

Personal, physical and socioeconomic factors affecting farmers' adoption of land consolidation

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Abstract

Ownership of agricultural land is very fragmented in Turkey, as is the case in countries within central Europe. This prevents agricultural efficiency from reaching desired levels. Land consolidation involves redistributing land ownership so that individual farmers own fewer, larger, more compact and more contiguous land parcels. In Turkey, generally voluntary land consolidation projects are performed, while some financial limitations and political conditions prevent land consolidation reach to its desired level. For this reason, only 2.2% of the agricultural areas have been consolidated so far. Ideally, farmers adopt consolidation and are pleased by its results; this helps maintain the sustainability of the land structure formed by consolidation and accelerate acceptance of consolidation in other areas. In this study, the factors that are effective on farmers' adopting land consolidation and their contentment were investigated. For this purpose, the results of the survey carried out in the selected villages within the Bursa- Karacabey plain were assessed using a logit model. According to the results obtained from this consolidation study, the criteria farmers value are the utilization of the irrigation system, reduction of inter-farmer conflicts, shaping parcels into a form proper for mechanized agriculture, and forming parcels of large dimensions by consolidating parcels. A higher level of contentment was observed among the farmers who were provided with above mentioned factors.

Additional key words: evaluation, land fragmentation, land re-allotment, rural development.

Resumen

Factores personales, físicos y socioeconómicos que afectan a la adopción de la concentración parcelaria por los agricultores

La propiedad de la tierra en Turquía está muy fragmentada, tal y como sucede en los países de Europa central. Este fenómeno impide que el rendimiento llegue a los niveles deseados. La concentración parcelaria implica la redistribución de la propiedad, lo que provoca que los agricultores individuales obtengan menos parcelas, pero más contiguas y compactas y de mayor tamaño. En Turquía, se han aplicado en general proyectos voluntarios de concentración parcelaria, pero las limitaciones financieras y las condiciones políticas del país impiden que la concentración parcelaria llegue al nivel deseado. Por ello, solo el 2,2% de la tierra cultivable está consolidada hasta ahora. Normalmente, los agricultores aceptan la concentración y están satisfechos con los resultados. Esto ayuda a mantener la nueva estructura de la tierra obtenida y acelera la aceptación de la concentración en otras zonas. En este estudio, se investigaron los factores que afectan a los agricultores para aceptar la concentración parcelaria y su nivel de satisfacción. Con este fin, el modelo logit se aplicó a los pueblos localizados en la llanura de Bursa-Karacabey y se vio que en un trabajo de concentración bien planificado, los agricultores están más satisfechos si sus demandas se tienen en cuenta, si las parcelas están irrigadas, si los conflictos entre los agricultores se reducen, si la forma de la parcela es adecuada para la agricultura mecanizada, y si aumenta el tamaño de las parcelas.

Palabras clave adicionales: desarrollo rural, evaluación, fragmentación de la tierra.

Introduction

Farm fragmentation exists in many parts of the world and typically occurs where the landholdings of individual

farmers are small and widely dispersed. Opinions concerning the drawbacks and merits of fragmented land ownership differ. Some observers point out that there are significant benefits for the individual farmer, such as ecological diversity (Bentley, 1987; Agrawal, 1999; Tan *et al.*, 2006). That is, by planting crops in several different ecological zones, a farmer reduces the risk

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of a meager harvest. Others contend that farm fragmentation is the single greatest deterrent to modern agricultural development, creating inefficiencies in the movement of labour and machinery, hindering large-scale mechanization of production processes, and increasing administration expenses and the complexity of the cadastre and rights-of-way considerations (Bonner, 1987; Tan *et al.*, 2006). In view of these considerations, numerous land consolidation (LC) and land reform policies have been implemented to reduce fragmentation in European countries like the Netherlands, France, Spain, Czech Republic or Turkey; in African countries like Kenya, Tanzania and Rwanda; in China, Japan, India and elsewhere (Rosman and Sonnenberg, 1998; Akkaya Aslan and Arici, 2005; Wu *et al.*, 2005; Miranda *et al.*, 2006; Sklenicka, 2006; Tan *et al.*, 2006). In Central and Eastern Europe, LC was carried out by the former communist regimes. Since the fall of the regimes, both deconsolidation and reconsolidation of lands have been used with the aim of furthering development (FAO, FIG, GTZ, Arge Landentwicklung and TU München, 2002).

LC is not just re-allocation of fragmented parcels. The re-allotment of land continues to be an important instrument of rural development in many countries (Huylenbroeck *et al.*, 1996; Van den Brink, 1999; Borec, 2000; Gudman, 2000; Van Lier, 2000; Semlali, 2001; Crecente *et al.*, 2002; González *et al.*, 2004, 2007). LC provides social and economical benefits, though with some negative environmental effects based on their comparison of consolidated and non-consolidated areas in terms of social, economical, and environmental effects (Crecente *et al.*, 2002; Miranda *et al.*, 2006).

