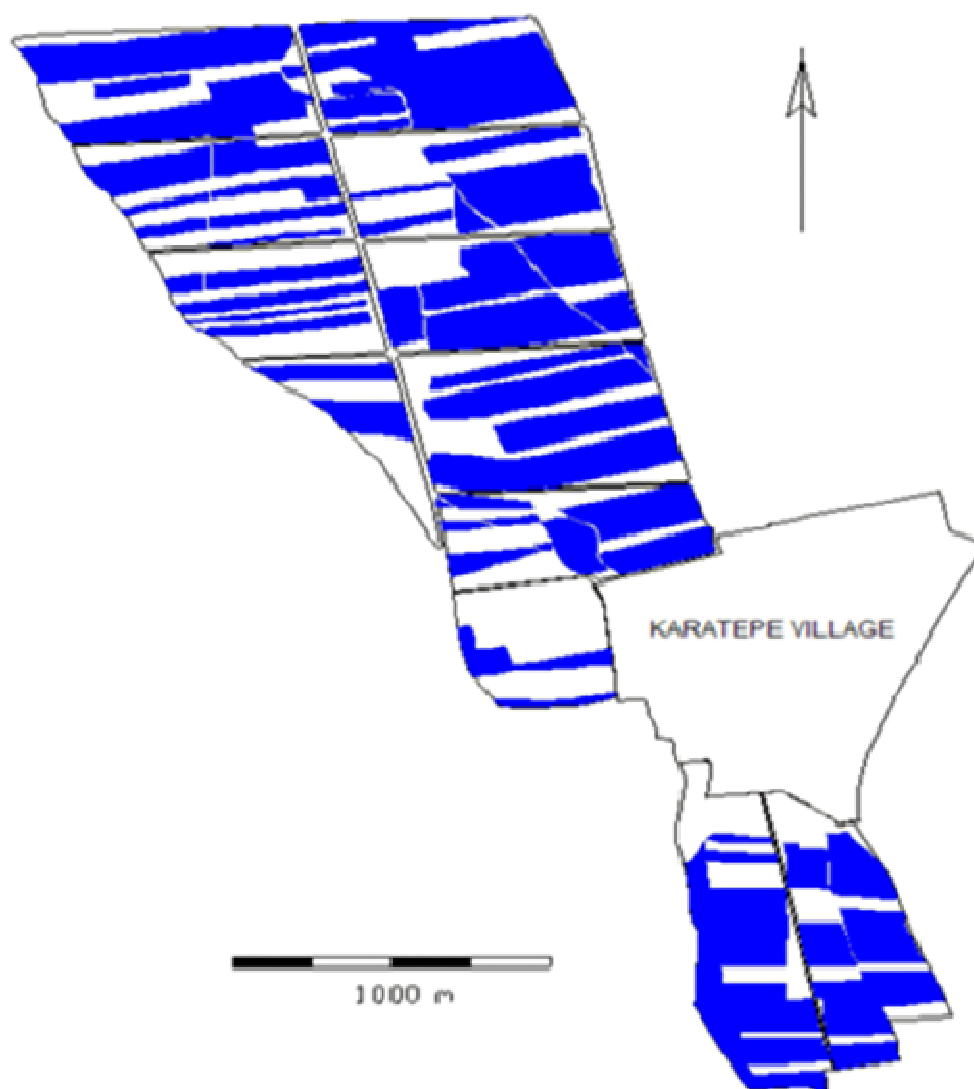
Figure 4. Parcellation plan after applying Model B.

Table 3. Scattered parcels of the landholdings.

Number of parcel	Cadastral situation		Model A		Model B	
	Number of landholding	%	Number of landholding	%	Number of landholding	%
1	55	40.2	111	81	130	95
2	35	25.6	17	12.4	6	4.3
3	14	10.2	3	2.2	-	-
4	13	9.5	3	2.2	-	-
5	7	5.1	1	0.7	-	-
6	4	2.9	1	0.7	1	0.7
7	2	1.5	1	0.7	-	-
8	1	0.7	-	-	-	-
9- +	6	4.3	-	-	-	-
Total	137	100	137	100	137	100

Table 4. Non-transposed parcel area and ratio according to landholding size groups.

