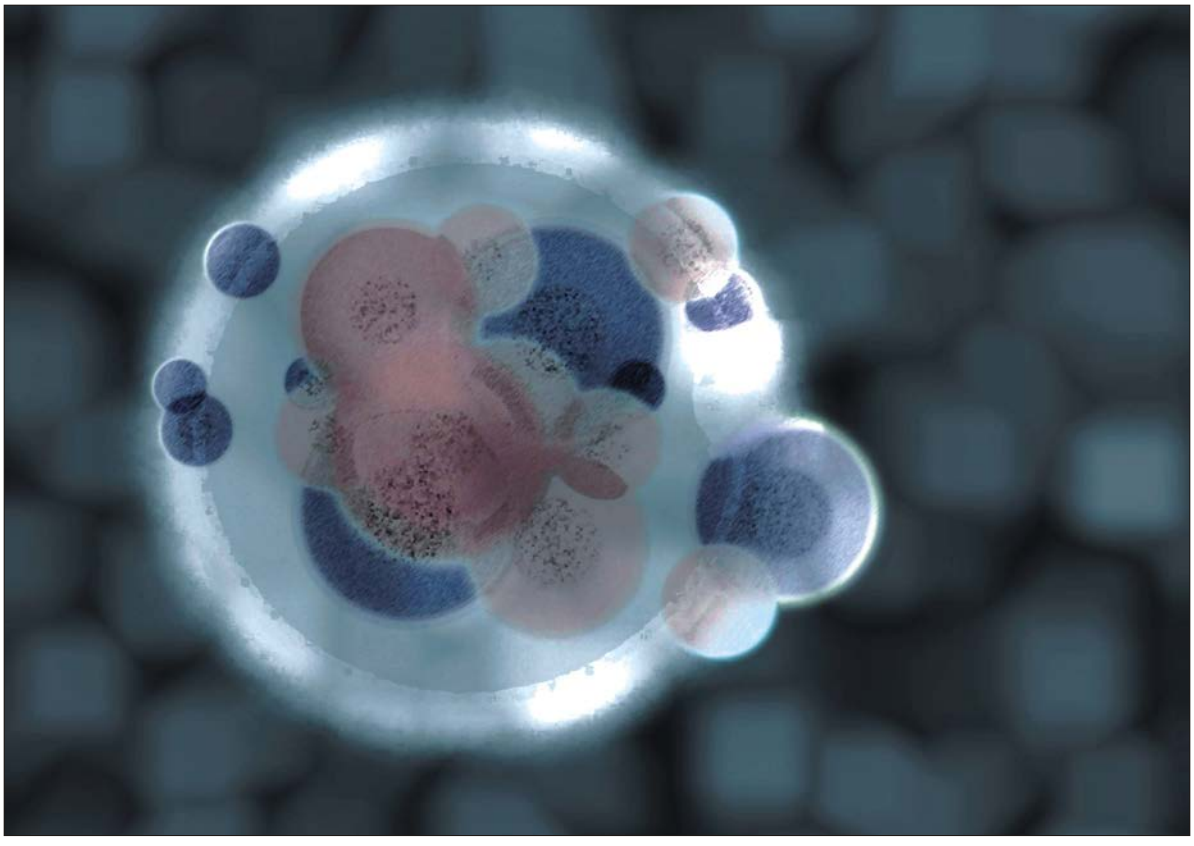

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The Effects of Irrigation on Land Degradation by Land Division

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Abstract: This study was carried out to determine the effects of irrigation on the land degradation by land division in cultivated lands of Yenisarbademli district, Isparta-Turkey. In the study, some maps of lands and the database which created in another study were used mostly and data were evaluated using the electronic computing tables and some computer programs. Results indicated that total of 8308.7 da cultivated lands consisted of 7251 parcels of which 58.3% had a size smaller than 1.0 da. An average size of these parcels is 1.15 da. Lands were separated into five irrigation groups based on irrigation case and length of irrigated period. There were significant differences in average parcel sizes among the groups ($p<0.01$). Although, the average parcel sizes of the lands which have been irrigated over 30 years were in the same group, they were in different groups for the lands which have been irrigated for seven years or not under irrigation at all. It was concluded that the degree of land division increased by increment in irrigated period and affected by soil properties related to irrigation.

Key words: Land degradation, irrigation, land division

INTRODUCTION

Intensive and unplanned uses of agricultural lands cause rapid degeneration of many properties that are very important for agricultural production. The fact of being scattered and separated into small parts of lands has negative effect on agricultural production and sustainable use of land. Number of studies on agricultural inputs and using of new technologies in agriculture have been carried out for effective use of soils, however, the need for keeping up specific size of a cultivated field for its sustainable use has not taken much interest in agricultural researches.

