Economic and productivity analysis of cherry production in Turkey: case of the Çukurova Region

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Abstract

This study was carried out in cherry enterprises in the Adana and Mersin provinces of the Çukurova Region in Turkey. The study aimed to put forward the socio-economic structures of the cherry enterprises and the profitability of cherry production. The data used in the study were obtained from a total of 90 cherry producers in the 2018-2019 production period. The

average age and the family size of the producers were determined as 57.8 years and 3.4 persons, respectively. The average land size of the enterprises was found as 9.07 da, and the average cherry yield was found as 13880.00 kg ha^{-1}. The total production costs, gross output value, gross profit, and net profit of cherry production were found as 8121.04 \$ ha^{-1}, 9022.00 \$ ha^{-1}, 3374.68 \$ ha^{-1}, and 900.96 \$ ha^{-1}, respectively. Besides, the cost of producing 1 kg of cherry was calculated as 0.58 \$ ha^{-1}. In cherry production, gross labor productivity and net labor productivity values were found as 2.56 \$ and 0.26 \$, whereas gross and net capital productivity values were determined as 0.44 \$ and 0.04 \$, respectively. Gross factor productivity of cherry production was found as 1.11, whereas net factor productivity was 0.11. These values indicated that the return ratio of the costs was 11%. According to the results, it was concluded that the cherry production in Çukurova Region was profitable.

Keywords: Cherry, economic analysis, productivity, profitability

1. Introduction

Cherry is a kind of common fruit that is being produced since former times. But, its consumption and international trade have been increased starting from 1970-1980 (Uzer, 2012). The convenient status of the climate zone for the ecological demands of many fruits makes Turkey one of the leaders among fruit-producing countries. The importance of cherry in Turkey's economy is being increased due to its fresh consumption, raw material, exportation, and contribution to employment.

Between 2014 and 2018, following the FAO data, Turkey has an average of 570 thousand tons of cherry production per year and leads by %19 of total cherry orchards of the World (FAO, 2020). Factors such as different soil and ecologic properties, new sort of cherries produced, long harvesting season, and premium price for the domestic market besides foreign demand make Turkey the leading country in the World. Therefore, the importance of the research-development activities is very high for improving the new sort of cherries. Because almost all amount of cherry production in Turkey is one of the most critical cherries in the World known as "Turkish Cherry" 0900 Agriculture kind (Erdal et al. 2014). In Mersin and Adana provinces belong to the Cukurova region where the research was executed, the amount of 22.941 tones cherry matches 3.5% of Turkey's total production. 82.5% of the total cherry production of the Cukurova region is performed in Adana and Mersin provinces (TUIK, 2020). Besides the domestic market of the cherry produced in the region, there are export-oriented foreign markets.

In this study, the economic activities of the enterprises producing cherry in Mersin and Adana were analyzed. The way for the sustainability of the enterprises is to observe the changes in technical and economic data and take the necessary precautions. To make wise

investments and executions, the producers should know the ratio of the total cost to the total income, production cost, and expenses of the production activities (Özkan et al., 2002). This will help the producers evaluate the existing production factors in the medium and long term or make new production planning in deciding how to produce the new product.

This study aims to determine the profitability and production cost of the cherry enterprises in the villages of the Cukurova region to present the economic aspects of cherry production. The results of this study are expected to shed on the decisions of the policymakers for the development of cherry production.

2. Literature Review

Various studies were conducted on socio-economic analysis, profitability, and marketing of cherry production in Turkey and the World. Demircan and Aktaş (2004) examined the input usage in cherry production and determined that 8.31% and 5.37% of the production costs were fertilizer and irrigation costs, respectively. Tekdemir (2011) examined the socio-economic structure of the cherry producers and determined that 72.2% of the producers were primary school graduates, the producers' agricultural experience was frequently 16-20 years, and 45.7% of the farm income was obtained from cherry farming. Finally, Unakıtan et al. (2016) examined the economic analysis of cherry production. They determined that the gross profit was 4692 \$ ha^{-1} and that benefit-cost ratio values were 1.31 and 1.29 in the enterprises that produced domestic markets and exporting companies.

