

Economic analysis of almond production in Turkey: the case of Adıyaman Province

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Abstract

The aim of this study is to reveal the economic analysis of almond producing enterprises, and to make suggestions for the problems encountered in almond production. The primary data of the research were obtained by face-to-face interviews with 96 businesses producing almonds in the Besni region of the Adıyaman province during the 2020-2021 production period. The single product budget analysis was used to determine the cost and profitability of almond production in the examined enterprises. According to the research results; the average land width of the almond enterprises was determined as 71.70 da, the average tree age was 7.77 years, the average almond seed yield was 144.44 kg/da, and the average almond yield was 301.55 g. The production cost of 1 kg of almonds was 20.49 Turkish Lira (TL), the average sale price of almonds was 18.05 TL, and the profit margin of 1 kg of almonds was -2.44 TL. Gross production value was calculated as 3909.89 TL, gross profit as 2952.56 TL, absolute profit as 950.85 TL, and relative profit as 1.32. It was observed that, the number of trees that do not bear fruit and the number of plantations that have not reached productivity, negatively affect the profit margins of the producers.

Keywords: Almond. Production Cost. Gross profit. Adıyaman. Turkey.

1. Introduction

Almonds are economically significant crops whose cultivation areas have been increasingly expanding in recent years (Atlı et al., 2011). Until the 1990s, almonds in Turkey were primarily grown as hedge plants. However, with almonds fetching high prices in the market, in addition to government support through certified sapling programs; producers have

transitioned to cultivating them in orchards. According to the United Nations Food and Agriculture Organization (FAO), Spain ranks first in almond planting areas globally, with 744,470 hectares. Other significant countries include; the USA with 534,191 ha, Morocco with 219,013 ha, Tunisia with 213,471 ha, and Iran with 75,553 hectares. Turkey's planting area is 57,732 hectares. In 2021, the global almond production amount was 3.9 million tons. Over the last five years, the world almond production increased by 54%, although it saw a 4% decrease to 4.1 million tons in 2020. The USA is the leading producer with 2.1 million tons, accounting for the largest share of global almond production. Turkey contributes 4% of the world's almond production. In 2021, the global almond export value was \$5,390,674, with the USA exporting almonds worth \$3,381,672. The global almond import value in 2021 was \$5,360,395, with Germany being the largest importer at \$619,467. Turkey's import value in 2021 was \$111,232, a 16% decrease from \$133,272 in 2020 (FAO, 2022).

According to the Turkish Statistical Institute (TSI), Turkey's total almond production area expanded from 78,000 decares in 2004 to 632,663 decares in 2022, an eightfold increase. The number of almond trees rose from 3.45 million in 2004 to 21.2 million in 2022, a 295% increase over 18 years, with 13,616,290 of these being fruit-bearing trees. Turkey's almond production in 2022 amounted to 190,000 tons. Adıyaman leads Turkey in almond planting areas with 100,082 decares. In Adıyaman, the number of almond trees increased from 40,350 in 2004 to 3,158,112 in 2021. The total almond production in Adıyaman in 2021 was 39,109 tons. The districts with the highest production volumes were Kahta (25,382 tons), Besni (5,748 tons), Gölbaşı (2,893 tons), and other districts collectively producing 5,086 tons (TSI, 2023).

2. Literature Review

Research on almond production generally focuses on cost analysis, technical and economic efficiency, policy implementations, and marketing. Summaries of studies analyzing the factors influencing almond production are provided below.

Tursun et al. (2022) conducted a cost and profitability analysis of almond production in Adıyaman, highlighting the potential and current state of almond production in the region. Their research of the cost and profitability of almond orchards in Adıyaman revealed a benefit/cost ratio of 1.70, an internal rate of return of 28.74%, and a capital cost of 13.50%. The study concluded that almond production is highly profitable for regional producers and that almond orchards contribute positively to the regional economy.