Parcel size (da)	Cadastral situation	Model A			Model B		
		Area	Number of parcel	%	Area	Number of parcel	%
0 - 5	227.485	102.686	42	45.1	92.177	36	40.5
5 - 10	629.106	378.655	51	60.2	420.556	56	66.8
10 - 20	1830.551	1087.795	81	59.4	1052.294	81	57.5
20 - 30	725.976	544.097	23	75	463.054	20	63.8
30+	330.830	99.100	3	30	64.660	2	19.5
Total	3743.948	2211.334	200	59.1	2092.742	195	55.9

**Figure 5.** Non-transposed parcel areas in Model A.

in Model B were not transposed. In Model A, 59.1% of the total area was allocated to owners in their previous locations. In other words, 40.9% of the area was

allocated to new locations that differed from their previous locations. In Model B, 55.9% of the total area was allocated to owners in their previous locations, and

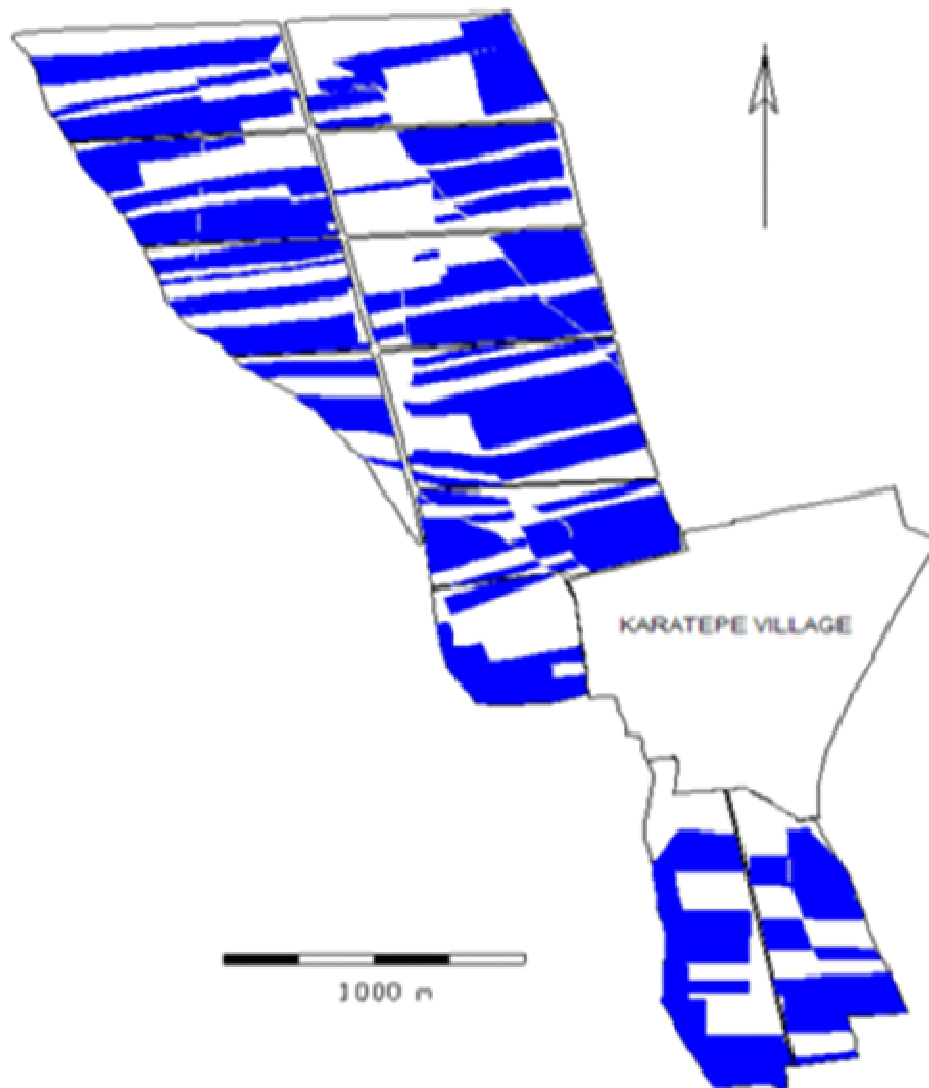


Figure 6. Non-transposed parcel areas in Model B.

44.1% was allocated from different locations. The highest PTR was obtained from the 20 - 30 da landholding groups in Model A. The landholding group which had the lowest non-transposition was the landholding group larger than 30 da in Model B.

