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Evaluation of land consolidation impact criteria for rural development

Halil Burak Akdeniz[*1], **Tayfun Çay** [1], **Şaban İnam** [1]

[1] *Konya Technical University, Engineering and Natural Sciences Faculty, Geomatics Department, Konya, Türkiye*

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Abstract

Land consolidation is one of the most important means of rural development practices. In order for land consolidation studies to successfully achieve rural development-oriented goals, they must be carried out "with the feature and content that responds to the expectations in the most appropriate quality". In this study, the effect of the land consolidation and on-farm development projects, which were implemented and approved in two separate units in the Manyas district of Balıkesir province of Turkey, on rural development was examined. As a result of land consolidation, it was determined that the average size of the parcels in the study areas increased, the average number of parcels per enterprise decreased, all parcels benefited from the transportation and irrigation system, the parcel shapes were made suitable for modern agriculture, the amount of border area loss decreased and public investments were made without paying any price.

1. Introduction

Today, the continuous increase in the world population increases the importance of soil and water, which are limited natural resources. Global warming, climate change and epidemic diseases that have increased in the last 10 years have revealed the importance of agricultural production. All these developments increase the importance of rural development policies that directly affect food production (Yoğunlu 2013). One of the important criteria of a correct rural development planning is the efficient and effective use of agricultural lands. Among these, "Land Consolidation (LC)" is an important and effective tool. LC has become an effective tool used to improve the quantity and quality of cultivated lands, reduce land fragmentation, regulate land shape and property structure, increase modern agricultural development, improve rural environment, realize public investments without expropriation, support rural development and poverty reduction (Jiang et al. 2017; Zhou et al. 2020).

LC is important not only for increasing agricultural production, but also for solving the socio-economic problems of rural areas. Therefore, LC should not be accepted as a practice for agricultural production only. Land consolidation is also a versatile rural area planning that will improve the living standards of the population living in rural settlements and slow down the migration from villages to cities.

In this study, the effects of land consolidation and on-farm development projects implemented in the Manyas district of Balıkesir province of Turkey on rural development were examined.

2. Materials and methods

2.1. Materials

Eskiçatal and Kayaca neighborhoods, which are connected to the Manyas district of Balıkesir province in the northwest of Turkey, constitute the study areas (Fig. 1). The study areas are 5 km away from Manyas district and 80 km away from the city center of Balıkesir. The altitude of the region above sea level is about 50 meters and the slope value is low. According to the census data of 2021, the total population of both neighborhoods is 600. In the area with Mediterranean climate characteristics, the winters are cool and rainy, and the summers are hot and dry. The average annual precipitation is 700 mm. As its lands are very fertile, the main livelihood of the people in the region is agriculture and animal husbandry. It is possible to get crops from irrigated land twice a year. Mostly wheat, rice, corn, sunflower, tomato and cabbage are grown in agricultural production areas. Small cattle breeding also has a special place in the region, which is famous for its milk and dairy products.

* **Corresponding Author**

*(hbakdeniz@ktun.edu.tr) ORCID ID 0000 – 0002 – 9504 – 051X
(tcay@ktun.edu.tr) ORCID ID 0000 – 0002 – 4661 – 5583
(sinam@ktun.edu.tr) ORCID ID 0000 – 0002 – 9101 – 6109

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Land consolidation and on-farm development services in Kayaca and Eskiçatal neighborhoods were completed in 2014 and 2015. In the study, numerical and attribute data obtained before and after the land consolidation projects were used.

