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Analysis of Factors Affecting Potato Growing Decisions of Farmers: The Case of Ödemiş District of İzmir Province

Mine BURHAN[1], Sait ENGİNDENİZ[2,*], Duran GÜLER[2]

[1]Ege University, Institute of Science, Department of Agricultural Economics, İzmir, Türkiye
[2]Ege University, Faculty of Agriculture, Department of Agricultural Economics, İzmir, Türkiye

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ABSTRACT

The aim of this study is to determine the factors affecting the potato growing decisions of the farmers in Ödemiş district of İzmir province. In the study, data were collected from 90 farmers by proportional sampling method and face-to-face survey method. The production period of 2019 was included in the scope of the study. In the analysis of th,e data, first the socio-economic characteristics of the farmers were examined, then the criteria that the farmers gave importance to in their potato production decisions and the economic aspects of potato production were analyzed. Five-point Likert scale and Fuzzy Paired Comparison method were used in the analysis of farmers decisions. According to the results of the study, the average age of the farmers is 52.49 years and the average education period is 8.29 years. The most important criterion in potato production is price. Average potato production area is 4.19 hectares. The average yield obtained from potato production per hectare was determined as 38,758 kg. Average potato price received by the farmer was 1.43 TL kg. The average net profit from potatoes per hectare was calculated as 22,720 TL. Farmers want to sustain potato production. For this, effective potato policies should be prepared, farmers should be supported and Turkey should be self-sufficient in potato production.

1. Introduction

Different purposes can be taken into account in determining the crop pattern in farms. Farmers aim to provide the highest income while determining the crop pattern. However, they also have to take into account natural, economic and political conditions. However, in some cases, farmers can direct their production according to their knowledge level and habits (Işın, 2001). The products grown by the farmers on irrigable lands can also change over time and under the influence of various conditions. For example, it is seen that farmers prefer products that require less water in dry periods, products with low cost in times of economic crisis and high input prices, and products that require less labor in times of labor force problems. In addition, the product selections of the farmers may vary from region to region. The products mostly grown by the farmers in irrigated lands of İzmir province are cotton, potato, tomato, cucumber, pepper, green beans, watermelon, wheat, corn and some forage crops.

Potatoes are mostly grown as the main product in Turkey, and in the Mediterranean and Aegean regions, they are also grown for winter use for the purpose of early-season potato. The most important advantage of early-season potato growing is that farmers can provide high income in winter when alternative crops are scarce (Samancı et al., 2003). According to TURKSTAT data, 5.2 million tons of potatoes were produced on 147,993 hectares of land in Turkey in 2020. Average potato yield is 35,137 kg per hectare. Considering the distribution of potato production by provinces; Niğde (13.3%) ranks first, Konya (12.3%) second, Afyon (10.6%) third, Kayseri (10.4%) fourth and İzmir (8.4%) fifth (TURKSTAT, 2021).

It is seen that many studies have been carried out on the economic aspects of potato cultivation in Turkey so far (Karadaş, 2000; Özdemir, 2003; Şahin, 2003; Uzundumlu, 2005; Yılmaz et al., 2006; Birinci and Küçük, 2006; Engiz, 2007; Engindeniz and Karakuş, 2008; Tok and Davran, 2010; Bağcıtek, 2017; Karsan and Gül, 2017; Örmeci Kart et al., 2017; Kılıçer, 2019; Yücel and Oğuz, 2020; Kadakoğlu and Karlı, 2021). However, the fluctuations in potato prices in recent years have brought

* Corresponding author email: *sait.endindeniz@ege.edu.tr*

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up the importance of this issue and that it should be researched. When potato prices increase in Turkey, the adoption of imports instead of solving the problems arising from production causes these problems to continue increasingly (Yegül, 2020). For this reason, it is necessary to reveal the farmer's decisions and the factors affecting them.

Many factors can be effective in determining the crop pattern and crop rotation system of the farmers. Therefore, the changes that may occur over time should be closely followed in the farmer's conditions. In this way, local production resources can be used efficiently, as well as increasing the income of farmers and preparing production plans. In addition, researches to be conducted in this direction will reveal the problems encountered and shed light on the determination of the most appropriate agricultural policies to be applied.

