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ECONOMIC ANALYSIS OF SUNFLOWER PRODUCTION IN TURKEY

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SUMMARY

Sunflower is the main crop in the rotation system in Trakya region which is located in the European part of Turkey. As this area is the main sunflower-producing region in Turkey, a large survey was organized there in order to determine the uses of agricultural resources and their effectiveness in sunflower production in Turkey. Data compiled via a questionnaire circulated to 182 agricultural enterprises in Edirne, Kirklareli and Tekirdag provinces in the region in the 2005 production year were used in the study. The examined locations were classified in 3 groups according to input uses for sunflower production per unit area. Cobb-Douglas type production functions were calculated for each group. It was found that farm size/land area was the main production factor in each 3 groups. In the analyzed enterprises, the sum of production elasticity coefficients was found to be 0.978 for group I (Tekirdag), 0.938 for group III (Edirne) and 0.856 for group II (Kirklareli). The production elasticity coefficients for inputs were positive for group I and the coefficients for herbicide, fertilizer and hoeing costs were negative for group II. For group III, the production elasticity coefficients for seed, fertilizer and hoeing costs were negative.

Key words: sunflower, production, input use, economic analysis, Cobb Douglas

INTRODUCTION

Sunflower is a major oilseed in both Turkey and worldwide. Based on 2005 FAO statistical data, Turkey is among the top ten sunflower-producing countries in the world. Turkey holds 3.06% of the world's sunflower production (31,065,709 metric tons) and 2.05% of the acreage (23,397,453 ha) (2006 FAO Database and The Ministry of Agriculture of Turkey 2006 Statistics). In Trakya region, sunflower is the main crop in the rotation system together with wheat. The region holds 80.63% of the Turkish sunflower production (950,000 tons) and 65.31% of the

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national acreage (480,000 ha) based on the 2005 statistics. Therefore, this region was chosen for economic analysis of sunflower production in Turkey. The obtained results reflect the main economic issues in sunflower production of both Turkey and Black Sea Region which holds 34% of the sunflower acreage and 50% of the global sunflower production.

While Turkey still maintains its national agriculture concept, it has lost self-sufficiency in vegetal crops in the 1980's. From an exporter/importer of oilseeds and vegetable oils, it became a net importer of these relevant commodities. In recent years, the Turkish sunflower acreage and crop production have ranged from 500,000 to 600,000 ha and from 650,000 to 950,000 tons, respectively. The fluctuations imply that a sufficient and efficient oilseeds policy has not been mastered. As a natural result of these developments and under conditions of a steady oilseeds shortage, the gap in vegetable oils demand has been filled by imports from various countries, in the first place from Ukraine, Argentina, Bulgaria and Romania (Kaya, 2004).

Although the sunflower price has been stable in recent years, the cost of sunflower inputs kept increasing both in Turkey and elsewhere in the world. These increases influenced both the sunflower acreage in Turkey and also the sunflower yield performance due to a lower use of inputs. Therefore, it became worthwhile to determine which input is more important and which increases the cost of production. Additionally, sunflower production has not been investigated to such detail before, in spite of its importance in Turkey.

In this study, the intensity of input use by sunflower farm enterprises and the intensity of input use in different provinces were examined. The results of this research may help other countries such as Spain, Bulgaria, Romania, Ukraine, Russia etc. with similar climatic conditions and input uses and problems in sunflower production.

MATERIAL AND METHOD

Trakya region was chosen as research area because about 80% of the Turkish sunflower production in located there (Semerci, 1998). The Ministry of Agriculture and Rural Affairs started a program of oilseeds support and subsidy in the year 2000. Based on 2004 national statistics data, the total sunflower acreage in the provinces Edirne, Kirklareli and Tekirdag, which comprise the study area, was 313,473 ha (2005 Statistics of the Turkish Ministry of Agriculture). The sunflower acreages in Tekirdag, Edirne and Kirklareli take the following percentages: 44.81%, 33.98% and 21.21%, respectively. In the provinces in which the questionnaire was circulated, total counts of sunflower acreage are 76% in Kirklareli, 63% in Tekirdag and 57% in Edirne.