An examination by Ukav et al. (2021) titled "Factors Influencing Almond Cultivation Decisions of Producers in Adıyaman Province," investigated the socio-economic characteristics of producers who grow almonds versus those who do not. The study compared the personal norms and future expectations of producers who transitioned to almond cultivation within the framework of the theory of planned behavior. The findings indicated that factors such as; meeting family consumption needs, utilizing idle lands, increasing income, and enhancing product diversity, positively influenced producers' decisions to switch to almond cultivation. Conversely, producers not engaged in almond cultivation cited the long maturation period of almond trees and the challenging maintenance of almond saplings as deterrents.

Akın and Kara (2021) addressed the challenges faced in organic almond cultivation in their analysis. They identified that the fruit worm significantly limits commercial production and that the most critical issue for almond orchards is the difficulty in finding hired labor. Although almond cultivation is not a new practice for regional producers, organic almond cultivation represents an innovation. The researchers emphasized the necessity of agricultural extension work to promote this innovation and raise awareness among producers in the research area.

In a study titled "Turkey Almond Production: General Analysis of Recent Changes," Aydoğdu and Şahin (2020) analyzed almond production in Turkey from 1988 to 2018 and provided solutions. They observed that with the increasing commercial value of almonds, planting areas have expanded recently. However, despite this expansion, agricultural practices that could increase production quantity and yield are not widely adopted. The study emphasized the necessity of enhancing public policies, support, and agricultural extension activities to promote these agricultural practices.

Expósito and Berbel (2020) conducted an investigation aimed at determining the optimal irrigation amount for almond orchards in the southern region of Spain. They noted that water use rights in Spain are stringent. Their findings emphasized that deficit irrigation and precision irrigation practices enhance water efficiency. They highlighted that full irrigation during the rainy winter and spring months significantly improves water use efficiency. Additionally, they pointed out that deficit irrigation strategies allow for more sustainable water use in water-scarce areas.

Gök et al. (2020) reviewed almond breeding research conducted in Turkey and globally, evaluating the findings from these studies. They observed that almond breeding in Turkey predominantly involves selection breeding. This is because almonds in Turkey are

mostly grown from seeds, resulting in limited genetic potential. In contrast, global breeding efforts focus on both selection and hybridization. The study highlighted that hybridization efforts in Turkey are weak, whereas globally, breeding programs have successfully developed functional varieties that bloom late, are self-fertile, and maintain desirable traits.

A doctoral research titled "A Study on Supply Chain Analysis of Almond Production in Balkh and Samangan, Afghanistan," by Khaliq (2020) examined the supply chain and cost structure of almond production in those regions. The research findings indicated that the primary strengths of the almond sector in the region are the extensive experience of farmers and their strong interest in almond cultivation. Significant opportunities included the adaptation of almonds to the region, and favorable climatic conditions. To increase the efficiency of almond production, it was recommended to focus on the effective utilization of labor, fertilization, and pest management. Additionally, the analysis suggested; ensuring the provision of agricultural inputs at affordable prices to farmers, implementing capacity-building programs, informing all stakeholders about input and product prices, increasing credit facilities, and supporting organization efforts among farmers.

In their research "Economic Analysis of Almond Production: A Case Study of Muğla Province, Turkey," Demircan et al. (2019) directed an economic investigation of almond production in Muğla, a province playing a significant role in Turkey's almond production. In the study; surveys revealed that the average size of almond plantations in the area was 17.05 decare, and the establishment cost for almond production was determined to be \$1,089.20 per decare. The analysis further broke down these costs, finding that 65.57% of the average establishment cost was attributed to variable costs, while 34.43% was attributed to fixed costs.

Yazar (2018) inspected almond production and marketing structures in the Eastern Mediterranean region of Turkey, and interviews were conducted with almond-producing enterprises. The research identified issues related to almond production and marketing in the region. It was determined that the marketing organization in the research area was weakened due to the limited variety of intermediary types. This limitation was found to undermine the marketing function for producers.

Zai et al. (2016) conducted a case study on almond production and export in Afghanistan, focusing on the country's cultivation area, productivity, and international trade. They employed the SWOT analysis to assess the strengths, weaknesses, opportunities, and threats of Afghanistan's almond industry. The research identified several strengths such as; the competitive nature of almonds in export markets, favorable climatic conditions for almond cultivation, and the ease of almond storage. Weaknesses included; quality and supply issues,

deficiencies in packaging and labeling practices, overall insufficient technical knowledge, and weaknesses in marketing organization.