İşleyen and Erden (2019) found that the ratio of variable costs was 72.5%, the percentage of fixed costs was 27.5%, and gross profit was 8460 \$ ha^{-1} and relative profit was 1.84 in cherry production in the Ankara province of Turkey. Bilgili et al. (2019) stated that the variable and fixed costs composed 46.43% and 53.57% of the total production costs in cherry production in İzmir. Besides, they determined that the ratio of total production costs in gross production value was 37.38%. In the study carried out by Gül et al. (2020) in Afyonkarahisar, Denizli, Isparta, İzmir, Konya, and Manisa provinces of Turkey, it was determined that the relative profit values changed between 2.2 and 3 and by enterprise groups and the profitability increased as the enterprise groups enlarged.

Some studies were carried out on socio-economic structure and marketing of cherry production in the enterprises that applied good agricultural practices and in the conventional enterprises (Hasdemir and Taluğ, 2012; Bayraktar and Saner, 2016; Aydın et al., 2018), and it was determined that the enterprises that applied good agricultural practices had a more

profitable production structure. Besides, in the studies carried out by Emeksiz, 1999; Taner, 2001; Demircan and Hatırlı, 2003; Dere, 2006; Çerçinli Öz ve Bal, 2016; Nalinci and Kızılaslan, 2019, the marketing structure and foreign trade opportunities of cherry production was examined.

Wellner et al. (2017) examined alternative cherry production systems' investment costs and profitability in the study related to community sustainable agriculture in Germany. They compared cherry farming in open and close areas and stated that cherry production could be profitable by different production systems. Finally, Tricase et al. (2017) aimed the input and energy use in cherry production in the Apulia region of Italy. They put forward that the primary inputs were due to irrigation, large volumes of water used, and diesel fuel consumption, particularly fertilizer and pesticide transportation and administration.

Lukac et al. (2017) performed a comparative analysis to evaluate the most significant parameters of cost efficiency of some fruit kinds and improve the current situation. They determined that the optimal costly fruit production was pear farming (3.19) and recorded in apples 2.94, cherry 2.27, peach 2.17, and plum 1.44. Rattray (2017) calculated the rate of return as 12.30% in cherry farming and stated that the price risk, which occurred under 20% of the base price, was the most significant factor affecting profitability.

Noor et al. (2020) determined whether cherry production was rational when compared with the unit cost and net return per unit revealed the socio-economic characteristics of cherry farmers in the Balochistan district of Quetta. Economic analysis was carried out on cherry production. The results from this study showed that cherry production in Pakistan was a more competitive and sustainable activity. Vahid-Berimanlou and Nadi (2021) investigated the energy consumption and production costs of sweet-cherry and sour-cherry in Northeastern Iran. They determined that chemical fertilizers and diesel fuel were the most highly consumed energies in both crops. The economic analysis revealed that production costs for sweet-cherry were higher than sour-cherry. Still, sweet-cherry was more profitable than sour-cherry because of premium prices for sweet-cherry.

Long et al. (2021) evaluated the World cherry production trend. They emphasized that each producer should continue to increase and continue cherry production while cherry production increases in the World. They stated that cherry farming was profitable, but a high-risk attempt and cherry farming would depend on the risks, risk decreasing probabilities, and marketing potential in the future.

3. Material and Method

The primary data, obtained from 90 producers by survey method in the districts of Mersin and Adana provinces where the cherry production was intensively done (Toroslar, Çamlıyayla, Erdemli, Pozantı, Aladağ, Saimbeyli), composed the primary material of the study. The survey data includes the 2018-2019 production period. Besides, it was utilized from the studies related to the subject, statistics, and reports.