In Turkey, 8.5 million ha (out of an arable area of 28.5 million ha) can be economically irrigated; of these 8.5 million ha, 4.8 million are being irrigated. Average farm size was 10 ha in 1950, 6.8 ha in 1980, 5.9 ha in 1990 and 6.1 ha in 2001; the number of farms in the same years was 2.2 million, 3.5 million, 3.9 million and 3.02 million respectively. Average parcel number per landholding, although differing from region to region, is presently 5.4 (Gun, 2003; Anonymous, 2004; Babagiray, 2006).

LC implementations in Turkey started in 1961 at the Karkin Village of Konya Province. In spite of the fact that LC studies have been carried out for nearly 45 years in Turkey, legal arrangements on this matter are rather insufficient, and there is no special law code on it even though it has been studied on for many years (Arici, 1994; Gur and Demirel, 2002; Gun, 2003).

In Turkey, LC study is not implemented only as a reallocation of lands, but together with such works as irrigation, drainage, road system, land levelling, and land improvement. Nowadays, LC work is being carried out only in places where irrigated agriculture is practiced. No practice has yet been carried out in the areas without irrigated agriculture. All the project expenses are paid by the state, and participators do not pay for anything. However, some of the areas that are needed for the infrastructure facilities to be built on (such as irrigation, drainage, and road) are taken from the land of the participants—in equal ratio proportional to the size of the lands—without the state paying indemnity for expropriation.

LC projects (LCPs) in Turkey are performed by two different legal institutions (General Directorate of Rural Services, GDRS, and General Directorate of Land and Agriculture Reform) operating under two distinct legal arrangements. From 1961 to now, 724 LC projects have been performed involving an area of 514,193 ha. This corresponds to 6% of the irrigable area of the country, 11% of the irrigated area, and 2.2% of the arable area (Anonymous, 2004). In areas where LC is carried out, mean parcel size is 1.97 ha, mean number of parcels per landholding is 1.39, and the mean landholding size is 2.76 ha. Even though the consolidated parcels are better in terms of production and labour conditions when compared to their prior conditions, they are still not good enough to compete with those around the world due to the size of landholding. Furthermore, the failure in preventing the parcels from becoming fragmented after the LC is also one of the significant problems. For this reason, it is necessary to take preventative measures against fragmentations that are liable after consolidation and to carry out work as to increase the size of owners.

According to the legal arrangement, the institution which operates over a greater part of the country, the GDRS, is able to carry out its practices conditional to the participant's agreement, and this method is called «Voluntary Land Consolidation». Two prerequisites for Voluntary Land Consolidation were determined by the legal arrangements: (1) agreement to consolidate two thirds or more of the population in the project area and (2) agreement to consolidate a subset of the population owning more than half of the arable land in the project area. These prerequisites obstruct the practice of LC in the desired areas as the participants have to be persuaded to carry out a project. Participators do not feel warm to the LCPs for various reasons. The most significant of these reasons can be listed as alle-

giance to the family territory, the fear of losing their land, not having enough knowledge of LC study, unsuccessful projects carried out in the neighbouring villages, and lack of a precise legal arrangement. Other than these, politicians do not keep LC studies warm and throw it into their program as LC works are complicated, difficult, and time consuming works and farmer satisfaction does not take place immediately after the project is completed. These conditions are the most important factors for expansion and acceleration of LC studies. Further, the expansion of voluntary consolidation to new areas clearly depends on farmers' adoption. LCPs carried out efficiently and successfully will positively influence the farmers in adjacent villages. Therefore, they will be more willing to adopt consolidation in their own areas. LCP should be carried out carefully, sensitively, and fairly because it directly affects property rights.

The expected benefits and satisfactions of these studies may not be understood by all farmers immediately after consolidation, as it may take time for them to get used to re-allocated parcels and to accept the loss of parcels to which they were emotionally attached.

One of the areas where LC works are carried out intensively in Turkey is the province of Bursa (in Marmara region). To this day, LC works have been carried out in an area of 26,681 ha in Bursa (Anonymous, 2004). The area where the LC works have been carried out most intensively (16,683 ha) in the province of Bursa

is Karacabey plain. LC works in the Karacabey plain were started in 1987 in parallel with the irrigation system plan of DSI (State Hydraulic Works). All villagers in the area were persuaded of the propriety of LC in order for the DSI not to pay compensation for expropriation for the irrigation system and to make system designing easier, and after DSI completed the irrigation project, GDRS started LC studies.

Yavuz and Gurbuz (2001) conducted a survey to determine farmers' adoption level of LC in Bursa-Karacabey. They found that 76.4% of respondents adopted consolidation willingly; most of the others believed that they will be negatively affected from re-allocation due to the fear that they might be given lands of lower value.