The economic contributions and effects of the almond industry in California were examined by Sumner et al. (2014). The research highlights that increasing demand for California almonds has led to expanded production, triggering additional employment in processing, packaging, transportation, and other related sectors. In summary, the study underscores that the almond industry contributes significantly to the economy through direct and indirect means such as added value, employment for thousands of individuals, and billions of dollars in income.

Eldoğan et al. (2014) emphasized the high potential of almond cultivation in Turkey. They highlighted the importance of breeding programs to develop local almond varieties and stressed the need for increased production and expansion of cultivation areas to meet rising domestic and international market demands. The authors underscored that enhancing almond production in Turkey is crucial not only for meeting market demands but also for establishing a stronger presence in international trade. They advocate for efforts aimed at expanding almond cultivation areas as a means to achieve these objectives.

3. Materials and Methods

The primary material of the research consists of primary data obtained from face-to-face surveys conducted with almond producers in villages of the Besni district, in the Adıyaman province. The survey was conducted in 2021, and a total of 96 almond producers were interviewed. The villages where the survey would be conducted were determined based on the Farmer Registration System (ÇKS) data of the Besni District Directorate of Agriculture and Forestry in Adıyaman province, by identifying almond planting areas and creating a sample village framework. Accordingly, the Purposive Sampling Method was used to determine the villages where the survey would be applied, and the Stratified Random Sampling Method was used to determine the sample size (Oğuz, 2017).

The formulas used to determine the sample size are provided below:

$$n = \frac{(\sum N_h * S_h)^2}{N^2 * D^2 + \sum N_h * S_h^2} \quad (1)$$

In the formula:

n = sample size,

N = total number of units in the population,

N_h = number of units in stratum h ,

S_h = standard deviation of stratum h ,

S_h^2 = variance of stratum h ,

$D^2 = z^2/d^2$,

d^2 = permissible error amount from the population mean,

z^2 = value from the distribution table for the permitted confidence limit.

The sample size was calculated using the Neyman method with the following formula (Çiçek and Erkan, 1996; Yamane, 2010):

$$nh = \frac{N_h * S_h}{\sum N_h * S_h} * n \quad (2)$$

By using these formulas, the study achieved highly representative and valid results.

In addition to almond production, various other by-products are produced in the enterprises surveyed within the research. Therefore, only almond production was calculated to determine production costs and profitability, and a single product budget analysis was conducted. The expenses incurred during the production period were classified as variable costs and fixed costs and were presented as expenses per decare. Variable costs were calculated by considering input costs, labor costs, temporary labor, and working capital interest. Fixed costs consisted of land rent, establishment depreciation, establishment capital interest, family labor, and general administrative expenses. Production costs were obtained by summing variable and fixed costs. The prices of the 2021 season were used in calculating the costs. The labor wages of farmers and family members were calculated based on the current period and the wages paid to foreign labor in the region (Kıral, 1999). The working capital interest was calculated by taking half (9%) of the credit interest rate (18%) applied by T.C. Ziraat Bank for plant production. General administrative expenses were obtained by taking 3% of the variable costs in almond production (Açıl, 1977). It is a common practice in Turkey to calculate general administrative expenses as 3% of variable costs when calculating the costs of agricultural products (Keskin and Dağıstan, 2022). The cost of almond production

was calculated by multiplying the almond yield by the sales price. In the economic evaluation of almond enterprises, gross production value, gross profit, absolute (net) profit, and relative profit were calculated. The useful economic life of the almond tree is reported as 30 years by the Turkish Revenue Administration, and depreciation expenses for the establishment were calculated based on this determined economic life (TRA, 2022).

4. Results and Discussion

The almond production values and foreign trade figures for Turkey and the world are presented in Table 1. As of 2022, a total of 3.6 million tons of almonds were produced on 2,357,075 hectares globally. In the same year, Turkey produced 190,000 tons of almonds on 63,266 hectares. As of 2022, it is observed that Turkey's almond import value is higher than its export value. In 2022, the export value of almonds was 142 million USD, while the import value was approximately 223 million USD. There are fluctuations in Turkey's almond export values, whereas the import value shows an increasing trend over the years.

