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PROFITABILITY ANALYSIS OF POTATO GROWING IN ÖDEMIŞ DISTRICT OF IZMIR PROVINCE

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A B S T R A C T

The aim of this study is to perform an economic analysis of potato growing in Ödemiş district of Izmir province. For this aim, data were collected from 90 farmers by proportional sampling and face-to-face survey methods. Potato production in 2019 was included in the study. In the study, yield, production cost, gross production value, gross and net profit calculations were performed in order to reveal the profitability level of potatoes for entrepreneurs and farmers. According to the results of the study, the average potato production area is 41.88 decares, the average potato yield is 3875.79 kg/da and the potato price received by the farmers is 1.43 TL/kg. It was determined that the farmers used 392.74 kg of seeds, 39.72 kg of nitrogen and 746.89 g of pesticides per decare. The production cost per decare for potatoes is 3274.44 TL and 85.69% of it is variable costs. The gross and net profit from potato production was calculated as 2736.55 TL/da and 2267.94 TL/da, respectively. The results of this study show that potatoes can be grown economically in the district. But, the biggest expectation of the potato farmers included in the research is sustainable and planned production. At this point; there is a need to establish cooperation and coordination among farmers, processors, industrialists, universities and exporters.

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1. Introduction

Potato is one of the important crops in terms of nutritive value and nutrition. Potatoes can be grown in most of the countries today. The most important countries in potato production are; China, India, Russia, Ukraine, USA and Germany. The potato industry of these countries is also developed. China (78 million tons) ranks first in world potato production, while India ranks second (51 million tons) and Russia (21 million tons) third. These three countries account for 42% of world potato production (FAOSTAT, 2022). The ecological adaptability of the potato and the nutrients it contains have made it important in these countries. In addition to being a raw material for the food industry, potato maintains its importance with its hoe and alternation plant feature (Çalışkan et al., 2011).

Türkiye has important ecological and natural conditions in terms of plant production. These conditions allow many plant species to grow. However, it is seen that there are some densities in the distribution of herbal products by region. One of these products is potatoes. Potato, which is mostly grown as a family farm in Türkiye, is also grown commercially. Potatoes, which are grown intensively in the Central Anatolia, Marmara and Aegean, have started to find growing areas in the Eastern Anatolia as well (Şahin, 2003a).

According to TURKSTAT data, 5.1 million tons of potatoes were produced on 138.917 hectares of land in Türkiye in 2021. The average potato yield is 3671 kg per decare. Considering the distribution of potato production by provinces; Konya (12.2%) ranks first, Niğde (11.3%) second, Afyonkarahisar (11%) third, Kayseri (10.2%) fourth and Izmir (8.8%) fifth (TURKSTAT, 2022). The fact that production can be made on the plain and on the lowland in Izmir, and that the climate and soil conditions are suitable for early, and second crops necessitate increasing research on potato production in this province.

Many studies have been conducted to analyze the economic aspects of potato growing in Türkiye (Karadaş, 2000; Özdemir, 2003; Şahin, 2003a, b; Özdüzen, 2004; Uzundumlu, 2005; Yılmaz et al., 2006; Birinci ve Küçük, 2006; Tunçtürk et al., 2007; Engiz, 2007; Engindeniz and Karakuş, 2008; Tok and Kantar Davran, 2010; Kumbasaroğlu and Dağdemir, 2010; Bağcıtek, 2017; Karsan and Gül, 2017; Örmeci Kart et al, 2017; Kılıçer, 2019; Yıldırım et al., 2019; Yücel and Oğuz, 2020; Kadakoğlu and Karlı, 2021a, b; Kadakoğlu and Karlı, 2022; Yücel Engindeniz, 2022). However, it is seen that there is not enough research in Izmir. It is necessary to continue these researches and to develop measures regarding the direction to be given to potato production. A research to be conducted in Izmir, and especially in Ödemiş, will not only reveal the economic aspects of potato cultivation, but also provide important contributions to the development of potato production and to reveal the factors that affect entrepreneurs' orientation to this field.