The selection of the provinces, districts, and villages was made by the purpose sampling method. By considering TUIK data, 6 districts were selected where the cherry production was intensively performed (Adana; Pozantı, Aladağ, Saimbeyli, Mersin; Toroslar, Çamlıyayla, Erdemli). Besides, interviews were conducted with the Provincial and District Directorate of Agriculture, Chamber of Agriculture, and Cheery Producers Organizations. As a result of the interviews, three villages from each district, which had the most cherry area and production, were determined. The surveys were applied to 5 producers from each village, and consequently, 15 producers were subjected to surveys in each district. The producers were determined among the producers registered to farmer registration system by utilizing from random numbers table. The survey forms were prepared by using similar studies and taking the opinions of the experts.

Yield amount, prices, input amounts and production costs, gross and net incomes in cherry production were presented in the study. Cherry production costs consisted of variable and fixed costs. Labor and machinery costs, material (fertilizer, pesticide, etc.), and revolving interest composed the variable costs, whereas general administration expenses, interest on bare land value, machine-tool depreciation and interest, facility costs depreciation, and interest composed the fixed costs. One-half of the per-annum rate, which Rural Bank of Turkey applied for plant production credits, was considered for calculating the revolving interest (Kıral et al. 1999).

5% of the bare land value was taken as land rent, and 3% of the variable costs were taken to calculate general administration expenses. For determining the facility costs depreciation, the costs made in the facility period were accumulated to the end of the fourth year by using an 8% of interest rate. Then, the resulting value was divided into economic life (30 years). Finally, total production costs were subtracted from the gross production value to calculate the net profit obtained from cherry production.

The labor costs were calculated by adding the family labor equivalents to the prices paid to the temporary workers. The input amounts and the current prices paid for these inputs

were used for calculating the material expenses. To provide the homogeneity on the calculation of machinery expenses, unit land tillage prices (tool-machine rent) in the region were taken as a basis for the producers who used their tool-machines and thus, this method was used in many studies (Yercan and Engindeniz, 2003; Engindeniz and Çukur, 2003; Yılmaz et al.2017; Bilgili et al. 2019).

The following formulas were used to calculate gross and net profit (Açıl and Demirci; Kıral et al. 1999).

$$Gross\ profit = Gross\ production\ value - Variable\ costs$$

$$Net\ profit = Gross\ production\ value - Production\ costs$$

The following formulas were used in the productivity analysis. Productivity is defined as output per unit input in a certain period (Sadoulet and Janury, 1995).

$$Gross\ factor\ productivity = \frac{Gross\ production\ value}{Production\ costs}$$

$$Net\ factor\ productivity = \frac{Net\ profit}{Production\ costs}$$

$$Gross\ labor\ productivity = \frac{Gross\ production\ value}{Labor\ costs}$$

$$Net\ labor\ productivity = \frac{Net\ profit}{Labor\ costs}$$

$$Gross\ capital\ productivity = \frac{Gross\ production\ value}{Facility\ costs}$$

$$Net\ capital\ productivity = \frac{Net\ profit}{Facility\ costs}$$

4. Results and Discussion

4.1. Information about the enterprises

In the study, land size was considered to determine the size of the enterprise. As a result, it was determined that the cherry production was done in the ratio of 96.4% in the ownership areas, 1.8% in rented areas, and 1.8% in the common areas.

The average cherry land size of the enterprises was determined as 0.81 ha. Besides, it was determined that the number of small-scale enterprises (1-5 da) was excessive, and the ratio of these enterprises was 57.7%. The ratios of the enterprises with cherry orchards between 6-20 da and 21-50 da were 34.0% and 7.4%, respectively. The ratio of the enterprises which had cherry orchard more than 50 da was found as 0.9%.