Table 1: Almond production and foreign trade in the World (2022)

Data	World	Turkey	Ratio (%)
Area (ha)	2,357,075	63,266	2.68
Production Quantity (tons)	3,630,428	190,000	5.23
Yield (100 gr/ha)	15,402	30,032	-
Import (thousand \$)	6,705,354	222,626	3.32
Export (thousand \$)	6,909,571	142,112	2.06

Source: FAO, 2024.

4.1. Findings about the research area

The age range of the almond producers interviewed within the research was found to be between 23 and 80 years, with an average age of 52.20. Khaliq (2022) found the average age of almond producers in the Balkh and Samangan provinces of Afghanistan to be 45.13. Among the almond producers participating in the study, 3.10% had no education, 41.72% had primary education, 11.50% had secondary education, 29.20% had high school education, and 14.60% had university-level education. The average number of family members in the surveyed enterprises was calculated as 5.00 people. Demircan et al. (2019) reported the average number of family members of almond producers as 3.46. The average experience of producers in almond cultivation was 7.90 years, with 20.80% having 1-4 years of experience, 61.50% having 5-10 years of experience, 14.60% having 11-16 years of experience, and

3.10% having more than 20 years of experience. Akın and Kara (2021) stated that the experience of almond producers in almond cultivation was approximately 6.40 years, while Demircan et al. (2019) reported it as 37.63 years. The average area of enterprises engaged in almond production was 72.00 decares. Demircan et al. (2019) found the average farm size of almond producers in the Muğla province to be 17.05 decares. In the research area, the average yield per decare was found to be 144.44 kg/da, while the average yield per tree was 3.06 kg (Table 2).

Table 2: Almond farms and their features

Features	Mean
Age (year)	55.20
Experience in almond production (year)	7.90
Population (person/family)	5.00
Age of businesses	7.70
Almond land size (da)	71.70
Almond tree age	7.77
Yield per decare	144.44
Yield per tree	3.06

The proportion of producers who have participated in any training related to almonds is 21.90%, while the proportion of producers who have not participated in any training is 78.10%. Ukav et al. (2011) reported that 16% of almond producers in the Adıyaman province stated they had received training related to almonds. The membership status of almond enterprises in organizations was found to be 75% yes and 25% no.

Kernel yield of almonds refers to the amount of kernel obtained from the hard-shelled fruit. The kernel yield is calculated as follows: $\text{Kernel yield} = 100 \times \text{kernel weight (g)} / \text{hard-shelled fruit weight (g)}$ (Anonymous, 2022). The sale is expressed in grams per 1 kg of almonds, the average yield is determined, and the sale prices are found based on the yield. In the research area, the average almond kernel yield was determined to be 301.55 grams (Table 3).

Table 3: Almond kernel yield rates of the research area

Almond kernel yield	Ratio (%)
250-300 gr	58,00
301-310 gr	12,50
311-400 gr	29,50
Total	100.00

In the research area, it was observed that the use of family labor was low, with the average working time per decare found to be 3.54 hours. The cost of hired male labor per unit area was calculated as 37.20 TL, female labor as 16.25 TL, and the total hired labor as 72.25 TL. The average daily wage paid to women was 958.52 TL, while the average daily wage paid to men was 2188.85 TL. The average workforce size for hired female and male labor in the enterprise was 18 individuals, with an average daily wage paid of 4,925.52 TL. (Table 4).