The relationship between amounts of area of the landholdings before and after land consolidation

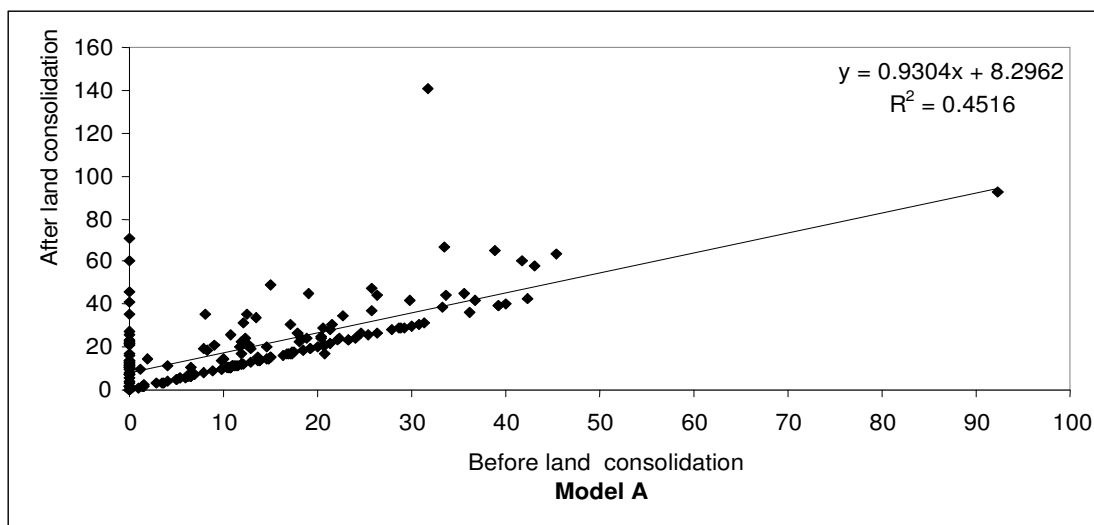
For each landholding, the areas in parcellation plans before the project and after two different land reallocation models (Model A and Model B) were compared. The relationships between the areas before and after the project were statistically evaluated. Figure 7 shows the regression equation obtained after this evaluation.

As indicated in Figure 5, $r = 0.672$ and $r^2 = 0.4516$ for

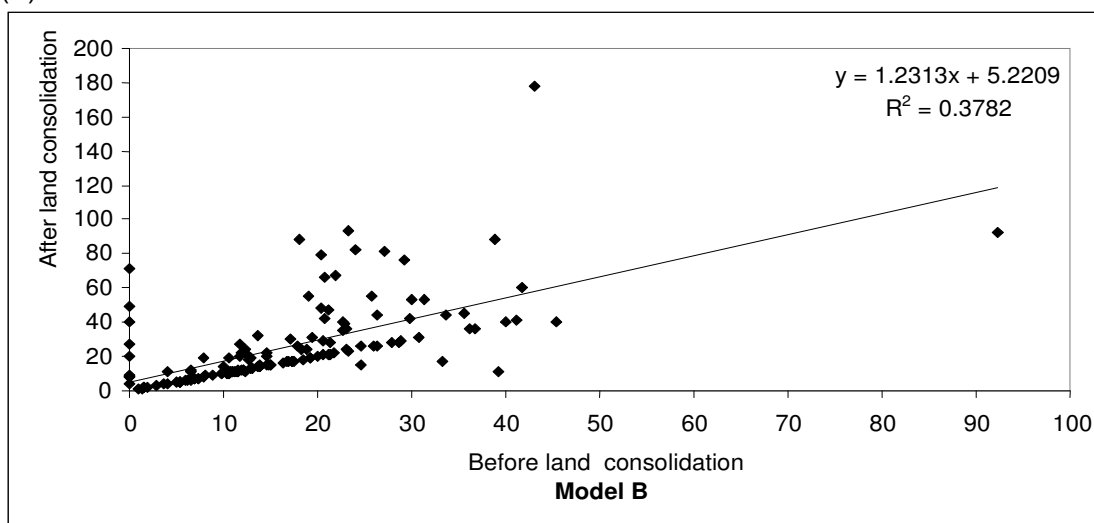
Model A. For Model B, values were $r = 0.615$ and $r^2 = 0.3782$. These results are positive for both models.

According to the results of the regression analysis, Model A was more successful in terms of the amount of land allocated to the landholdings in the same block before and after the consolidation. Since the correlation coefficient was non-zero, there is a positive correlation. In other words, the larger the area of a landholding in a block before the consolidation, the greater is the possibility of allocating the parcel in the same block after the consolidation. As the correlation coefficient was between 0.5 - 0.75, it can be suggested that, there is a moderate relationship between the variables.