Kizilaslan and Almus (2002) conducted a study of LC adoption in Tokat, Turkey. They found that levels of social participation in LCPs and consolidation awareness have an effect on adoption. They concluded that farmers with larger farms are more likely to adopt consolidation. Economic factors such as number of parcels owned, annual sales of agricultural products, and gross production value had significant effect on adoption.

Gajendra and Gopal (2005) found that land ownership and land parcels are undergoing fragmentation in South Asia, thereby accelerating the pace of their degradation and constraining agricultural development. They stated that scattered farms and tiny parcels dis-

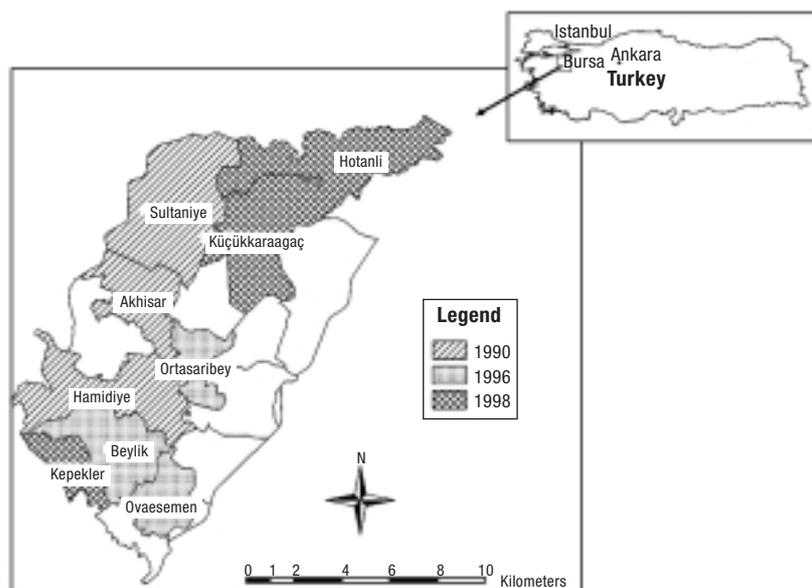


Figure 1. Location of study areas in the Bursa-Karacabey plain, Turkey.

courage farmers from adopting agricultural innovations and so realizing economical benefits.

In this study, considering the view that LC perception does not arise immediately upon putting it into practice but it takes up time, the aim was to determine the factors that could be effective on the adoption and perception of LC studies by the farmers. For this purpose, villages in the Karacabey plain, where LC works started in 1987 and finished at different intervals, were selected as study areas. A survey was carried out in order to determine farmer satisfaction with LC and their expectations.

Material and Methods

Study area

The Bursa-Karacabey Plain (Fig. 1) covers an area of 16,683 ha and includes 17 villages. The LCPs started in 1987 within the plain and were carried out in groups, which were completed in different years. There are two projects still being carried out. The LC and irrigation system has been completed and came into use in the first village group in 1990. Before the year 1990, while dry farming was intensively applied, farmers also applied subsurface irrigation from their own resources. With the irrigation system coming into operation in 1990, irrigated farming started first in an area of 2,148 ha, and then in an area of 10,027 ha in 2004 (Table 1). The state of production and productive

values in the plain pre and post consolidation are given in Table 1.

The study area, villages of the Karacabey plain, was divided into three groups according to the application dates of the LC studies (i.e., finished by 1990, 1996, or 1998), and nine villages were selected, three from each group, upon advice from Regional Directorate of Rural Services (RDRS, an arm of the Turkish government) and the Plain Villages Irrigation Association (Fig. 1). Akhisar, Hamidiye, Sultaniye villages were in the first group; Beylik, Ovaesemen, Ortasarıbey villages were in the second group; and Kepekler, Küçükarağaç, and Hotanlı villages were in the third group.

Survey

A survey was carried out on December 2005 in order to determine the opinions of the farmers about LC. There were 3,513 landholdings in the study area (9 villages). The number of owners to be surveyed in each village (Table 2) was determined by a graduated random sampling method (Hays and Winkler, 1971). As the selected villages are not homogeneous in terms of landholding size—small family owners, medium size owners, and large farm owners—owner size was divided into four groups (i.e., 0-1 ha, 1.1-5 ha, 5.1-10 ha, and > 10 ha) in order to be able to do the surveys with sufficient number of owners from each size group in each village. Information about each farm owner (e.g., age, education level, family size, amount of land owned,

Table 1. State of production and productive values in Karacabey Plain in the years 1990, 1996 and 1998