Even though the plant spacing of the trees in the cherry orchards differed, it was determined that the average tree number per enterprise was found as 346.6, and the tree number per hectare was determined as 350.8. When the number of trees per hectare was examined in the researches related to cherry production, it was determined that the number of the trees was found as 331.9 in İzmir (Bilgili et al. 2019). The average age of the cherry trees was found as 21. In the regions in which export-oriented cherry production was done in Turkey, the cherry plantations consisted of commonly wild cherry and citronella rootstock trees. In this study, the most common rootstocks used in the orchards were citronella (54.2%) and wild cherry (44%). As a result, the cherry yield was found as 13880.00 kg ha^{-1}. When the cherry yield was examined in previous studies, it was found as 9447 kg ha^{-1} in İzmir (Bilgili et al. 2019), 14000 kg ha^{-1} (Aydın et al. 2016), and 16000 kg ha^{-1} in Tokat (Balcı et al. 2016). In this study, the yield per tree was found as 50.5 kg, and the minimum and maximum yield amounts were found as 10 kg and 180 kg.

It was determined that 8% of the producers were between 26 and 35 ages, 19% were between 36 and 51 ages, and 73% were between 52 and 81. In the study carried out in the Thrace region by Unakıtan et al. (2016), it was determined that the cherry producers were between 50-59 ages (51.85%), 40-49 ages (19%), and under 30 ages (3.70%). The average age of the producers was 57.8, and the ratio of the producers over the average age was 58.8%. Unakıtan et al. (2016) found that the average age of the cherry producers was approximately 53 in the Thrace region.

It was determined that the maximum agricultural experience of the producers was 57 years and the maximum experience in cherry farming was 48 years. The average agricultural experience of the producers was 29.3 years, and the average cherry farming experience was 22.1 years. Unakıtan et al. (2016) stated that the average cherry farming experience of the producers in the Thrace region was 23 years.

There is a strong relationship between agricultural enterprise and family labor due to the typical structure of agriculture. According to the age groups, analyzing the family population in the enterprises is a significant subject that contributes to a good number of purposes, foremost to reveal the workable and inactive population (Öztürk, 2010). The average family size in the enterprises was 3.4 persons, and the average family labor potential was determined as a 1.8 man labor unit. Furthermore, it was determined that the woman population in the households (60.3%) was higher than the man population (39.7%). The main reason for the fewer population in small-scale enterprises is that some family members find employment in the provinces due to the insufficient land size.

It was determined that 60% of the cherry producers was primary school graduate, 3.3% was reading-challenged, 3.3% was university graduate, 10% was secondary school graduate, and 17.8% was a high-school graduate. Furthermore, Sayılı and Özbek (2016) studied cherry production in the Suluova district of Amasya and determined that the producers were frequently primary and secondary school graduates.

4.2. Production costs

The agricultural processes in cherry farming were determined, and labor, machinery, and input costs were separately discussed in the study (Table 1). In cherry farming, 38.3 man labor unit was used, and labor costs and machinery costs were 473.10 $ ha^{-1} and 157.40 $ ha^{-1}, respectively in tillage. Fertilizing, irrigation, weeding, pruning, and harvesting processes were based on labor, and 20.00, 10.00, 9.60, 21.10, and 192.00 man labor units were used, respectively. Total of 443.60 $ ha^{-1} and 198.80 $ ha^{-1} input costs were made for fertilizing and irrigation processes, respectively. In the agricultural spraying process, a 30 man labor unit was used 317.50 $ ha^{-1} labor costs, 141.10 $ ha^{-1} machinery costs, 481.30 $ ha^{-1} input costs were made. The transport process was done by the rented vehicles, and a total of 427.70 $ ha^{-1} transport costs were made.