The aim of this study is to determine the factors affecting the potato growing decisions of the farmers in Ödemiş district of İzmir province. Some solutions for the problems encountered in the study are also presented.

2. Materials and Methods

The data constituting the main material of the research were obtained by face-to-face survey method from farmers engaged in potato (main product) growing in Ödemiş, İzmir. Apart from this, the agricultural data of the relevant organizations and the findings of previous researches were also used.

According to the information received from the Ödemiş District Directorate of the Ministry of Agriculture and Forestry, approximately 85% of the potato production in İzmir is the Ödemiş district and the majority of the potato production in the district is Bozdağ, Gölcük, Çaylı, Cumhuriyet, Umurbey, Yolüstü, Üçeylül, Gereli, Yolüstü and Karakova. carried out in the neighbourhoods. Therefore, these neighborhoods were included in the study. The total number of farmers registered in the Farmer Registration System in these neighborhoods was determined as 1,242, and these farmers constitute the main population of the study.

In the research, some of the farmers were included in the scope by sampling method. At this stage, the following Proportional Sampling Formula was used (Newbold, 1995). As a matter of fact, it is seen that this formula is used in the sampling phase of many studies (Çobanoğlu et al., 2005; Kızılaslan and Somak, 2013; Çakır et al., 2015; Erdoğan and Gökdoğan, 2017; Barlas et al., 2019; Akboğa and Pakyürek, 2020).

$$n = \frac{Np(1-p)}{(N-1)\sigma_{p_x}^2 + p(1-p)}$$

In the formula;
n = Sample size
N = Total number of farmers
p = Proportion of farmers growing potatoes (0.5 for maximum sample size)
$\sigma_{p_x}^2$ = The variance of the ratio.

In the study, the 95% confidence interval and 10% margin of error were taken as basis and the sample size was calculated as 90. In determining the number of farmers to be interviewed in each neighborhood, the ratios of the neighborhoods to the total number of farmers were taken into account. The farmers interviewed in the neighborhoods were determined by using the random numbers table. The research was based on the 2019 production period and survey studies were carried out in the January-February 2020 period.

In the study, first of all, the socio-economic structures of the farmers were analyzed. For this purpose, age, education level of farmers, family population, land characteristics and use, family labor potential, capital structure and organizational characteristics were examined. Then, the factors affecting the farmers' decisions to grow potatoes and the results of their activities were analyzed.

In the economic analysis of potato production, input usage levels, yield levels, product prices, production costs and net profits were determined. In potato production, labor and towing costs and material (pesticide, water, seeds, fertilizer, etc.) costs are the variable cost elements, while the land rent, the interest of the total variable costs and the administration cost are the fixed costs. The interest for the total variable costs is calculated based on half of Ziraat Bank's agricultural loan interest rate (10%). The administration costs was determined by taking 3% of the total variable costs (Kıral et al., 1999).

Labor costs were calculated by adding the equivalent of family labor to the payments made for temporary labor in farms. Material costs were determined based on the amount of inputs used and the current prices paid. In order to ensure homogeneity, the unit soil preparing costs (tool-machine rent) in the region were taken into account in the determination of the machine costs (Tanrivermiş, 2000; Birinci and Küçük, 2004; Özkan et al., 2005; Aydın Can and Yercan, 2006; Engindeniz and Öztürk Coşar, 2013). Turkish Lira (TL) was used as the currency in the study. 1 USD was equal to 5.68 TL in 2019.

In the study, the factors that the farmers attach importance to in their agricultural production decisions and their future goals are analyzed. At this stage, a five-point Likert scale was used.

The Fuzzy Paired Comparison method was used in the analysis of the criteria that producers give importance to in their potato production decisions. In this study, six different criteria were presented to farmers for determining the decision choices. These criteria were price, cost, government support, yield level, climatic conditions and soil characteristics. Method steps may be summarized as follows (Zadeh 1983; Ross, 1995; Klir and Yuan, 1995; Tanaka, 1997; Pedrycz and Gomide, 1998).

First, pairwise comparisons were presented to indicate individual preferences. The total distance in comparison is follow equal.