Crop pattern	1990			1996			1998		
	Area (ha)	Percentage of cultivated area (%)	Average yield (kg ha ⁻¹)	Area (ha)	Percentage of cultivated area (%)	Average yield (kg ha ⁻¹)	Area (ha)	Percentage of cultivated area (%)	Average yield (kg ha ⁻¹)
Sugar beet	309.9	14.7	782	295.0	4.1	722	604.0	7.6	785
Maize	8.5	0.4	72	172.6	24.2	99	2,346.9	29.5	114
All kinds of vegetables	1,561.3	74.2	500	4,498.0	63.0	459	4,592.7	57.8	452
Onions, garlic	4.1	0.2	280	59.0	0.8	335	137.5	1.7	393
Fodder crops	69.2	3.3	152	113.0	1.6	113	81.2	1.0	420
Other crops	153.2	7.3	120	1,871.0	6.3	675	174.5	2.3	127
Maize (2 nd crop) ¹	—	—	—	8.7	1.2	78	—	—	—
All kinds of vegetables (2 nd crop) ¹	40.6	1.9	300	100.0	1.4	380	—	—	—
Total	2,146.8	102.0	—	7,117.3	102.6	—	7,936.8	100	—

¹ A second crop is a crop succeeding one already harvested during a growing season; either a regrowth of the harvested crop, or a newly planted crop. Due to the second crop, total percent is bigger than 100. *Source:* General Directorate of State Hydraulic Works (DSI).

Table 2. Characteristics of farms in the area of study, classified by date of end of consolidation (I Group-1990, II Group-1996, III Group-1998)

	I Group ¹	II Group ¹	III Group ¹	Turkey average ²
Number of surveys	76	44	70	—
Average number of parcels	3.00	2.86	2.75	5.4 (1.39 ³)
Average farm size (ha)	5.12	2.05	6.84	6.1
Average age of owner	54.14	46.34	48.82	42
Average household size (ha)	4.40	4.45	3.57	4.5

Source: ¹ Our own surveys. ² 2001 Agriculture census (Turkish Statistical Institute). ³ Average number of parcels in the consolidated owners in Turkey (Anonymous, 2004).

number of parcels owned) was obtained and questions were asked to determine the respondents' opinions and expectations with LC.

In the survey, 50 questions were aimed to determine the owners' view and satisfaction. The questions were prepared in a way that is conformable to the logit model.

Conceptual model of land consolidation adoption

In our application of the logit model, adoption is assigned a value of 1, non-adoption is assigned a value of 0, and a free variable is assigned to adoption (Amemiya, 1981; Jamnick and Klindt, 1985). Deciders are assumed to make decisions that maximize benefits (Amemiya, 1981; Rahm and Huffman, 1984). The dependent variable is the natural logarithm of a simple function of the probability of a positive selection being made (i.e., of consolidation being adopted):

$$\ln[P_x/(1 - P_x)] = \sum B_i X_i \quad [1]$$

Here P_x is the probability that the event «farmer adopts LC» occurs for an observed set of variables, B_i is the i^{th} coefficient to be estimated, X_i is the i^{th} explanatory variable, i.e., the i^{th} variable effective in LC adoption.

Factors expected to affect land-consolidation adoption

Perception and adoption of LC have been related to success of previous studies, which have classified the

variables relevant to adoption as personal, physical, institutional, and socioeconomic (Ervin and Ervin, 1982; Feder *et al.*, 1985; Shortle and Miranowski, 1986; Napier *et al.*, 1991; Sheikh *et al.*, 2003). For this study, the factors expected to affect land-consolidation adoption were classified as personal, physical and project-related factors, social presence, and crop pattern.

Personal characteristics

Personal factors related to an individual's management skills or entrepreneurial ability (Feder *et al.*, 1985) include attributes such as the level of education, farming experience, age, or any vocational training (Shiferaw and Holden, 1998; Herath and Takeya, 2003; Sheikh *et al.*, 2003). They reflect a farmer's ability to understand farm technologies and their impact on farming as farmers do vary in their management skills (Feder *et al.*, 1985; Belknap and Saupe, 1988). Age and education level of farmer are considered significant in adoption.

Physical characteristics

The physical features of a farm include its size, infrastructure (irrigation, drainage, road system), topography, soil type, and number of parcels.

Farm size is one of the most important determinants in the adoption of new developments, including consolidation (Shiferaw and Holden, 1998; Sheikh *et al.*, 2003). Its relationship with adoption depends on fixed costs of new technology, risk preferences, and constraints on credit availability (Feder *et al.*, 1985). In adopting LC, farm size, number of parcels, parcel size, and parcel shape are all important.

Irrigation, drainage, road systems, and land arrangement carried out within LC studies are also important factors for farmer satisfaction. Formerly dispersed and poorly-shaped lands start to accrue these benefits when consolidation and current infrastructure problems are solved.

Project-related factors

During LCP, the participation and support of farmers are also very important for adoption.