Villages and enterprises included in the survey were determined by the stratified random sampling method taking in consideration sunflower acreages in the concerned provinces (Yemane, 1967).

In this survey, 17 villages were selected based on the local capabilities regarding sunflower production technique and level, soil structure and productivity of the land. When sunflower acreages of the selected villages and enterprise numbers were considered (with 99% confidence interval and 3% deviation from average), 182 enterprises were selected based on the 2005 cross-section data on sunflower acreages of the enterprises. The provinces were divided in 3 groups and each group data were considered individually.

Thus composed groups were analyzed by the equation that included the following variables:

- Y : total sunflower crop production (kg)
- X_1 : sunflower acreage (ha)
- X_2 : seed cost (USD)
- X_3 : chemical fertilizer cost (USD)
- X_4 : herbicide cost (USD)
- X_5 : hoeing cost (USD)

In each group, Cobb-Douglas type production functions were obtained for total sunflower crop production (Y) and for production factors X_1, X_2, X_3, X_4 and X_5 (Heady and Dillon, 1966). A production function test was then performed (Duzgenes *et al.*, 1987). Production factors, elasticity coefficients and marginal yield values were calculated and the values obtained for the three provinces were compared. LSD test (at 0.05 significance level) was used to determine differences in input use level among the provinces. Furthermore, SPSS statistical program was used for determination of production functions, production elasticities and other parameters (Green *et al.*, 2000).

In this paper, statistical processing of production functions was omitted, since detailed information was already supplied in earlier reports (Semerci, 1998; Zoral, 1973 and 1975; Uluð, 1973; Dilmen, 1976; Karagolge, 1973; Kip and Isyar, 1976).

RESULTS AND DISCUSSION

Production functions

In the survey where the data of the enterprises in Trakya sunflower production areas were used, three production functions were obtained with Cobb-Douglas type production functions including the same variables for the three provinces (Edirne, Kirklareli, Tekirdag) which were used to evaluate the differentiation of input uses among the provinces.

The production functions calculated for the dependent and independent variables in each group were:

Group I (Tekirdag, 87 enterprises);

- $Y= 2,254\ X_1^{\ 0,906}\ X_2^{\ 0,029}\ X_3^{\ 0,026}\ X_4^{\ 0,014}\ X_5^{\ 0,003}$
- [R^2: 0.941 (P< 0. 01), F: 259,973 (%1)]

Group II (Kirklareli, 42 enterprises);

- $Y= 2,098\ X_1^{\ 0,923}\ X_2^{\ 0,288}\ X_3^{\ 0,106}\ X_4^{\ -0,359}\ X_5^{\ -0,102}$
- [R^2: 0.909 (P< 0.01), F: 71,875 (%1)]

Group III (Edirne, 53 enterprises);

- $Y= 2,669\ X_1^{\ 1,308}\ X_2^{\ -0,358}\ X_3^{\ -0,023}\ X_4^{\ -0,008}\ X_5^{\ 0,019}$
- [R^2: 0.915 (P< 0.01), F: 101,306 (%1)]

To estimate the functions, direct influencing factors were chosen and used as dependent variables. For the expression of land factor, which has a close relationship with production, land size was taken into account.

In each of the three functions, determination coefficients were obtained and found meaningful at 1% significance level. According to the obtained results, the independent variables were able to explain the changes in sunflower production volume (a dependent variable) in the amount of 94.1% for the first function, 90.9% for the second function and 91.5% of the third function in group I.

Production elasticity of the factors

Production elasticity and significant levels of production functions are presented in Table 1. Based on the evaluated production elasticities, while sunflower acreage factor (X_1) was the most important factor for each of the three groups, only herbicide cost factor (X_4) in group II (Kirklareli province) of production elasticity was found to be statistically significant among the other examined parameters.