Today, the idea of sustainability of natural resources is more important than getting maximum profit from them. Therefore, the combined evaluation of all physical, economic and social effects is needed for sustainability of natural resources today than ever before[1].

In addition to soil quality, land quality is also important in agricultural production. Suitability of land for specific purposes and its behavior under specific use are affected by some simple and measurable land characteristics such as slope and complex land characteristics such as water supply capacity, tendency to erosion and suitability for farm traffic[2,3]. Dynamic soil quality relates to how soil quality is changing in response to management or use. Thus, sustainable land management involves land evaluation, based on inherent soil quality and the evaluation of sustainability, based on dynamic soil quality[4].

Land division is defined as the separating of lands into many small parts as a result of irregular distribution of lands in different places[5]. It is affected by agricultural population intensity, lack of legal arrangements, lack of capital, type of land use, type of land distribution and uses for non-agricultural purposes[6].

Sungur[7] had reported that loss of time for turning in mechanized agriculture increased if the length of parcel was less than 300 m. It was also concluded that the losses increased 50% in tillage and 30 and 40% in harvesting of cereals and sugar beets, respectively, if the parcel length was less than 50 m.

This study was carried out on cultivated lands of which about 90% were under irrigation for many years to determine the relationship between irrigation and dividing of lands into parts.

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MATERIALS AND METHODS

The study area is located to the west of Beysehir Lake and consists of cultivated lands of Yenisarbademli district of Isparta province in Turkey. Soil parent material is colluvial at footslopes and alluvial deposited by Hizar and Ardic creeks at the center parts. Cultivated lands are mostly in the 1st and 2nd land capability class and small part was grouped as the 3rd class land[8]. Soil texture is clay in soils near Beysehir Lake and soils in the other parts of the study area have medium or slight-texture. Slope changes from 0 to 6%, except for vineyard areas. About 92% of the lands in the study area are available for irrigation. The climate is Mediterranean-Plato type, annual precipitation is 788 mm and annual average temperature is 11.2°C[9].

In study, the textural distribution map with scale of 1/25000[9], cadastre maps with scale of 1/2500 and 1/1000[10,11] and the database created by Akgul and Ucar[12] was used. In addition, data were obtained from District Directory of Agriculture, State Hydraulic Works[13], field observations and personal communications for evaluation. One-way analysis of variance and Duncan's Multiple Comparison Tests were used in statistical evaluation of the data[14] and electronic computing tables and specific computer programs developed for this purpose by using basic programming language were used in data processing.

RESULTS AND DISCUSSION

Land use and land division: In the study area, cultivated lands occupied 8308.7 da land of which 78.3% was field, 7.8% was garden, 5.5% was vineyard, 5.7% was poplar growth area and 2.7% was abandoned land. Although irrigation systems were present in about 98% of the cultivated lands except for vineyard areas only 4330 da lands were irrigated during the 1996 irrigation season[13].

The population of the district was 6180 in 1990, so the cultivated land per capita is only 1.34 da. Although this rate is very low, most of the residents are farmer (either as a first job or second) since there is no any factory or other industrial activities for work, in the region. The number of parcels under cultivation is 7251 of which 58.3% had a size smaller than 1.0 da. These parcels occupy 27.5% of the whole land. The largest group, both in size and in number, is the group of 1.0-2.5 da, which occupies 43% of the whole land and 33.2% of the parcels. Average parcel size in the study area is only 1.15 da, which is an indication of severe land degradation. As a comparison, the average parcel size in Turkey is 10.85 and 4.24 da in Isparta[15].

Suitability of land for specific use is related to its irrigation case. Therefore, irrigation and the type of land use both affect on land division. From the view of that point, it was found that the average parcel size were 1.28 da in field lands, 1.03 da in vineyards, 0.80 da in gardens and 0.78 da in poplar growth areas. On the other hand, the average parcel size was 0.73 da in abandoned lands used hi one of the land types mentioned above in the past.

The effects of irrigation on land division: Cultivated lands were sectioned into five irrigation groups based upon their irrigation cases and lengths of irrigated periods in order to evaluate the effects of irrigation on dividing of the lands into parts. The lands in the first irrigation group were under irrigation for over 50 years, although the initial time of irrigation was not known exactly. The second group of lands has been irrigated for a number of years as well, but they were used both in irrigated and dry agriculture, that is the land was under irrigation in the first year and not under irrigation in the following year, until 1970s. The third group of lands has been irrigated for 28-30 years and the fourth group of lands was under irrigation since 1990. The fifth group of lands refers to the lands, which has not been irrigated until now. The lands, which were used in continue vineyard and which not under irrigation were not included into the fifth group.

