Economic efficiency of cotton production in Turkey

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Abstract

Cotton production, which has strategic significance, is vital to the Turkey's economy. The purpose of this research is to determine profitability of cotton production and economic efficiency of cotton farms. The main material of the research consists of the data obtained from the face-to-face interviews conducted with 165 producers in Şanlıurfa province, where cotton production is most intense in Turkey. According to the findings, the average cotton cultivation area was found to be 16.3 ha, with the average yield at 5357.2 kg/ha. Cotton production cost was calculated as 0.61 $/kg. The average selling price of cotton, including supports is 0.76 $/kg. The gross production value is 4086.27 $/ha, and gross profit is 1697.28 $. The profit margin per kilogram is found to be 0.15 $/kg, with a proportional profit of 1.25. As a result, it has been determined that in the case there is no agricultural support for cotton production, profit cannot be made and, in fact, producers will be at a loss. Moreover, increased agricultural support for cotton production, which is more difficult and toilsome compared to alternative products, will increase producers' interest in the product. According to CRS, Mean Economic Efficiency (EE) score was 0.88 for the economicially inefficient farms (n=55) compared to a mean score of 1.000 for the EE farms (n= 110). Inefficient farms' hoeing cost is 27.2%, irrigation cost is 12.6%, harvesting cost is 11.4%, soil preparation cost is 10.7% more than efficient farms. Efficient farms earn 17.5% more income and receive 11.2% more agricultural support than inefficient ones. Additionally, training on production techniques and production economy to be provided by relevant public institutions, will contribute to the conscious use of inputs and reduce cost. The continuity of cotton production can be ensured as long as the producer makes a profit.

Keywords: Cotton. Economic effiency. Profitability.

1. Introduction

The cotton is a strategic product that contributes greatly to the country's economy with its wide usage area, as well as the added value and employment opportunities it creates. These features contribute to the development of agriculture and industry in areas where cotton is cultivated (Anonymous, 2018).

According to 2019 data, world cotton production is approximately 82.6 million tons. The top five cotton producing countries are China (23.5 million tons), India (18.5 million tons), America (13.0 million tons), Brazil (6.9 million tons), and Pakistan (4.5 million tons), respectively. These five countries meet 80.4% of the total cotton production. Turkey, ranking seventh in world cotton production, meets 2.7% of world production (FAO, 2019).

Turkey has an important place in the production of cotton, an important fibre plant, in terms of its geographical features. However, the current production is unable to meet the total cotton demand. Thus, efforts are made to cover this deficit through raw material, thread, and fabric imports (UPK, 2018). According to the Turkish Statistical Institute's data, 1.77 million tons of cotton were produced in Turkey across an area of approximately 3.6 million decares in 2020. In the last decade, cotton cultivation area decreased by approximately 33.7%, and the production amount decreased by 31.3%. Cotton is produced in 23 provinces across Turkey. Şanlıurfa, Aydın, Hatay, Diyarbakır, and İzmir provinces are areas that have the most cotton cultivation. Şanlıurfa province meets 36.1% of the total cotton cultivation area with approximately 1.3 million decares, and 32.1% of the total cotton production with 567,300 tons of cotton production (TSI, 2020). Şanlıurfa province became an important center in cotton production with the plains that opened to irrigation within the scope of the Southeastern Anatolia Project (GAP) (Deepayan et al., 2016).

The production of the cotton, which has strategic importance worldwide, is labour intensive and costly. In studies conducted to determine the cost and profitability of cotton production in Turkey, it has been determined that either profitability is very low (Yılmaz and Demircan, 2005; Yılmaz, 2012; Yılmaz and Gül, 2015) or that production turns a loss, and profitability is achieved through agricultural supports only (Alemdar et al. 2014; Candemir et al. 2017; Semerci and Çelik, 2018). Producers making production in 2021 are given 0.12 $/kg deficiency payment (premium) support for seed cotton within the scope of Turkey's agricultural basins production and support model. Another support given to seed cotton is diesel (69.9 $/ha) and fertilizer (4.51 $/ha), which fall into the field-based support category (Official Gazette, 2021). The highest input support among plant products is given to cotton. In Turkey, cotton farmers receive an average of 667.21 $/ha (4940 kg/ha*0.12 $/kg+74.41 $/ha) agricultural support in a traditional production. While the agricultural support given is considerably higher than the support given to other plant products, it reveals once more the importance of cotton production for the country.