Table 1: Costs of the agricultural processes in cherry production

Agricultural processes	Labor (MLU ha^{-1})	Costs ($ ha-^{1})			Total cost ($ ha^{-1})
		Labor cost ($ ha^{-1})	Machinery cost ($ ha^{-1})	Input cost ($ ha^{-1})	
Tillage	38.30	473.10	157.40	0.00	630.50
Fertilizing	20.00	158.70	0.00	443.60	602.30
Irrigation	10.00	105.80	0.00	198.80	304.60
Agricultural spraying	30.00	317.50	141.10	481.30	939.90
Weeding	9.60	264.60	0.00	0.00	264.60
Pruning	21.10	176.40	0.00	0.00	176.40
Harvesting	192.00	2032.40	0.00	0.00	2032.40
Transport	0.00	0.00	427.70	0.00	427.70

The cost items were examined under variable and fixed cost items. Total production cost items of cherry production are given in Table 2. Total production costs were calculated as 8121.04 $ ha^{-1}. It was determined that 69.54% of the total costs were variable costs, whereas

30.46% were fixed costs. Harvesting was determined as the most significant cost item with a ratio of 25.03%, as it was done by entirely human labor. Interest in bare land value, agricultural spraying, and facility costs depreciation followed the harvesting process with 19.55%, 11.57%, and 8.36%, respectively.

When the ratios of the variable costs were examined in the researches related to the cherry production in different regions of Turkey, it was determined that the ratios of variable costs in total production costs were 55% in İzmir-Kemalpaşa (Adanacıoğlu, 2012), 65.44% in Isparta (Demircan and Aktaş, 2004), 72.19% in Tokat (Balcı et al. 2016), 62.24% in Çanakkale (Aydın et al. 2016).

Table 2: Cherry production costs ($ ha^{-1})

Costs	Total cost ($ ha^{-1})	Ratio (%)
Tillage	630.50	7.76
Fertilizing	602.30	7.42
Irrigation	304.60	3.75
Agricultural spraying	939.90	11.57
Weeding	264.60	3.26
Pruning	176.40	2.17
Harvesting	2032.40	25.03
Transport	427.70	5.27
Revolving interest	268.92	3.31
Variable costs	**5647.32**	**69.54**
General administration expenses	169.42	2.09
Interest on bare land value	1587.30	19.55
Machine-tool depreciation	14.10	0.17
Machine-tool interest	7.00	0.09
Facility costs depreciation	679.00	8.36
Facility costs interest	16.90	0.21
Fixed costs	**2473.72**	**30.46**
Production costs	**8121.04**	**100.00**

Production costs and profitability in important cherry production regions in Turkey were put forward in the study carried out by Çelik et al. (2020). The study conducted in the Aegean region (İzmir, Manisa, Kütahya, and Denizli) determined that harvesting cost had the highest ratio within the production costs 25.82% and 1388.99 $ ha^{-1} expense. The variable costs were 5322.57 $ ha^{-1}, the fixed costs were 2020.81 $ ha^{-1}, and the shares of the variable and fixed costs in total production costs were calculated as 72.5% and 27.5%, respectively.

The study conducted in the Marmara region (Bursa, Bilecik, and Çanakkale) determined that harvesting cost had the highest ratio within the production costs with 27.09% 1251.4 $ ha^{-1} expense. Therefore, the variable costs were 4850.44 $ ha^{-1}, the fixed costs were 1968.95 $ ha^{-1}, and the shares of the variable and fixed costs in total production costs were calculated as 67.7% and 32.3%, respectively.

The variable and fixed costs were 4666.13 $ ha^{-1} and 4364.37 $ ha^{-1}, and the shares of the variable and fixed costs in total production costs were calculated as 51.7% and 48.3%, respectively Afyonkarahisar and Isparta provinces. It was determined that harvesting cost had the highest ratio within the production costs, with 32.54% in Amasya and Tokat provinces. The variable costs were 2688.18 $ ha^{-1}. The fixed costs were 2796.29 $ ha^{-1}, and the shares of the variable and fixed costs in total production costs were calculated as 49% and 51%, respectively, in cherry enterprises in Amasya and Tokat provinces. It was determined that irrigation cost had the highest ratio within the production costs with 19.71% and 1709.34 $ ha^{-1} expense in Konya, Karaman, and Niğde provinces. The variable and fixed costs were determined as 9105.82 $ ha^{-1} and 5334.03 $ ha^{-1}, respectively. The production costs in the Konya, Karaman, and Niğde provinces were higher than the other regions, and the shares of the variable and fixed costs in total production costs were 63.1% and 36.9%, respectively.