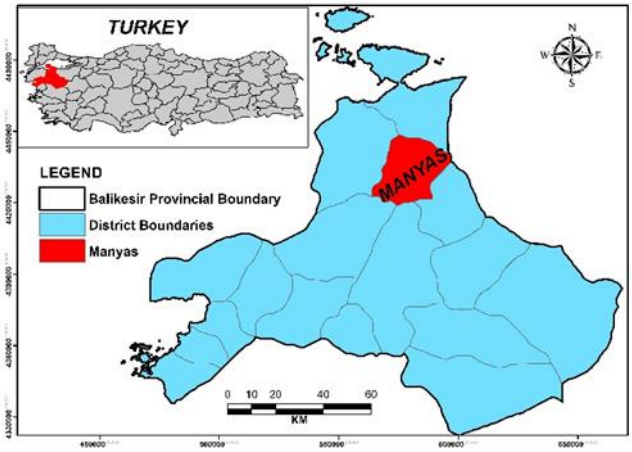

Figure 1. Study area

2.2. Methods

In this study, in which the effects of land consolidation and on-farm development services on rural development were evaluated, the issues determined were

- Consolidation rate of LC projects,
- Change in average parcel size and average number of parcels per enterprise before and after LC,
- Number and rate of parcels directly benefiting from the transportation and irrigation system before and after LC,
- The size of the parcels before and after LC,
- Change of parcel geometry,
- The amount of area loss caused by the inability to approach the parcel border, and
- The area to be expropriated by the public finance, and the expropriation cost to be paid if infrastructure and superstructure investments are made without the implementation of the LC project

Netcad 8.5 software was used in the production of spatial analysis, and ArcMap 10.5 software was used in the display of thematic maps. Subdivision maps before and after LC for each study area are shown in Fig. 2 and Fig. 3.

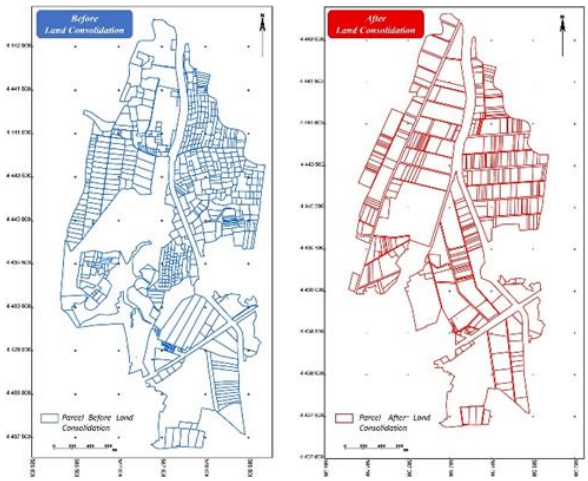

Figure 2. Eskiçatal parcellation maps before and after LC

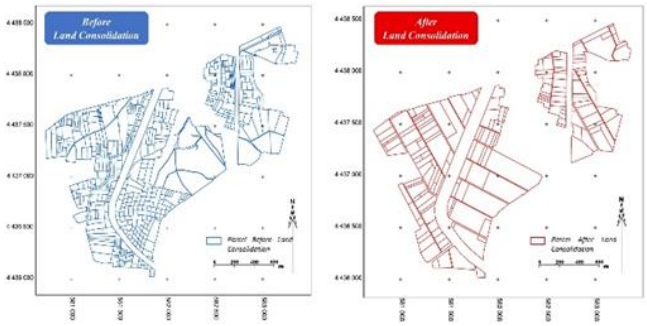

Figure 3. Kayaca parcellation maps before and after LC

3. Results

3.1. Consolidation rate

There are a total of 344 private enterprises within the scope of the Eskiçatal LC project. While the total number of parcels belonging to private enterprises was 626 before LC, the total number of parcels decreased to 373 after LC and the consolidation rate was calculated as 40.41% (Table 1). There are a total of 194 private enterprises within the scope of the Kayaca LC project. While the total number of parcels belonging to private enterprises was 470 before LC, the total number of parcels decreased to 177 after LC and the consolidation rate was calculated as 62.34% (Table 1). Considering that the consolidation rate in the land consolidation projects in Turkey is 42.4% on average [Yağanoğlu et al. 2000; Döner and Kaya 2021), it is observed that the consolidation rate value in both projects is similar to the country average.