In this study, economic analysis of potato growing was performed in the light of the data collected from the farmers by the survey method, some suggestions were made by determining the problems encountered.

2. Materials and methods

The data constituting the main material of the study were obtained by face-to-face survey method from the farmers engaged in potato growing in Ödemiş district of Izmir. 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 Izmir is the Ödemiş district and the majority of the potato production in the district is Bozdağ, Gölcük, Çaylı, Cumhuriyet, Ocaklı, Umurbey, Yolüstü, Üçeylül, Gereli 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 1242, and these farmers constitute the main population of the study.

In the study, some of the farmers were included in the scope by sampling method. At this stage, the following proportional sample size formula was used (Newbold, 1995). In fact, it is seen that this formula is used in the sampling phase of many studies (Çobanoğlu et al., 2005; Kızılaslan and Somak, 2013; Tiryakioğlu and Artukoğlu, 2015; Çakır et al., 2015; Engindeniz et al., 2017; Bozdemir et al., 2019; Akboğa and Pakyürek, 2020).

$$n = \frac{Np(1-p)}{(N-1)\sigma^2{}_{px} + p(1-p)} \quad \text{.....(1)}$$

In the formula;
n = sample size
N = Total number of farmers
p = Proportion of farmers growing potatoes (0.5 for Maximum sample size)
σ^2px = The variance of the ratio.

In the study, 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 questionnaire form prepared to collect the data included questions to determine the socio-economic characteristics and activity results of the farmers. The study was based on the 2019 production period and the survey studies were carried out in the January-February 2020 period.

In the technical and economic analysis of potato growing, input usage levels, yield levels, farmer prices, production costs, gross profit, net profit and relative profit were determined. Potato production costs consist of variable and fixed costs. Labor and machine costs, material (seed, pesticide, fertilizer, etc.) costs and interest of working capital are variable cost items; land rent and administrative costs are fixed costs. The interest for the working capital is calculated based on half of Ziraat Bank's agricultural loan interest rate (5%). The administrative costs was determined by taking 3% of the total variable costs (Kiral 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 machine-tool rent in the region were taken into account in the determination of the machine costs (Tanrıvermis, 2000; Özkan et al., 2005; Aydın Can and Yercan, 2006; Engindeniz and Öztürk Coşar, 2013; Kadakoğlu and Karlı, 2022).

The following equations are used in the calculations of gross production value, gross profit, net profit and relative profit regarding potato production in farms (Kıral et al., 1999; Birinci and Küçük, 2006; Kumbasaroğlu and Dağdemir, 2010; Kadakoğlu and Karlı, 2022).

Gross Production Value = Production Amount x Sales Price …….. (2)
Gross Profit = Gross Production Value – Variable Costs ……...(3)
Net Profit = Gross Production Value – Production Costs ……(4)
Relative Profit = Gross Production Value / Production Costs ……..(5)

In the evaluations made in the research, decare (1000 m^2 = 0.1 hectares) was used as the area and Turkish Lira (TL) was used as the currency. 1 USD=5.68 TL was in 2019.

3. Results and discussion

The ages of the farmers ranged from 27 to 76 and the average age was calculated as 52.49. The education period of the farmers varies between 5-15 years and the average is determined as 8.29 years. The experience of farmers in potato growing was found to be 24.44 years on average. Approximately 89% of the farmers are partners in any agricultural cooperative. The average potato production area in the farms is 41.88 decares. Potato yield per decare varies between 3000 and 4300 kg. Average potato yield was calculated as 3875.79 kg. For example, it was determined as 2587 kg (Özdemir, 2003) in a study conducted in Izmir, 5280 kg (Engiz, 2007) in a study conducted in Nevşehir, and 2450 kg in a study conducted in Tokat (Yıldırım et al., 2019). 60% of the farmers use loans for potato growing, approximately 76% benefit from government support, and approximately 28% plan to produce organic potatoes (Table 1). When the farmers were asked whether they

found the support of the state sufficient in potato production; 61.11% stated that they found it very inadequate, 34.44% found it insufficient. It was determined that only one farmer had insurance in potato growing. It has been determined that farmers mostly grow Marabel, Marfona, Agria, Ausonia, Jearla, Impala, Resy, Concerde and Granola potato varieties.