4.3. Economic analysis

Economic analysis results of cherry production are given in Table 3. The average cherry yield per hectare was determined as 13880 kg. The average cherry selling price was calculated as 0.65 $ kg^{-1}, whereas the gross production value was 9022 $ ha^{-1}. Production costs per kilogram were calculated by dividing the production costs by the production amount and average cherry production cost as 0.58 $ kg^{-1}. Gross profit and net profit values were calculated as 3374.68 $ ha^{-1} and 900.96 $ ha^{-1}. Both of the profitability indicators revealed the profitability of cherry production.

Table 3: Economic analysis of cherry production

Profitability indicators	Value
Variable costs	5647.32
Fixed costs	2473.72
Production costs ($ ha^{-1})	8121.04
Yield (kg ha^{-1})	13880.00
Selling price ($ kg^{-1})	0.65
Gross production value ($ ha^{-1})	9022.00
Gross profit ($ ha^{-1})	3374.68
Cherry cost ($ kg^{-1})	0.58
Net profit ($ ha^{-1})	900.96

4.4. Productivity analysis

Labor, capital, and total factor productivities were discussed within the productivity analysis (Table 4). Gross and net labor productivity values indicated the gross production value and net profit amounts obtained in return for 1 $ labor cost. Gross and net labor productivity were found as 2.56 $ and 0.26 $, respectively, in cherry production.

Another productivity indicator was capital productivity. In the enterprises, facility costs (investment) were taken as capital. Gross and net capital productivity values indicated the gross production value and net profit amounts obtained in return for 1 $ cherry orchard investment. Gross and net capital productivity were found as 0.44 $ and 0.04 $, respectively, in cherry production. These values indicated that 0.44 $ gross production value and 0.04 $ net profit were obtained in return for 1 $ cherry orchard investment. The other productivity indicator was total factor productivity in the research. Gross and net factor productivity indicated the gross production value and net profit amounts obtained in return for 1 $ of cost. In the enterprises, 1.11 $ production value was obtained in return for 1 $ of cost. In other words, 0.11 $ net profit was obtained in return for 1 $ of cost. These values showed that the return rate of the costs was 11%.

The profitability ratios in different cherry production regions should be examined to better evaluate the cherry production profitability in the research. Çelik et al. (2020) presented that the highest relative profit was 1.66 in the cherry enterprises in Amasya and Tokat provinces. The relative profit was 1.52 in the provinces in the Aegean region, whereas it was 1.36 in the provinces in the Marmara region.

Table 4: Productivity indicators in cherry production ($)

Productivity indicators	Value
Gross labor productivity	2.56
Net labor productivity	0.26
Gross capital productivity	0.44
Net capital productivity	0.04
Gross factor productivity	1.11
Net factor productivity	0.11

5. Conclusion

In the current situation, Turkey is the world leader in cherry production and takes place near the top in exporting. "Turkish Cherry" is a trademark and having competitive superiority in terms of international trade. Nevertheless, adverse conditions and inabilities in cherry production and exportation are the reasons for the decrease in performance. As a result of the research, it was observed that the producers had sufficient knowledge and experience, and the average age was 57.8. The migration of the young generation to the downtown affects the cherry production that has a craft production in a negative way. The highest amount in production cost was harvest cost. It was observed that there were severe problems in labor supply where the family labor was being used. Harvest labor was vital both for the quality of the present product and for the productivity of the next production season. Inappropriate labor causes loss in harvest, and it is necessary to make some training and publishing work on this issue. As the harvesting cost is high, it can be said that conversion to semi-dwarf cherry orchards, application, and investigation of developed pruning systems can be effective in decreasing the harvesting costs. Even though cherry production seems profitable in the region, it has lower profitability than the other regions, affecting the new cherry investments.

Arising the problems in production, marketing, and economy and developing suggestions for these problems will contribute to the producers and the region's economy.

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