Table 4: Hired labor use in the research area

Use of hired labor	Average number of hired labor (Units)	Average daily wage paid (TL)	Costs per unit area of hired labor (TL/da)
Male	11.95	2,188.85	37.20
Woman	31.06	958.52	16.25
Average foreign labor force	18.00	4,925.52	72.25

*1 USD=8.89 TL (2021)

4.2. Cost of almond production in the surveyed enterprises

The cost of almond production for the surveyed enterprises is presented in Table 5. Variable costs were 957.33 TL/da, accounting for 32.35% of the total production costs. Fixed costs were 2001.71 TL/da, accounting for 67.65% of the total production costs. The total production cost was 2959.04 TL/da. Tursun et al. (2022) reported that for almond producers in the Adıyaman province; the depreciation share of the establishment was 561.24 TL/da, the share of maintenance and harvest costs per unit area was 28.02%, the share of fixed cost elements was 71.98%, and the total production costs were 4004.70 TL/da. Erkuş (2021) found that the total variable costs for almond producers in the Diyarbakır province were 807 TL/da, the total fixed costs were 697 TL/da, and the total production cost was 1504.00 TL/da. Based on the information obtained from the research area, the cost of producing 1 kg of almonds was calculated by dividing the total almond production costs of the enterprises by the amount of almonds produced. Accordingly, the average almond yield of the enterprises was 144.44 kg/da, and the average cost of producing 1 kg of almonds was found to be 20.49 TL. The average selling price of 1 kg of almonds was determined to be 18.05 TL, resulting in a profit margin of -2.44 TL per kg of almonds. The negative profit margin of -2.44 TL per kg of almonds was attributed to the high number of non-fruiting trees and immature plantations in the region. The average age of the orchards in the research area was 7.77 years. Oğuz et al. (2011) concluded in their study on almond cultivation, production, and marketing potential in

the southeastern provinces; that the low yield in the region was due to inadequate cultural practices and the fact that new plantations had not yet reached economic yield.

Table 5: Distribution of almond production costs per unit area (TL/da)

Almond Production Costs	Cost Per Decare (TL/da)	Ratio (%)
Input Costs		
Manure	200.88	6,79
Fertilizer	132.72	4,49
Water	121.75	4,11
Fuel	39.74	1,34
Labor Costs		
Fertilizing	10.05	0,34
Spraying	17.27	0,58
Watering	8.15	0,28
Tillage (Version)	43.91	1,48
Care (Pruning, thinning, hoeing, grafting)	36.02	1,22
Other Costs (Marketing, storage, packaging, etc.)	17.02	0,58
Harvest	178.5	6,03
Temporary Labor	72.26	2,44
Revolving Fund Interest (9%)	79.06	2,67
A- Total Variable Costs	957.33	32,35
Land Lease	1161.53	39,25
Plant Depreciation	537.00	18,15
Facility Capital Interest (4%)	32.22	1,09
General Administration Expenses (3%)	28.72	0,97
Permanent Family Workforce	242.24	8,19
B- Total Fixed Costs	2001.71	67,65
C- Total Production Costs	2959.04	100
D- Almond Production Yield (kg/da)	144.44	
Almond Sales Price (TL/kg)	18.05	
Almond Production Cost (C/D) (TL/kg)	20.49	
Almond Profit Margin (TL/kg)	-2.44	

*1 USD=8.89 TL (2021)

The profitability indicators of almond production per unit area in the surveyed enterprises are presented in Table 6. The gross production value was 3909.89 TL, the gross profit was 2952.56 TL, and the absolute profit was 950.85 TL. The relative profit was calculated as 1.32 TL. Gül and Poyraz (2023) calculated the profitability of apricot production and determined the gross production value as 20,245.77 TL, the gross profit as 17,191.00 TL, the absolute profit as 14,296.20 TL, and the relative profit as 3.38 TL according to the regional average per unit area.

Table 6: Profitability indicators in the businesses

Indicators	(TL/da)
GPV	3,909.89
Gross Profit	2,952.56

Absolute Profit	950.85
Relative Profit	1.32

4.3. Problems in almond production

According to the findings from the research area, the problems faced by almond-producing enterprises were tested using a five-point Likert scale. The most significant issues faced by producers in production were identified as the high cost of agricultural inputs (seedlings, diesel, fertilizers, pesticides, irrigation, and electricity) (4.84), low almond sale prices (4.32), and frost damage during the flowering period (4.18) (Figure 1). The almond tree blooms earlier than many other temperate fruit species, and while it is resistant to winter cold before blooming, late spring frosts are of greater concern for almonds. Therefore, as identified by the producers, in areas where late spring frosts are consistently observed, a balanced yield cannot be achieved. Each year, the Besni district faces frost and icing during the spring period, which reduces the yield of almonds and other agricultural productions.