Table 1. General characteristics of farmers and potato growing

Characteristics	Results
Age of farmers	52.49
Education level of farmers (years)	8.29
Potato growing experience of farmers (years)	24.44
Potato production area (da)	41.88
Yield (kg/da)	3875.79
The credit using rate of farmers for potato growing (%)	60.00
The rate of farmers benefiting from the supports (%)	75.56
Tendency of farmers to produce organic potatoes (%)	27.78

Table 2. Input usage amounts for potato growing

Inputs		Results
Seed (kg/da)		392.74
Fertilizer (kg/da)	N	39.72
	P_2O_5	18.61
	K_2O	11.78
Pesticide (g/da) (*)		746.89
Labor (h/da)	Sowing seeds	5.66
	Fertilization	3.57
	Irrigation	6.79
	Pesticide application	4.08
	Hoeing	23.96
	Harvesting and packaging	27.94
	Total	72.00
Machine use (h/da)		6.32

(*) It is active ingredient

When the inputs used in potato production were examined, it was determined that an average of 392.74 kg of seeds, 39.72 kg of nitrogen, 746.89 g of pesticides, 72 h of labor and 6.32 h of machine were used per decare (Table 2). 54.44% of the farmers stated that they had a soil analysis done. It was determined that farmers mostly used Compound fertilizer (15.15.15 and 20.20.0), Ammonium Sulphate, Potassium Nitrate, Ammonium Nitrate (26%, 33%), TSP, DAP and Urea as chemical fertilizers. Farmers generally use pesticides containing the active ingredient Azadirachtin, Spinosad, Lamda-Cyhalothrin, Novaluron and Thiamethoxam for potato control. Producers make use of groundwater for irrigation and flood irrigation method is generally used. The average number of irrigation in the farms was determined as 5.39.

In a study conducted in Nevşehir, it was determined that 372 kg of seeds, 103.75 h of labor, 7.88 h of machine, and 255 g of pesticide were used (Engiz, 2007). In a study conducted in Tokat, it was determined that 400 g of seeds and 700 g of pesticide were used (Yıldırım et al., 2019).

The average cost of potato growing per decare in the examined farms is 3274.44 TL. Variable costs constitute 85.69% of production costs. Material costs account for 46.93% of production costs, labor and machine costs for 34.68%, and other costs for the remaining 18.39%. Average labor and machine costs in farms were determined as 1135.55 TL/da, and average seed costs 764.44 TL/da (Table 3). The ratio of variable

cost to production costs; it was found to be 83.6% in Niğde (Karsan and Gül, 2017), 91.93% in Tokat (Yıldırım et al., 2019), and 85.67% in Nevşehir (Engiz, 2007). In the study, 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).

The average gross production value of potatoes per decare was determined as 5542.38 TL. The average gross profit and net profit per decare were calculated as 2736.85 and 2267.94 TL in the examined farms (Table 4). In a study conducted in Bitlis, it was determined that variable costs constitute 57% of the gross production value (Şahin, 2003a), and in a study conducted in Izmir, it was determined that the farmers could not even meet the variable costs and incur losses (Özdemir, 2003).

Relative profit refers to the production value obtained in return for one unit of cost in potato production. It was determined that a production value of 1.69 TL was obtained in exchange for a cost of 1.00 TL for potato production. In a study conducted in Afyonkarahisar, this value was calculated as 1.01 (Kadakoğlu and Karlı, 2022).