Table 1: Production elasticity of factors and their significance levels

Variable		t-calculation	Production elasticity ($\hat{a}_i$)	Standard error (S_{bi})	Significance level (%)
G I	X_1	6.719*	0.906	0.142	1.0
	X_2	0.242	0.029	0.126	80.9
	X_3	0.365	0.026	0.065	71.6
	X_4	0.359	0.014	0.028	72.1
	X_5	0.042	0.003	0.053	96.7
G II	X_1	3.709*	0.923	0.245	1.0
	X_2	1.099	0.288	0.257	27.9
	X_3	1.709**	0.106	0.032	9.6
	X_4	-3.772*	-0.359	0.047	1.0
	X_5	-1.842**	-0.102	0.039	7.4
G III	X_1	5.321*	1.308	0.269	1.0
	X_2	-1.462***	-0.358	0.272	15.0
	X_3	-0.461	-0.023	0.029	64.7
	X_4	-0.167	-0.008	0.048	86.8
	X_5	0.307	0.019	0.042	76.0

(*) Significance level: *: 1%, **: 5-10%, ***: 11-20%, G: group

Resource use level and marginal yield values

Based on the performance of the investigated enterprises, geometric averages and marginal yield values of resource use levels according to the groups were presented in Table 2. In group I, 2,354.0 kg/ha of sunflower seed were obtained with inputs of USD 58.97 for seed, USD 85.11 for fertilizer, USD 5.78 for herbicide and USD 46.92 for hoeing costs. In group II, 1,965.0 kg/ha of sunflower were obtained with inputs of USD 59.36 for seed, USD 39.57 for fertilizer, USD 13.88 for herbicide and USD 28.94 for hoeing costs. In group III, 2,354.3 kg/ha of sunflower were produced with inputs of USD 58.74 for seed, USD 7.31 for herbicide, USD 28.43 for fertilizer and USD 22.21 for hoeing costs.

Table 2: Factors' averages, production elasticities and marginal yield values

Group	Factor	X_1 Sunflower acreage (ha)	X_2 Seed cost (USD)	X_3 Chemical fertilizer cost (USD)	X_4 Herbicide cost (USD)	X_5 Hoeing cost (USD)	Y Sunflower crop prod. (kg)
G I	Geometrical average	4,868	287.05	414.44	28.15	228.41	11459.350
	Avg. per ha	2354.00	58.97	85.11	5.78	46.92	
	Produc. elast.	0.906	0.029	0.026	0.014	0.003	($\hat{a}_i$:0.978)
	Marg. yield	2132.74	1.16	0.72	5.70	0.15	
G II	Geometrical average	6,2777	372.66	248.37	87.17	181.67	12335.876
	Average per ha	1965.03	59.36	39.57	13.88	28.94	
	Production elasticity	0.923	0.288	0.106	-0.359	-0.102	($\hat{a}_i$:0.856)
	Marginal yield	1813.06	9.53	5.26	-50.80	-6.93	
G III	Geometrical average	4,182	245.62	118.88	30.56	92.85	9844.644
	Average per ha	2354.33	58.74	28.43	7.31	22.21	
	Production elasticity	1.308	-0.358	-0.023	-0.008	0.019	($\hat{a}_i$: 0.938)
	Marginal yield	3080.57	-14.35	-1.90	-2.58	2.01	

The average yields were close in groups I and III, and it was lower in group II. In all groups, values of unit area usage of X_2 input (seed cost) were similar, but the other inputs showed significant diversity.

As shown in Table 2, the highest sunflower yield per unit area (ha) was obtained in group III, followed by those in group I and group II. Similar production elasticities, *i.e.*, the highest marginal yield value, were shown by the factor X_1 (sunflower acreage).

Marginal yield comparisons

If sunflower acreage is not considered, group III had highest marginal yield values for sunflower acreage and hoeing factors, group II had the highest marginal yield values for seed and fertilizer factors and group I has the highest marginal yield value for herbicide factor.