LCPs are dependent on farmers' opinions and participation more than any other services taken to rural areas. As consolidation activities directly affect personal property rights, projects should be designed carefully, sensitively, and fairly. For this reason, producer opinion, participation, and confirmation are needed in various stages.

One-to-one negotiations should be arranged with farmers regarding the lands to be transferred to them or away from them or to be reorganized. Regulations made in the context of such negotiations will certainly increase the adoption rate. Regulations made without taking into account the opinions and demands of farmers will result in decreased farmer satisfaction and project efficiency.

The finishing year of the project appears as a significant variable because benefits and increased farmer satisfaction may not appear immediately after the end of project. Rather, the benefits will be appreciated over time. As the land usage period after consolidation increases, farmer's evaluations of the results of consolidation may become more realistic.

Conflict reduction

In rural areas where properties are small and scattered, one of the biggest problems is conflict between farmers over borders, water, and roads. LC may be an effective solution for these conflicts. After well-designed LC, roads and water reach to all farms, reducing the dependence of some farmers on others and easing the tension that lead to conflicts. As a result of this conflict reduction, consolidation satisfaction will increase.

Crop pattern

Positive effects of LC and improved infrastructure on the crop pattern increase the efficiency and income, therefore, positively affect the adoption of LC.

Specification of the adoption model

The dependent model variable in this study is the adoption of consolidation (yes or no). All the variables that are considered to affect the adoption were evaluated in the logit model. The results given in this study are obtained from the limited model. After that, a limited model was formed of the important variables and

calculated. The results presented in this paper are limited to the restricted model. Several criteria such as chi-square test, goodness of fit, importance of inclusion or exclusion of a particular variable and the significance of attributes of adoption were used in deciding the set of independent variables used eventually in the models as specified later. The model that affects the LC adoption, already given in general form in Eq. [1], can be written more explicitly as follows:

$$\ln\left[\frac{P_x}{(1-P_x)}\right] = B_0 + B_1 EDUC + B_2 COMBPLT + B_3 PLTSHP + B_4 WTRACS + B_5 RDWDTH + B_6 ARGMNT + B_7 CRPT + B_8 APPRV + B_9 DMND + B_{10} PFND + B_{11} PLTSZ \quad [2]$$

The variables in Eq. [2] are defined as follows:
EDUC: Educational level of farmer; = 1 if primary school or less, = 2 if secondary school or more.
COMBPLT: Combination of parcels; = 1 if sufficient, = 0 if insufficient.
PLTSHP: Change in size and shape of the parcels; = 1 if sufficient, = 0 if insufficient.
WTRACS: Ability to take water directly from the canal; = 1 if positive, = 0 if negative.
RDWDTH: Road-width suitability; = 1 if suitable, = 0 if not suitable.
ARGMNT: The effect on reduction of road, water, and border conflicts reduction; = 1 if positive, = 0 if negative.
CRPT: Crop patterns; = 1 if the crop-pattern planning becomes easier, = 0 otherwise.
APPRV: = 1 if LC is approved, = 0 otherwise.
DMND: = 1 if demands are satisfied during consolidation project, = 0 otherwise.
PFND: Project finish dates: = 1 for 1998, = 2 for 1996, = 3 for 1990).
PLTSZ: Size of farm; = 1 if 0-1 ha, = 2 if 1-5 ha, = 3 if 5-10 ha, = 4 if > 10 ha.

These parameters were estimated according to the logit model and maximum probability method in the SPSS (vers. 10) statistics package program (SPSS, Chicago, Illinois, USA).

Results

Logit regression results for LC adoption are summarized in Table 3A. The chi-square statistic for the model was 89.492, which is significant at 0.0001 level for the

Table 3. A) Logit regression estimates of coefficients of variables affecting adoption of land consolidation. See text for explanation of variables. B) Logit model predictions of adoption of consolidation vs observed adoption

A)						
Variable	B_i	SE	Wald	Sig	$\exp(B_i)$	$1/\exp(B_i)$
Constant (B_0)	4.564	1.603	8.107	0.004	96.002	
EDUC	-2.893	1.123	6.638	0.010	0.055	18.181
COMBPLT	2.345	0.835	7.883	0.005	10.429	
PLTSHP	2.929	1.005	8.490	0.004	18.701	
WTRACS	3.879	1.281	9.168	0.002	48.371	
RDWDHT	-2.638	1.495	3.113	0.078	0.071	14.084
ARGMNT	5.440	1.833	8.808	0.003	230.459	
CRPT	3.865	1.352	8.167	0.004	47.701	
APPRV	4.218	2.121	3.956	0.047	67.907	
DMND	3.594	1.114	10.407	0.001	36.397	
PFND (1)			5.778	0.056		
PFND (2)	-1.625	0.930	3.052	0.081	0.032	31.250
PFND (3)	2.234	1.244	3.225	0.073	9.337	
PLTSZ (1)			4.957	0.175		
PLTSZ (2)	1.059	0.974	1.182	0.277	2.882	
PLTSZ (3)	3.255	1.466	4.932	0.026	25.915	
PLTSZ (4)	0.070	1.109	0.004	0.949	1.073	
N	190					
-2 log likelihood	65.840					
Chi-square (14 df)	89.492 ($P < 0.0001$)					