Table 3. Cost items of potato growing

Cost items		Costs (TL/da)	%
1. Labor and machine costs	Tillage and preparation	264.44	8.07
	Sowing seeds	155.56	4.75
	Fertilization	71.67	2.19
	Hoeing	86.67	2.65
	Irrigation	79.44	2.43
	Pesticide application	96.11	2.93
	Harvesting and packaging	277.22	8.47
	Transport	104.44	3.19
	Sub-total	1135.55	34.68
2. Material costs	Seed	764.44	23.35
	Fertilizer	325.56	9.94
	Pesticide	191.67	5.85
	Electricity and fuel costs (for irrigation)	193.89	5.92
	Others	61.11	1.87
	Sub-total	1536.67	46.93
3. Interest of working capital (5%)		133.61	4.08
4. Total variable costs (1+2+3)		**2805.83**	**85.69**
5. Fixed costs	Administrative costs (3%)	84.17	2.57
	Land rent	384.44	11.74
	Sub-total	**468.61**	**14.31**
Total production costs (4+5)		**3274.44**	**100.00**

Table 4. Economic results of potato growing

Economic results	Value
1. Yield (kg/da)	3875.79
2. Farmer potato price (TL/kg) (5)	1.43
3. Gross production value (TL/da) (1x2)	5542.38
4. Total variable costs (TL/da)	2805.83
5. Total production costs (TL/da)	3274.44
6. Unit potato cost (TL/kg) (5/1)	0.84
7. Gross profit (TL/da) (3-4)	2736.55
8. Net profit (TL/da) (3-5))	2267.94
9. Relative profit (3/5)	1.69

4. Conclusion

Results of this study show that potatoes can be grown economically in the district. The biggest expectation of the potato farmers included in the study is 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.

One of the most important cost factors in potato production is seeds. In order to increase both yield and quality, certified seed production should be expanded. This can be done with new and improved projects integrated by institutions such as research institutions and universities. Thanks to these projects, our country's foreign dependency on seeds will decrease and production costs will be reduced.

Increases in fertilizer prices require effective use in potato production. Some of the farmers (46%) make unconscious fertilization in order to get more efficiency from the field without soil analysis, which leads to a decrease in the quality of the product and environmental pollution. Farmers should be informed about soil analysis and effective fertilization should be ensured. In this way, costs can be reduced.

In order to increase yield and profitability in potato production, timely and effective plant protection is required. Considering the increase in pesticide prices, one of the ways to reduce costs is to reduce pesticide costs. Plant protection processes that are not done correctly and on time cause very important product losses. In order to prevent these losses, an effective control program should be followed, integrated control should be given importance, and both product and income loss should be prevented by informing the farmers more.

Potato is a plant that needs a lot of water. When the research area is examined, potato irrigation is generally done in the form of flood irrigation using groundwater. Farmers bear the electricity and diesel costs for irrigation. This also increases costs. In terms of cost reduction, irrigation should be done with alternative methods that will use water more efficiently.

There is no regular market structure in potato production in our country. Potatoes is one of the crops with the most fluctuations in price in Türkiye. The reason for this can be shown as environmental and climatic conditions, 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. In order to prevent product losses and seasonal fluctuations, a production plan should be made, food-industry integration should be made and diversity in production and processing should be ensured. In this way, supply fluctuations can be prevented. Policies should be developed to prevent price instability.

Farmer incomes in potato production vary due to fluctuations in potato prices, increase in input prices used in production, and failure to produce by providing a suitable input composition in farms. For this reason, it is of great importance for the sustainability of potato production in the region to reduce the production costs of the farmers by reducing the input costs and to ensure the market equilibrium price of the potato.

As a result; in order to develop potato production in the region and to ensure its sustainability, first of all, the problems encountered should be solved. At this point; there is a need to establish cooperation and coordination among farmers, processors, industrialists, universities and exporters.

Compliance with Ethical Standards

Conflict of Interest

The authors declare no conflict of interest

Authors' Contributions

The authors have equal contribution to the article.

Ethical approval

Since the survey was conducted in the research, it was examined by the Scientific Research and Publication Ethics Committee of Ege University and its suitability was reported.

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Data availability

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Consent for publication

We humbly give consent for this article to be published.

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