If GKH=0.5 then K≈H; if GKH>0.5 then K>H and if GKH<0.5 then K<H.

The number of paired comparisons of the objectives (C) were determined as C= [(Z*(Z-1))/2]. Z refers to preferred number of objectives in the formula.

In this study, 15 comparisons of six different criteria were presented to each individual. For each pairwise comparison, gcr preference was obtained. Measurement of the preference degree of r according to c can be expressed as gcr=1-grc. Then, fuzzy preference matrix was as follow generated as follow;

$$G_{cr}=\begin{cases}0 & if\ \ c=r\ \ \forall\, c,r=1,\dots.n\\ g_{cr} & if\ c\neq r\ \forall\, c,r=1,\dots..n\end{cases}$$

In this study, 6x6 fuzzy preference matrix was created for each individual as follow (G);

$$G=\begin{vmatrix}0 & g_{12} & g_{13} & . & . & g_{1r}\\ g_{21} & 0 & . & . & . & .\\ g_{31} & g_{32} & 0 & . & . & .\\ . & . & . & 0 & . & .\\ . & . & . & . & 0 & .\\ g_{c1} & . & . & . & . & 0\end{vmatrix}$$

Separately preferred density of each objective (μj) was obtained using the following equation;

$$\mu_{j=}1-(\sum_{c=1}^{n}G_{cr}^{2}/(n-1))^{1/2}$$

The value of μj ranges between 0 and 1. The purpose of the comparison was determined whether they are equally important using Friedman Test. Furthermore, Kendall's coefficient of concordance for ranks was used.

3. Results and Discussion

Some socio-economic characteristics of potato farmers are presented in Table 1. The average age of the farmers was 52.49 years and the average education period was 8.29 years. The average household size is 3.80 people. Men constitute 54.21% of the total population. When examined in terms of age, it was determined that 53.42% of the population was 15-49 years old, and 30.53% were 50 and older people.

Table 1
Socio-economics characteristics of potato farmers

Variables	Mean
Age of farmer	52.49
Education level of farmer (year)	8.29
The experience of the farmers in growing potatoes (year)	24.44
Household size	3.80
Land size (ha)	5.11
Family labor potential	2.54
Equity capital rate (%)	93.24
Cooperative rate (%)	88.89

The average family labor potential was determined as 2.54 as unit of male labor. 49.69% of the family labor potential consists of male population. In terms of age; 70.47% of the population is between the ages of 15-49. In the farms, 58.95% of the family labor potential is used in potato production. The experience of producers in potato production was found to be 24.44 years on average.

The average land size in the farms was determined as 5.11 hectares. The average parcel number is 4.86, and the average parcel size is 1.05 hectares. 92.19% of the farm lands are cultivated by the owner. On average, 95.54% of the lands are irrigated. Land capital constitute 88.66% of the total active capital, and equity capital constitutes 93.24% of the total passive capital. It has been determined that 88.89% of the farmers are partners in any agricultural cooperative. The most common cooperative is the Agricultural Credit Cooperatives.

The factors that they give importance to when making decisions in agricultural production were asked to the farmers and the level of importance was examined. Factors that farmers consider the most important at this stage; market conditions and price changes, as well as the level of profitability and sustaining the activity (Table 2).

Table 2
Factors that farmers give importance to in the decision of agricultural production

Factors	Level of importance*
Level of knowledge about agricultural activity	4.41
Choosing the area of production	4.39
Profitability level and sustaining the activity	4.48
Market conditions and price change	4.50
Personal disposition and preferences	4.37
Total costs	4.40

*1. Not at all important, 2. Not important, 3. Undecided, 4. Important, 5. Very important

Fuzzy Paired Comparison method was used to analyze the factors affecting the farmers' decision on potato production. Farmers were asked to compare price, cost, soil characteristics, yield level, climatic conditions and government support bilaterally. Fuzzy Paired Comparison method results are given in Table 3. Influencing factors are listed according to their weights, from largest to smallest. It has been determined that the most important factor for the farmers to decide on potato production is the price. Other important factors are cost, government supports, yield level, climatic conditions and soil characteristics, respectively. According to the Friedman test results, the difference between the preferences is statistically significant. It can be said that some factors related to the production decisions of the farmers are preferred over the others.