B)			
Observed	Predicted non-adoption (0)	Adoption (1)	Percentage correct predictions
Non-adoption (0)	17	10	63.0
Adoption (1)	7	156	95.7
Overall			91.1

«-2 log likelihood ratio» of the model (65.840). In the study area, estimates of the coefficients that are significant for their values of $\exp(B_i)$ are quite different than 1. The estimated logit model correctly predicted and classified 91.1% of farmers' reactions (Table 3B).

Table 3A shows that satisfying farmer demands (*DMND*) is one of the most important variables for adoption of LC. If farmers' demands and opinions are taken into consideration, adoption level would be increased. As a result of participation, suspicious and hesitations about consolidation are overcome, consequently reliability is increased.

Another important factor is the accessibility to irrigation water (*WTRACS*), which approaches 100% after LC. Because water is quite important for production in arid and semiarid regions, direct access to the irrigation water increase the adoption level.

The resolution of water, road, and border arguments (*ARGMNT*) after LC increases the social presence and satisfaction of farmers. Each solved problem increase satisfaction.

Parcel-shape changes and developments increased the possibility of adoption. However, parcel consolidation (*COMBPLT*) has less of an impact on adoption than parcel-shape (*PLTSHP*).

As a result of road and irrigation systems reaching each parcel after consolidation, farmers started to grow second and even third crops as well as growing economically valuable crops. This change in crop pattern (*CRPT*), and income increases makes possible to increase the adoption level of LC.

In this study, the effect of education level (*EDUC*) on adoption was also observed. As education level increased, the likelihood of adoption decreased. Negative

coefficient for education can probably be attributed to off-farm employment opportunities, which increase with the increase in education level.

The satisfaction of the farmers approving the project (*APPRV*) in the beginning is much more than the others.

Discussion

In this study, factors that affect the adoption of LC by farmers are evaluated using a logit model and results are given. These results are considered to prove useful in creating projects that optimize farmer satisfaction. According to these results, the most important factors in LC adoption are *DMND*, *WTRACS*, *ARGMNT*, *PLTSHP*, *COMBPLT*, *CRPT*, *EDUC* and *APPRV*. Water access (*WTRACS*), *PLTSHP* and *COMBPLT* are physical factors that are directly related to project efficiency. These factors can be maximized with the help of the software that has been widely used in land consolidation projects in recent years (especially geographical information system supported software), and this is a substantial factor for a higher level of project success and farmer satisfaction.

In arid and semi-arid regions, water is the most important factor for production. In areas where irrigation systems were planned without consolidation projects, a lot of problems related to water use occurred. After LC, the irrigation ratio rapidly approaches 100%. Fair and thrifty water delivery, reduction in labour use for irrigation, and easiness in irrigation technology usage can be achieved with LC. Additionally, when farmers' reliance on agriculture increase, sustainability in agriculture also increases (Anonymous, 2000).

Satisfying farmers' demand (*DMND*) is one of the most important factors in modern practices. Besides the land re-arrangement, it is also effective in public facilities design, ensuring the farm entirety, providing social presence and utilizing from the agricultural land with highest level (Gamperl, 1967; Läpple, 1992).

The effects of *CRPT* factors on adoption of LC depend on irrigation. Huylenbroeck *et al.* (1996) emphasized that factors such as expanding the irrigation areas and improving the state of access to the parcels have a substantial effect on planning the plant pattern after land consolidation. Similarly, effects from *ARGMNT* greatly depend on the road and irrigation system.

Because connecting the systems to each parcel provides elimination of the farmers' dependency to each other, social presence, improved land utilization, production of appropriate crops to region with the advantages of climate, increase in farm efficiency.

Reduction in parcel number and improvement in parcel shape made agricultural works easier as labour requirements were decreased. Because the effects from these factors could be understood easily and in a short time after LC, it greatly affects the adoption level (Läpple, 1992). A study carried out in Galicia (Spain) implies that a reduction in the number of parcels is effective on the protection of agricultural activity in urban area; thus in the stabilization of the population in these areas (Miranda *et al.*, 2006).

Innovation adoption is faster and more frequent among farmers with a higher level of education, interested in land acquisition to increase their farm size and on farms with a better structure. Innovation is slower among older farmers, preparing their retirement, interested in selling land and on farms with poor external structures (Huylenbroeck *et al.*, 1996).