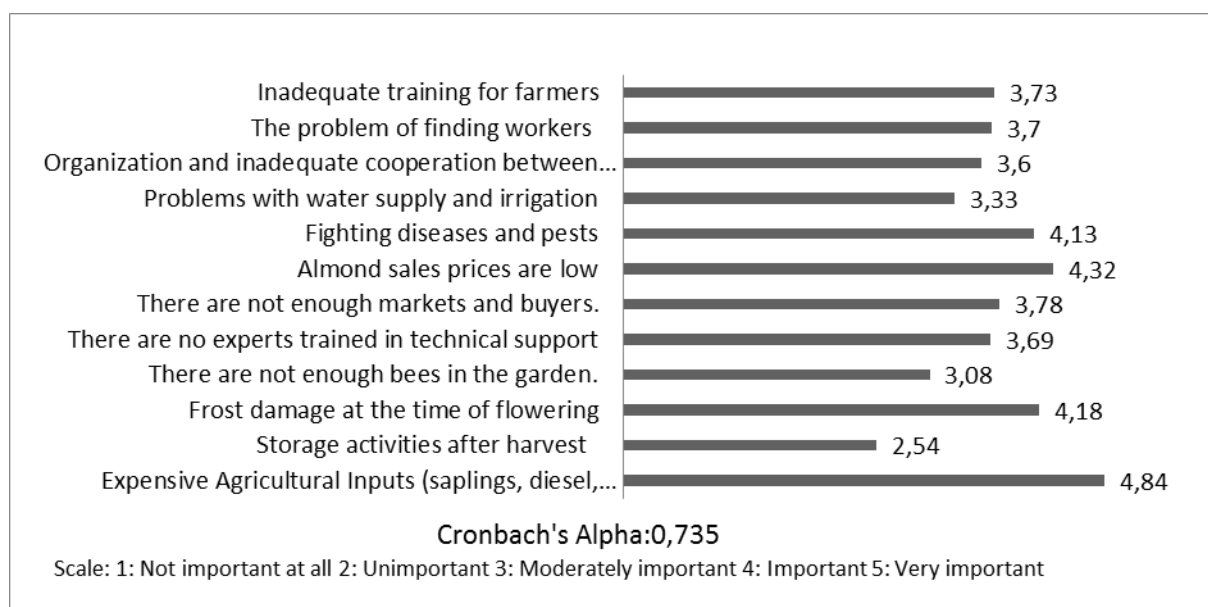


Figure 1: Problems in Almond Production

5. Conclusion and Recommendations

Turkey is one of the leading almond producers in the world, accounting for 5.23% of global almond production as of 2022. This study provides an economic analysis of almond production in Adıyaman, one of Turkey's most important agricultural regions. In the research area, the average age of producers was calculated as 52.20 years, and the average experience

in almond production was 7.90 years. The average family size was 5 members, and it was found that 75% of the producers were members of an agricultural organization. The rate of producers who received training on almond production was found to be 21.90%. The average almond production area was 72 decares, the average yield per decare was 144.44 kg/da, and the average yield per tree was 3.06 kg.

The use of family labor in the enterprises was quite low. The share of variable costs in the total production costs was calculated as 32.35%, while the share of fixed costs was 67.65%. The cost of producing 1 kg of almonds was determined to be 20.49 TL, with a profit margin of -2.44 TL per kilogram. Additionally, the high number of non-fruiting trees and immature plantations negatively affected the profit margins of producers. However, in the coming years, as almond trees reach their full productive age and yield per decare increases, almond production is expected to become more profitable.

The rapidly increasing prices of agricultural inputs due to sharp fluctuations in exchange rates in recent years pose a significant threat, exerting downward pressure on profit margins. By adopting sustainable agricultural practices, reducing the use of chemicals, using natural resources more efficiently, and lowering input costs, almond producers can improve their economic outcomes. It is crucial to revise and update agricultural subsidies according to the current prices.

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