Table 3
Fuzzy Paired Comparison method results

Factors	Mean	Std. error	Min.	Max.
Price	0.655	0.140	0.300	0.900
Cost	0.640	0.109	0.397	0.874
Government support	0.445	0.144	0.139	0.759
Yield level	0.423	0.089	0.228	0.615
Climatic conditions	0.276	0.090	0.100	0.776
Soil characteristics	0.233	0.070	0.119	0.482

Friedman test is significant for p<0.01. Kendall's W: 0.703

Considering the values of Kendall's W test, it can be said that the fit is very weak (0.1), weak (0.3), moderate

(0.5), strong (0.7), and strongly strong (0.9). Kendall's W value was found to be 0.703 in the study. While determining the weights of the important criteria, the agreement between the producers is strong (Table 3).

60% of farmers used loans for potato production. farmers mostly used enterprise and investment loans from Ziraat Bank. When the farmers were asked whether they received support from the state, 24.44% stated that they did not. Supported farmers mostly benefited from diesel-fertilizer support. 61.11% of the farmers stated that they found the state supports very insufficient, 34.44% insufficient.

When the farmers were asked about their level of knowledge on organic potato production, 36.67% of them stated that they had knowledge. 27.78% of farmers consider producing organic potatoes. On the other hand, 42.22% of the farmers stated that they had knowledge about good agricultural practices. 27.78% of farmers consider producing potatoes with good agricultural practice.

38.9% of the farmers have a positive attitude towards contract production and want to make contract production. When the farmers were asked whether they had insurance in potato production, only one farmer stated that he had insurance for his potatoes.

The results for the economic analysis of potato production in the farms included in the study are presented in Table 4. Average potato production area in farms is 4.19 hectares. Potato yield per hectare varies between 30,000 and 43,000 kg. Average potato yield per hectare was calculated as 38,758 kg. According to the studies carried out in different regions in Turkey, it is seen that the potato yield per hectare varies according to the regions. For example, in a study conducted in İzmir, 25,870 kg (Özdemir, 2003), in a study in Nevşehir 52,800 kg (Engiz, 2007), in a study in Tokat 24,500 kg (Yıldırım et al., 2019), in Bitlis It was found to be 32,800 kg in a study (Şahin, 2003), and 15,790 kg in a study conducted in Erzurum (Birinci and Küçük, 2006).

Table 4
Economic analysis of potato production

Variables	Mean
1.Potato production area (ha)	4.19
2.Verim (kg ha)	38,758
3.Price received by the farmer (TL kg)	1.43
4.Gross production value (TL ha) (2x3)	55,424
5.Variable costs (TL ha)	26,722
6.Total production costs (TL ha)	32,704
7.Unit cost (TL kg) (6/2)	0.84
8.Gross profit (TL ha) (4-5)	28,702
9.Net profit (TL ha) (4-6)	22,720
10.Relative profit (4/6)	1.69

In the farms examined, 79.27% of the potatoes were marketed to merchants, 9.12% to brokers, 7.312% to potato processing companies and 4.30% to consumers directly. Again, in a study conducted in İzmir, it was determined that 97.73% of it was marketed to merchants and 2.27% to processing companies (Özdemir, 2003). The price of potatoes received by the famers varied between 0.85-2.00 TL kg. The average price is calculated as 1.43 TL kg. In a study conducted in the province of Niğde in the same period, it was determined that the price ranged between 0.6-1 TL kg (Kılıçer, 2019).

The average production cost per hectare for potatoes in the examined farms was calculated as 32,704 TL. Material costs account for 46.99% of production costs, labor and machine costs 34.72%, and other costs account for the remaining 18.29%. As can be seen, 81.71% of production costs in farms are variable costs. The ratio of variable costs to production costs; it was found to be 83.6% in Niğde (Karsan and Gül, 2017), 92.17% in Erzurum (Birinci and Küçük, 2006), 91.93% in Tokat (Yıldırım et al., 2019), and 85.67% in Nevşehir (Engiz, 2007).