APPRV is a factor which is related to farmers' approval of the project. As mentioned before, voluntarily LC is commonly used in Turkey. Farmers' approval of the project can be achieved through offering information about LC. Thus, LC studies have a democratic characteristic. But, dissatisfaction with the first LC studies in certain regions may change the idea farmers have about LC to be performed in their villages. Therefore, farmers' satisfaction or adoption is one of the most important factors to be considered in LC studies. As a matter of fact, useful results obtained in a research area impressed the other farmers in neighbouring villages and they insist LC studies to be carried out in their villages (Arici, 1994).

In LC studies once success in basic factors for adoption increases, new project implementation will be easier. Considering that only 2.2% of the total arable land in Turkey is consolidated, acceleration and expansion of LC will be more important in the future. Turkey is currently making an effort to access the EU. In this accession period, one of the most important measures for solving structural problems in agriculture and farm efficiency improvement is LC (Arici and Kirmikil, 2005). Voluntarily LC studies will be implemented easily, if highly adopted and preferred factors are considered in future studies. Thus, farmers will be more willing to accept LC implementation.

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References

- AGRAWAL P., 1999. Urban land consolidation: a review of policy and procedures in Indonesia and other Asian countries. *Geojournal* 49, 311-322.
- AKKAYA ASLAN S.T., ARICII., 2005. GIS-supported land consolidation planning information system: ARTOP. *Bodenkultur* 56(2), 103-110.
- AMEMIYA T., 1981. Qualitative response models: a survey. *J Econ Lit* 19, 1483-1536.
- ANONYMOUS, 2000. Sonderheft Leitlinien Landentwicklung, Beispiele zur nachhaltigen Entwicklungen im ländlichen Raum. Schriftenreihe des Bundesministers für Ernährung, Landwirtschaft und Forsten, Münster- Hiltrup. [In German].
- ANONYMOUS, 2004. Türkiye'de arazi parçalılığı, tarımsal işletme durumları ve arazi toplulaştırma çalışmaları. T.C Tarım ve Köylüleri Bakanlığı Köy Hizmetleri Genel Müdürlüğü Sulama Dairesi Başkanlığı, Ankara. [In Turkish].
- ARICII., 1994. Arazi toplulaştırması. Uludag Üniversitesi, Ziraat Fakültesi Ders Notları No. 60, Bursa. 94 pp. [In Turkish].
- ARICI I., KIRMIKIL M., 2005. Die Bedeutung der Flurbereinigung in der Türkei bei der Behebung der strukturellen Probleme in der Landwirtschaft, VIII. Symposium des Verbandes deutsch-türkischer Agrar- und Naturwissenschaftler, Ergebnisse deutsch-türkischer agrarwissenschaftlicher Forschung, Braunschweig, Deutschland. Oct 3-9. [In German].
- BABAGIRAY Z., 2006. Tarımsal yapı bozukları ve işletmelerin analizi. *Turktarım* 171, 19-24. [In Turkish].
- BELKNAP J., SAUPE W.E., 1988. Farm family resources and the adoption of no-plow tillage in southwestern Wisconsin. *North Central J Agri Econ* 10, 13-23.
- BENTLEY J.W., 1987. Economic and ecological approaches to land fragmentation: in defense of a much-maligned phenomenon. *Annu Rev Anthropol* 16, 31-67.
- BONNER J.P., 1987. Land consolidation and economic development in India: a study of two Harvana Villages. Riverdale Company. USA.
- BOREC A., 2000. The significance of land consolidation for the development of farmland in Slovenia then and now. *Ber Landwirtschaft* 78(2), 320-334.
- CRECENTE R., ÁLVAREZ C., FRA U., 2002. Economic, social and environmental impact of land consolidation in Galicia. *Land Use Policy* 19, 135-147.
- ERVIN C.A., ERVIN D.E., 1982. Factors affecting the use of soil conservation practices. *Land Econ* 58, 79-90.
- FAO, FIG, GTZ, ARGE LANDENTWICKLUNG & TU MUNICH, 2002. Opening speeches. International Symposium on Land Fragmentation and Land Consolidation in CEEC: a gate towards sustainable rural development in the new millennium, München. Feb 25-28.
- FEDER G., JUST R.E., ZILBERMAN D., 1985. Adoption of agricultural innovations in developing countries: a survey. *Econ Dev Cult Change* 33, 255-298.
- GAJENDRA S.N., GOPAL B.T., 2005. Impacts and causes of land fragmentation, and lessons learned from land consolidation in South Asia. *Land Use Policy* 22(4), 358-372.
- GAMPERL H., 1967. Handbuch der Vermessungskunde, Band Bd. 4b, Ländliche Neuordnung (Flurbereinigung), Stuttgart: Metzler. [In German].
- GONZÁLEZ X.P., CRECENTE R., ÁLVAREZ C.J., 2004. Evaluation of land distributions with joint regional to plot size and shape. *Agr Syst* 82(1), 31-43.
- GONZÁLEZ X.P., MAREY M.F., ÁLVAREZ C.J., 2007. Evaluation of productive rural land patterns with joint regard to the size, shape and dispersion of plots. *Agr Syst* 92(1-3), 52-62.
- GUDMAN K.R., 2000. Give or take an acre: property norms and the Indian land consolidation. *Act Iowa Law Rev* 85(2), 595-662.
- GUN S., 2003. Legal state of land consolidation in Turkey and problems in implementation. *Pakistan J Biol Scien* 6(15), 1380-1383.
- GUR M., DEMIREL Z., 2002. Development in rural land arrangement and legal regulations in Turkey. FIG XXII International Congress, Washington DC, USA. Apr 19-26.
- HAYS W.I., WINKLER R.L., 1971. Statistics, probability, inference and decision. Holt, Rinehart and Winston, NY, USA.
- HERATH P.H.M.U., TAKEYA H., 2003. Factors determining intercropping by rubber smallholders in Sri Lanka: a logit analysis. *Agr Econ* 29(2), 159-168.
- HUYLENBROECK G.V., COELHO J.C., PINTO P.A., 1996. Evaluation of land consolidation projects (LCPs): a multidisciplinary approach. *J Rural Stud* 12(3), 297-310.
- JAMNICK S.F., KLINDT T.H., 1985. An analysis of «no-tillage» practice decisions. Department of Agricultural Economics and Rural Sociology, University of Tennessee, USA.
- KIZILASLAN N., ALMUS S., 2002. Research on the determination of the socio-economic factors affecting the farmers' behaviour in adopting land consolidation implemented in Guzelbeyli town in Zile County, Tokat Province. *Turk J Agr Fores* 26, 101-108.
- LÄPPE E.C., 1992. Flurbereinigung in Europa, Schriftenreihe des Bundesministers für Ernährung, Landwirtschaft und Forsten, Heft 78, Münster- Hiltrup. [In German].
- MIRANDA D., CRECENTE R., ÁLVAREZ M.F., 2006. Land consolidation in inland rural Galicia, NW 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(4), 511-520.