Each state has different parcel properties. As a result of this, the same land reallocation model can yield different results in different land consolidation areas. The correlation coefficients obtained for the project area can



(a)



(b)

Figure 7. The land reallocation of areas allocated to landholdings from the same block before land consolidation a) Model A b) Model B.

reach a value of 1 for different applications. However, this situation means that the parcels of each landholding remain in their previous locations, which is not consistent with the principle of land consolidation.

Conclusion

In this study, when compared to the condition before the consolidation, both models reduced the average number of parcels per landholding; in addition, the amount of land in the same block as before the consolidation was found to be 59.1% for Model A and 55.9% for Model B, which are successful results.

When the success of land consolidation is analyzed in

terms of the number of parcels and shares, average number of parcels per landholding, average parcel size and number of parcels allocated to the landholding, it was found that Model B was more successful than Model A. However, Model A was found to be more successful in terms of the statistical analysis of the parcel areas that were allocated to their previous locations on behalf of their owners and the parcellation plans allocated to each landholding before and after the project.

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REFERENCES

- Food and Agriculture Organization (2003). The design of land consolidation pilot projects in Central and Eastern Europe. FAO Land Tenure Studies. Rome p. 6.
- Avcı M (1999). A new approach oriented to new allotment model based on block priority method in land consolidation. *Turk. J. Agric. For.* 23: 451-457.
- Ayranci Y (2000). Using the parcel transposition ratio (PYO) in the evaluation of land consolidation projects. *Turk. J. Agric. For.* 24: 745-749.
- Ayranci Y (2009). A method for the construction of a new reallocation plan in land consolidation (LC) and its application. *Philipp. Agric. Sci.* 92: 254-264.
- Bonfanti P, Fregonese A, Sigura M (1997). Landscape analysis in areas affected by land consolidation. *Landscape Urban Plan.* 37: 91-98.
- Borec A (2000). The significance of land consolidation for the development of farmland in Slovenia then and now. *Ber. Landwirtsch.* 78: 320-334.
- Cay T, Ayten T, Iscan F (2010). Effects of different land reallocation models on the success of land consolidation projects: Social and economic approaches. *Land Use Policy* 27: 262-269.
- Crecente R, Alvarez C, Frau U (2002). Economic, social and environmental impact of land consolidation in Galicia. *Land Use Policy* 19: 135-147.
- Eichenauer M, Joeris D (1994). The historical relationship between land consolidation and nature conservation. *Ber. Landwirtsch* 72: 329-450.
- Goodale MR, Sky PK (1998). Owner's relationships to property and land consolidation: a social approach. *Kart. Og. Plan.* 4: 264-268.
- Gorton M, White J (2003). The politics of agrarian collapse: decollectivisation in Moldova. *E. Eur. Polit. Soc.* 17: 305-331.
- Lusho S, Papa D (1998). Land Fragmentation and Consolidation in Albania. Albania Series. Working Paper 25. University of Wisconsin-Madison, Madison.
- Miranda D, Crecente R, Alvarez MF (2006). Land consolidation in inland rural Galicia, N.W. Spain, since 1950: an example of the formulation and use of questions, criteria and indicators for evaluation of rural development policies. *Land Use Policy* 23: 511-520.
- Monke E, Aviller F, Ferro M (1992). Consolidation policies and smallfarm agriculture in northwest Portugal. *Eur. Rev. Agric. Econ.* 19: 67-83.
- Thomas J (2005). Actual Trends concerning, Land Management, Land Readjustment and Land Consolidation in Europe - Possible Fields of Research. Report at the 7th workshop and 8th MC meeting of the Action G9 of COST, Thessaloniki, Greece p. 21.
- Van Dijk T (2000). Effects of land consolidation in practice analysis of post-war experience in The Netherlands. In: Fendel, E.M. (Ed.), *Proceedings of the 22nd Urban and Regional Data Management Symposium-Seminar on Land Markets and Land Consolidation in Central Europe*. TU Delft, Delft.
- Viitanen K, Vitikainen A (2005). Land Readjustment and Land Consolidation, WG 2 Cadastral Science Meeting. Aalborg, Denmark.
- Yomralioglu T, Inan HI, Aydinoglu AC, Uzun B (2009). Evaluation of initiatives for spatial information system to support Turkish agriculture policy. *Sci. Res. Essays* 4(12): 1523-1530.