3.2. Average parcel size and average number of parcels per enterprise

While the average parcel size in the Eskiçatal project site was 9.79 da before LC, it was 16.43 da after LC (Table 1). The average parcel size increased by 67.82% before and after LC. While the average parcel size in the Kayaca project site was 4.96 da before LC, it was 13.17 da after LC (Table 1). The average parcel size increased by 62.33% before and after LC.

Table 1. Information before and after consolidation of Eskiçatal and Kayaca neighborhoods

		ESKİÇATAL	KAYACA
Project implementation period		2010-2015	2011-2014
Project area (da)		24585.0	23317.0
Number of parcel	*Before LC*	626	470
	After LC	373	177
Average parcel size (da)	*Before LC*	9.79	4.96
	After LC	16.43	13.17
Number of enterprises		344	194
Average number of parcels of the enterprise	*Before LC*	1.82	2.42
	After LC	1.08	0.91
	Reduction ratio (%)	40.66	62.40
Consolidation rate (%)		40.41	62.34

3.3. Transportation and irrigation system

When Table 2 is examined, while 156 of the 626 parcels (24.92%) in the Eskiçatal neighborhood have direct access to the transportation system before LC, 113 (24.04%) of the 470 parcels in the Kayaca neighborhood have direct access to the transportation system. It was determined that all parcels (100%) in both neighborhoods have direct access to the transportation system after LC.

While none of the parcels in the Eskiçatal neighborhood had an irrigation system before LC, 153 (32.55%) parcels in the Kayaca neighborhood benefited from the irrigation system. It was determined that all parcels (100%) in both neighborhoods directly benefited from the irrigation system after LC. The number and rates of parcels benefiting from the transportation and irrigation system before and after LC are given in Table 2.

Table 2. Number and rate of parcels direct access to the transportation and irrigation system before and after LC

	Status	Transportation System		Irrigation System	
		Number of parcels	Parcel rate (%)	Number of parcels	Parcel rate (%)
Eskiçatal	*Before LC*	156	24.92	0	0.00
	After LC	373	100.0	373	100.0
Kayaca	*Before LC*	113	24.04	153	32.55
	After LC	177	100.0	177	100.0

3.4. The effect of land consolidation on parcel size

Parcel sizes (da) were divided into six groups as 0-5, 6-10, 11-20, 21-50, 51-100 and 100<. The number and rates of parcels belonging to the parcel size groups before and after LC are given in Table 3.

While 57.67% of the parcels in the Eskiçatal project site were in the range of 0-5 before LC, this rate became 39.41% after LC. A decrease was observed in the rate of parcels between 0-5 da size after consolidation, while an increase was observed in all other sizes.

While 74.90% of the parcels in the Kayaca project site were in the range of 0-5 decares before LC, this rate was 38.42% after LC. The rate of parcels over 20 decares increased after LC.

Table 3. Distribution of parcel size in Eskiçatal and Kayaca project area before and after LC

Parcel size (da)	ESKİÇATAL		KAYACA	
	Before LC (%)	*After LC (%)*	*Before LC (%)*	*After LC (%)*
0-5	57.67	39.41	74.90	38.42
6-10	24.60	26.01	17.23	28.25
11-20	12.94	19.57	5.96	22.60
21-50	2.56	9.92	1.49	7.91
51-100	1.28	3.48	0.21	2.26
100<	0.95	1.61	0.21	0.56

3.5. The effect of land consolidation on parcel shape

Parcel shapes were divided into five groups as rectangular, square, amorphous, triangular and trapezoidal. The number and rates of parcels belonging to these groups before and after LC are given in Table 4.

While the rate of rectangular parcels in Eskiçatal neighborhood was 53.03% before LC, it increased to 69.44% after LC. It was determined that while the rate of amorphous parcels was 36.10% before LC, it decreased to 9.65% after LC.

While the rate of rectangular parcels in Kayaca neighborhood was 37.23% before LC, it increased to 60.45% after LC. While the rate of trapezoidal parcels was 29.36% before LC, it decreased to 14.69% after LC.