The average kg cost of potatoes in the examined farms was determined as 0.84 TL. In a study conducted in Tokat in the same period, the unit cost was determined as 1.54 TL kg (Yıldırım et al., 2019). In a study conducted in Niğde, it was determined that the unit potato cost of 42.2% of the farmers was 0.41-0.60 TL kg, and the unit potato cost of 34.1% was 0.61 TL kg and above (Kılıçer, 2019).

The average gross production value of potato per hectare was determined as 55,424 TL, average gross profit per hectare 28,702 TL, and average net profit per hectare 22,720 TL in the examined farms. In a study conducted in Bitlis, it was determined that variable costs constitute 57% of the gross production value (Şahin, 2003), and in a study conducted in İzmir, it was determined that the farmers could not even meet the variable costs and incur losses (Özdemir, 2003).

The problems faced by the farmers in production and marketing are summarized in Table 5. They stated increases in input prices, fluctuations in potato prices, and inadequacy in support and organization as the most important problems. It is necessary to increase the sustainability of potato production in the region with short and medium-term measures to be taken for these problems.

Table 5
Problems faced by farmers in potato production and marketing

Problems in production	Problems in marketing
Increases in input prices	Fluctuations in potato prices
Insufficient support for potatoes	Problems in wholesaler organization and interruptions
Problems in the supply of seeds	Organizational deficiencies
Problems in fertilizer use	Inadequacy of processing facilities
Problems in pesticide use	Failure to develop contract farming
Problems in irrigation	Failure to produce for export
Negative effects of climate change	Inadequacy of cold storage
Insufficiencies in extension efforts	Product sales that could not be collected on time

The farmers were asked about their future goals regarding agricultural production and their participation levels were examined. The most important goals of the farmers regarding agricultural production; preserving the land and capital and transferring it to future

generations, sustaining potato production and producing at the lowest cost (Table 6).

Table 6
Future goals of farmers regarding agricultural production

Future goals	Level of participation*
Preserving land and capital, and transferring it to future generations	4.50
To produce at the lowest cost	4.48
Sustaining potato production	4.48
Reducing risks in production and marketing	4.47
Pay off debts	4.47
Implementing innovations and increasing profits	4.42
Using more technology	4.41
Sustaining family labor use	4.41
Buying new tools and equipment	4.39
Expand the farm land	4.39
Start a new farm	4.37
Using organic and environmentally friendly methods	4.32

*1.Strongly disagree, 2.Disagree, 3.Undecided, 4.Agree, 5.Strongly agree

4. Conclusion

According to the results of the study, market conditions and price changes were determined to be the most important factors for farmers in agricultural production. The most important criterion for the farmers to decide on growing potatoes is the price. Potato price recieved by the farmers in the examined farms varied between 0.85-2.00 TL kg. Average price is calculated as 1.43 TL kg. Farmers earn a net profit of 22,720 TL per hectare from potato growing. Farmers are considering sustaining their potato production in the future. However, they also expect solutions for the problems they encounter. For this, effective potato policies should be prepared, farmers should be supported and Turkey should be self-sufficient in potato production.

The biggest expectation of potato farmers is a sustainable and planned production. In order for the farmers to continue their potato production and to transfer this production branch to the next generations, their current problems should be solved in the short term. In particular, potato imports should not be seen as a solution and domestic production should be supported by planning. For this, first of all, a potato map should be created to determine how much and in which region the farmers will produce, the product should be guaranteed and the production amount to meet the country's needs should be planned.

One of the most important problems encountered in potato production is marketing. A regular market structure in potato production in Turkey not available. In order to prevent product losses and seasonal fluctuations, a production plan should be made, and diversity in production and processing should be ensured by integrating food and industry. In this way, supply fluctuations can be prevented.

Potatoes in Turkey; It is one of the products with the most fluctuations in price. The reason for this can be shown as environmental and climatic conditions and costs. In some periods, the amount of product supplied to the market is high, which causes the price to decrease in that period. In some periods, the quantity supplied is low and the price increases. Policies should be developed to prevent price instability.

Organization should also be utilized in solving the problems of potato farmers regarding input supply and marketing. Farmers especially need to be organized in the form of cooperatives. Cooperatives should take an active role in the production and marketing of quality products in accordance with market conditions.

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