The Analysis of Variance (ANOVA) was performed to determine the group's effect on parcel size. For this purpose, parcel sizes were recorded on the randomly chosen areas, which covered 10% of each group. There were significant differences in parcel sizes among the groups ($p<0.01$). Duncan's Multiple Comparison Tests indicated that there was no significant difference in the means of the first, second and third group at alpha level of 0.01. However, the means of the fourth and fifth groups were significantly different than the means of all other groups at alpha 0.01 levels (Table 1).

Results indicated that the rate of dividing of lands into parts increased with the length of irrigated period and the degree of land division got clearer effect as the irrigated period increased.

Table 1: Descriptive statistics relation to parcel size of irrigation groups

Descriptive statistics	Group 1	Group 2	Group 3	Group 4	Group 5
Means (da) *	0.798a	0.881a	1.027a	1.920b	2.942c
Standard error of means	0.0355	0.0505	0.0372	0.0850	0.3166
Standard deviation	0.4824	0.6434	0.4382	1.1147	1.5179
Maximum	3.8630	4.3250	4.6000	6.8500	8.6300
Minimum	0.1840	0.1830	0.4250	0.6500	1.1250
Coefficient of variation (%)	60.5000	73.0000	42.7000	58.1000	51.6000
The number of samples	185.0000	162.0000	139.0000	172.0000	23.0000

*: Means with different letter are significantly different and means with the same letter are not different at alpha 0.01 level

The differences in the average parcel sizes of the first, second and third groups of the lands which were under irrigation over 30 years and the lands in the fourth group, which has been irrigated since 1990, were very clear (Table 1). The large difference between the average parcel sizes of the forth (under irrigation for seven years) and the fifth (not under irrigation yet) groups may be due to some limitations in topography and soil properties which leads less preference in inheritance, in addition to irrigation effect. On the other hand, the degree of dividing of lands into parts was high in vineyard areas that were not under irrigation. It was supposed that this might be resulted from the willingness of all members of a family getting share from this type of land. The average parcel size was 1.03 da in this area.

It was believed that irrigation was effective on parcel size in three different ways. The first effect of irrigation on parcel size is related to land valuation. When the land is taken under irrigation, its productivity will increase and agricultural alternatives will be more. Therefore, all inheritors of this land want to get share from this kind of land which causes very severe land division. However, the difficulties in cultivating and increased unit cost due to land division are ignored, since the farmer's income from irrigated lands is generally higher than that of from dry lands.

The second effect of irrigation on parcel size appears in coarse-textured soils of which vertical water conductivity is very high. This type of soils is very common in the study areas, especially in river valleys. Since their infiltration and percolation rates are very high, water advances very slowly on the ground and is not distributed homogeneously within the field when flood irrigation is used, which is a common practice in the area? In this case, farmers separate the large fields into small parts and use border irrigation system. After a time, these small pieces of parcels are further shared by the different inheritors and/or have different agricultural practices. Also, the boundaries between parcels are evaluated by planting some trees, which make difficult to join these parcels again. In study area, each one of 169 parcels which larger than 1 da in size, located on alluvial material deposited by Hizar creek were separated into 2-5 irrigation borders with fixed boundaries and average border size was 0.58 da.

The third effect of irrigation on parcel size occurs during the establishment of irrigation network. For example, the primary and secondary canals and maintenance roads of the last irrigation network established between the years of 1988-1991 affected on 552 parcels. Among these parcels, while the shape of 389 parcels changed and their sizes declined the rest of 552-parcel (163) were divided 2 or more parts. Total land area lost by this way from the parcels was 134.5 da. But, the loss of agricultural land is more than that if the lands that abandoned because of its small size are included. The parcels affected by irrigation canals and maintenance roads were separated into 797 small parts with mostly irregularly shaped. One hundred ninety of these parcels had a size smaller than 0.25 da. Although, the average size of these parcels before irrigation network has been established was 1.22 da, it was 0.83 da after irrigation network.

Dividing of land into parts negatively affects on cost of agricultural production and especially on farm traffic. Also, the use of that type of lands for alternative purposes is restricted and this kind of lands is abandoned within a short time partly or completely, since its sustainable land management can not be done. Briefly, irrigation that essential for plant production may has been sometime cause undesirable effects such as dividing of lands into small parts, unless legal and technical regulations can be achieved.

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