Table 4. Changes of parcel shape

Parcel shape		Neighborhoods			
		ESKİÇATAL		KAYACA	
		Before LC	*After LC*	*Before LC*	*After LC*
Rectangle	Number	322	259	175	107
	%	53.03	69.44	37.23	60.45
Square	Number	4	1	9	4
	%	0.64	0.27	1.91	2.26
Amorphous	Number	226	36	132	36
	%	36.10	9.65	28.09	20.34
Triangular	Number	6	5	16	4
	%	0.96	1.34	3.41	2.26
Trapezoidal	Number	58	72	138	26
	%	9.27	19.20	29.36	14.69

3.6. Border area losses

In agricultural production, a strip of land with a width of about 40 cm parallel to the parcel border cannot be planted (Demirel 1997). While the non-cultivation area of the enterprises in the Eskiçatal and Kayaca project sites due to the parcel border facilities was 93.45 da and 52.83 da before LC, it decreased to 72.44 da and 30.45 da after LC. The 21.01 da and 22.38 da lands in the Eskiçatal and Kayaca project sites were made available for agricultural production after consolidation.

An area gains of 9.60% and 8.55% was achieved in Eskiçatal and Kayaca project sites due to the loss of border area after LC.

3.7. The amount and cost of expropriation

One of the benefits of the implementation of the LC project is the acquisition of public common-use areas by consolidation instead of expropriation. The area required for public investments in Eskiçatal and Kayaca project sites was calculated as 590.93 da and 219.65 da. According to the decision of the 25th Regional Directorate of State Hydraulic Works (DSI) dated 06.01.2020, the expropriation unit price in the irrigated agricultural lands of Eskiçatal and Kayaca neighborhoods in Manyas district was determined as 10 TL/m2. In line with this value, with the assumption that there were no

buildings and facilities on the areas to be allocated for public investments, the expropriation cost of Eskiçatal and Kayaca project sites was calculated as 8,105,800 TL. Such a situation would put an additional burden on public finances and cause a waste of resources.

4. Discussion and Conclusion

This study has been evaluated on the basis of 7 criteria, the impact criteria of the land consolidation project in ensuring rural development, as "consolidation rate, average number and size of parcels, number of parcels benefiting from the transportation and irrigation system, parcel geometry, the amount of border area loss and the amount of expropriation".

By decreasing the number of enterprise parcels and increasing the average parcel size after LC, the number of labor and workdays decreased while agricultural productivity and efficiency increased. With LC, it was ensured that all parcels in the project sites benefit directly from the road and irrigation network. Thus, it became easier and more economical for enterprise owners to access their lands, and damages caused by transportation to the parcel and disputes between property owners were prevented. One of the benefits of LC projects is the correction and improvement of the parcel geometry in a way that is suitable for agricultural mechanization. The most suitable parcel geometry for agricultural mechanization is rectangular (Boztoprak et al. 2015). Agricultural mechanization will be facilitated in the parcels formed in this way, and productivity will increase with the reduction in processing cost and time. The increase in the rate of rectangular parcels in both study areas after LC is an important gain in terms of rural development. Large number of enterprise parcels per unit area and the amorphous parcel geometry cause a certain section parallel to the parcel border not to be used in agricultural production. With the decrease in the number of parcels and the improvement of the parcel geometry after LC, border area losses will decrease and production will become more efficient in vacant areas. In the application areas that are the subject of the study, a total of 43.39 da of land was brought into agricultural production after LC. This will increase agricultural production, enterprise income and country added value. For rural development, accelerating public investment costs is as important as reducing them. With LC projects, public common-use areas were created both quickly and holistically and were obtained without paying the expropriation price. Thus, the public finances gained 8,105,800 TL.

As a result, it is necessary to develop and support land consolidation projects that accelerate the achievement of rural development goals and contribute to sustainability in rural areas.

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