Production elasticity was negative for factors X_4 (herbicide cost) and X_5 (hoeing cost) in group II and for factors X_2 (seed cost), X_3 (fertilizer cost) and X_4 (herbicide) in group III. So, marginal yield values for the relevant inputs (in the respective group) are also negative. Therefore, the increase in negative-value factors will result in the reduction of sunflower production.

Total production elasticity (Σ_i) was calculated as 0.978, 0.856 and 0.938 for groups I, II and III, respectively, implying near-constant (nearly 1) return to scale, especially group I. Based on these results, Tekirdag province (Group I) enterprises have a more profitable sunflower production than the enterprises from the other provinces.

Input usage and differences among groups

Regarding the usage level of the variables of production functions, LSD test was used to establish differences among the groups. The objective of the use of the LSD test was to determine meaningful differences (at 5% level) among the groups for the studied factors. When production areas were considered, a meaningful difference at 5% significance level was found between group II and group III (sig. 1.7>5). As it is known, enterprise size has positive impact on productivity.

The meaningful differences that occurred between the areas were also valid for the seed factor. In other words, the difference in seed cost is a subsidiary factor explaining why group II has higher productivity than group III. For fertilizer use, significant differences were found among the three groups. The differences were threefold between the group I and group III. Therefore, significant differences were found at 1% significance level between group I and group III and between group II and group III, and at 10% significance level between group I and group II.

Regarding herbicide cost, the difference in group II was threefold compared with the other two groups, implying the presence of significance at 1% level. However, no statistical difference was found in group I and group III. Herbicide cost may be also subsidiary factor in the explanation of crop size and profitability differences.

Regarding the hoeing factor figures, a meaningful difference at 1% level was found only between group III, having the lowest level, and the other two groups. For the crop production factor, statistical difference was not seen between the three groups, even at 20% significance level.

Considering the differences among the studied factors, it could be seen that group III had lowest meaningful values regarding almost all factors while group II had highest meaningful values. This situation also explains how the components (labor, land, climatic conditions, etc.) of the factors affect the production. Thus, the composition of production factors reveals the differences in crop production.

Table 3: The variables of usage levels and differences

Variables	Group	Group	Significance level	Group	Average	General avg.	Unit area avg.	General avg.
X_1	1	2	18,1	1	5,449	5,392	-	-
(Sunflower area - ha)	1	3	15,9	2	6,622		-	
	2	3	1,7*	3	4,503		-	
X_2	1	2	11.4	1	306.73	307.23	56.29	56.98
(Seed cost- USD)	1	3	19.1	2	386.56		58.38	
	2	3	1.2*	3	256.82		57.03	
X_3	1	2	7.8	1	446.99	297.57	82.03	55.19
(Fertilizer cost - USD)	1	3	1.0*	2	302.48		45.68	
	2	3	1.0*	3	150.62		33.45	
X_4	1	2	1.0*	1	33.92	43.91	6.22	8.14
Herbicide cost - USD)	1	3	97.9	2	104.49		15.78	
	2	3	1.0*	3	33.75		7.50	
X_5	1	2	23.6	1	252.74	187.21	46.38	34.72
(Hoeing cost - USD)	1	3	1.0*	2	199.91		30.19	
	2	3	1.0*	3	108.77		24.16	
Y	1	2	72.7	1	11966.794	11562.507	219.610	214.438
(Sunflower crop prod., kg)	1	3	25.9	2	12622.454		190.628	
	2	3	20.5	3	10195.065		226.386	

* At 5% probability level

CONCLUSION

In the equation composed to determine the effects of sunflower production inputs on crop production (Y), land size (X_1), seed cost (X_2), chemical fertilizer cost (X_3), herbicide cost (X_4) and hoeing cost (X_5) were used as independent variables.

In the obtained functions of the groups, the determination coefficients (R^2) were between 0.909 and 0.941, *i.e.*, they were found to be significant at 1% probability level. In the consideration of production elasticity and significance levels of production functions, the most important factor in all three groups was sunflower acreage.

With regard to marginal yield values, only land efficiency in group III was found to be above the average. However, no statistical difference was found regarding yield values among the groups. Significant differences were found in seed, fertilizer and herbicide costs.