- NAPIER T.L., NAPIER A.S., TUCKER M.A., 1991. The social, economic and institutional factors affecting adoption of soil conservation practices: the Asian experience. *Soil Till Res* 20, 365-382.
- RAHM M.R., HUFFMAN W.E., 1984. The adoption of reduced tillage: the role of human capital and other variables. *Am J Agr Econ* 66, 405-413.
- ROSMAN F.B., SONNENBERG J., 1998. New method for the design of reallocation plan in land consolidation projects. XXI FIG International Congress, Brighton. July 19-25.
- SEMLALI E.H., 2001. A GIS solution to land consolidation technical problems in Morocco. FIG Working Week, Seoul, Korea. May 6-11.
- SHEIKH A.D., REHMAN T., YATES C.M., 2003. Logit models for identifying the factors that influence the uptake of new «no-tillage» technologies by farmers in the rice-wheat and the cotton-wheat farming systems of Pakistan's Punjab. *Agr Syst* 75, 79-95.
- SHIFERAW B., HOLDEN S.T., 1998. Resource degradation and adoption of land conservation technologies in the Ethiopian highlands: a case study in Andit Tid, North Shewa. *Agr Econ* 18, 233-247.
- SHORTLE J.S., MIRANOWSKI J.A., 1986. Effect of risk perceptions and other characteristics of farmers and farm operations on the adoption of conservation tillage practices. Dept. Agricultural Economics, Penn St Univ, USA.
- SKLENICKA P., 2006. Applying evaluation criteria for the land consolidation effect to three contrasting study areas in the Czech Republic. *Land Use Policy* 23(4), 502-510.
- TAN S., HEERINK N., QU F., 2006. Land fragmentation and its driving forces in China. *Land Use Policy* 23(3), 272-285.
- VAN DEN BRINK A., 1999. Sustainable development and land consolidation. In: Land reform and sustainable development (Dixon-Gough R.W., ed). Ashgate, Aldershot. pp. 61-68.
- VAN LIER H.N., 2000. Land use planning and land consolidation in the future in Europe. *Z Kultur Landen* 41, 138-143.
- WU Z., LIU M., DAVIS J., 2005. Land consolidation and productivity in Chinese household crop production. *China Econ Rev* 16, 29-49.
- YAVUZ O., GURBUZ I.B., 2001. Bursa ili Karacabey ilçesinde arazi toplulastırması yapılan köylerde sosyo-ekonomik yapı ve yeniliklerin benimsenmesi. Uludağ Üniversitesi Ziraat Fakültesi Bilimsel Araştırmalar ve İncelemeler Serisi, No. 24. Bursa. [In Turkish].