Fertilizer application is a major component of yield increase in sunflower production. However, the growers in the analyzed region prefer to utilize their limited inputs for crops which may bring higher income to them**.** Therefore, since sunflower has a low profitability rate in both dry and irrigated conditions and it brings a lower income than wheat, corn and paddy rice, sunflower production on larger areas is rather limited both in the analyzed region and at the level of the whole country (Kaya 2004).

The other major factor of increased sunflower production in Trakya is the price relationship between sunflower and other crops. In the region, the sunflower/wheat parity is lower than 2, and it is seen a reduction factor in sunflower production. In the period 1990-2005, in the whole Trakya region, the sunflower production showed an increase while the sunflower/wheat parity was maintained at a level over 2.5. Therefore, aside from achieving satisfactory input use efficiency, securing a certain price parity between sunflower and other crops is absolutely important to get adequate increase in the sunflower production.

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ANÁLISIS ECONÓMICO DE PRODUCCIÓN DE GIRASOL EN TURQUÍA

RESUMEN

El girasol es el cultivo principal en el sistema de rotación que se aplica en la región de Tracia, que se encuentra en la parte europea de Turquía. Como esta región es el centro de la producción de girasol en Turquía, fue organizada una amplia investigación con el fin de determinar el grado de utilización de los recursos agronómicos y su eficacia en la producción de girasol en Turquía. En el estudio fueron utilizados los datos recopilados por medio de un cuestionario dirigido a 182 empresas agrícolas en las provincias Edirne, Kirklareli y Tekirdag de la región susodicha, durante el año productivo 2005. Las localidades investigadas fueron divididas en 3 grupos según la intensidad del uso de *inputs* en la producción de girasol por la unidad de superficie. Para cada grupo fueron calculadas las funciones productivas Cobb-Douglas. Fue establecido que el tamaño de la finca/superficie del suelo, era el principal factor productivo en todos los tres grupos. Las sumas de coeficientes de elasticidad de producción en las empresas investigadas, fueron 0.978 para el grupo I (Tekirdag), 0.938 para el grupo III (Edirne) y 0.856 para el grupo II (Kirklareli). Los coeficientes de elasticidad de producción para los *inputs* fueron positivos para el grupo I, y los coeficientes para el precio de herbicidas y abonos y los gastos de cava fueron negativos para el grupo II. Los coeficientes de elasticidad de producción para el precio de semilla y abono y los costos de cava, fueron negativos para el grupo III.

ANALYSE ÉCONOMIQUE DE LA PRODUCTION DU TOURNESOL EN TURQUIE

RÉSUMÉ

Le tournesol est la culture principale dans le système de rotation de la région de la Thrace orientale (Trakya) située dans la partie européenne de la Turquie. Comme cette région est la principale région de production de tournesol en Turquie, une étude importante y a été faite dans le but de déterminer le niveau d'utilisation des ressources agricoles et leur efficacité dans la production. Les données utilisées ont été recueillies au moyen d'un questionnaire adressé à 182 entreprises de cette région dans les provinces d'Edirne, Kirklareli et Tekirdag au cours de l'année de production 2005. Les localités sous examen étaient classifiées en trois groupes selon l'intensité d'utilisation d'intrants dans la production du tournesol par unité de surface. Les fonctions de production Cobb-Douglas ont été calculées pour chaque groupe. Il a été constaté que la dimension ferme/surface terre était le facteur de production le plus important dans les trois groupes. Dans les entreprises étudiées, la somme des coefficients d'élasticité de production était de 0.978 pour le groupe I (Tekirdag), 0.938 pour le groupe III (Edirne) et de 0.856 pour le groupe II Kirklareli. Les coefficients d'élasticité de production pour les intrants étaient positifs dans le groupe I et les coefficients pour les coûts des herbicides, des fertilisants et du binage étaient négatifs dans le groupe II. Dans le groupe III, les coefficients d'élasticité de production pour coûts des semences, des fertilisants et du binage étaient négatifs.