Observing the changes over the years in the production inputs of the cotton produced in the research area necessitates cost analysis. This research thus aims to determine the physical production inputs, cost and profitability and economic efficiency of cotton farms in Şanlıurfa, the province having the highest cotton production in the country.

2. Literature Review

The most important cost items in cotton production are labor costs, machinery power cost (Yılmaz et al., 2005; Yılmaz, 2012; Uğurlu, 2020), land rent and pesticide costs (Yılmaz et al. 2005). In recent years, machine harvesting has taken the place of manual harvesting, which was previously used extensively in cotton harvesting in Turkey. While Güneş (1993) stated in his research with cotton producers in the Çukurova region that an average of 63.99 hours of labor was used in cotton production, Semerci and Çelik (2017) was determined that an average of 2.67 hours of manpower was used in cotton production with the effect of machine harvesting.

Çelik and Bayramoglu (2007) found that insecticide use is high, irrigation numbers are low, labor force and machine drawing power are used effectively enough in cotton cultivation in the Harran Plain of Sanlurfa province. It was determined that an average of 2.62 kg of seeds, 64.88 kg of fertilizer and 0.85 lt of pesticides were used for one decare of cotton production in hatay province (Semerci and Çelik, 2007). An average of 50.8 kg of chemical fertilizer and 2.43 kg of seeds were used for 1 decare of cotton production and an average of 5.4 agricultural spraying was done in Antalya (Yılmaz and Gül, 2016).

Yılmaz and Demircan (2005) established in the study they conducted in the Adana, Şanlıurfa, Antalya, Aydın, Hatay, and İzmir province, where cotton production is intense, the highest yield was in Hatay province, and the lowest yield in Aydın province, while the difference between the highest and lowest average cotton yield was 18.5%. The production cost of 1 kg of cotton is highest in Antalya province and the lowest in Şanlıurfa province. Şanlıurfa province has the highest net profit to gross production ratio, followed by Hatay, İzmir, Adana, and Aydın provinces, respectively. In another study conducted in Antalya, it was determined that the income of the producers in cotton production did not cover the production costs (Yılmaz et al. 2005). In the study conducted in the Çukurova region, the gross profit and relative profit of cotton; wheat, the first and second crop corn, were determined to be the lowest compared to sunflower (Alemdar et al. 2014). For the development of cotton production; it is necessary to reduce input costs, increase incentive premiums and increase other supports in cotton (Yılmaz and Gül, 2015).

In a study conducted by Zahedi et al. (2014) in Isfahan, Iran, it was established that total cost and gross values are \$1927.93 and \$2359.21 ha^{-1}, respectively, and approximately 67% of the total cost is variable costs. They found that the cost-benefit ratio is 1.22, and the net return is \$431.29 ha^{-1}.

In the study Siamardov (2020) conducted in Tajikistan, he calculated the average yield in cotton production as 2200 kg/ha, gross production value as \$1232/ha, gross profit as \$664.42/ha, and net profit as -\$88.88/ha. Meanwhile, Ugurlu (2020) determined in his study on cotton producers in Manisa province that the average yield is 569.1 kg/da, the most important cost items are labor expenses (36.64%) and input cost (19.29%), respectively, while gross production value is 2.69 TL/da, and the cost of cotton production per kilogram is 2.17 TL.

Binici et al. (2006) found that 78% of cotton farms in Harran Plain had a pure technical efficiency score of over 90% and the lowest productivity rate was 74%. Gul et al. (2009) in their research with cotton producers in Çukurova region, 20.3% of the farms were found to be fully effective according to CRS and 23.9% according to VRS. The average efficiency ratio in cotton farms was found to be 0.79. Farmers can make the same production by reducing their input costs by 21%.

The average technical efficiency score for cotton producers in West Africa is 80%, with scores ranging from 15% to 98 percent (Theriault and Serra, 2014). According to the findings in Texas, Irrigated farms are 80% efficient, while nonirrigated farms are 70% effective. Irrigated farms might save 10% on other inputs, while nonirrigated farms could save 12% and 13% on machinery and labor, respectively, while producing the same amount of output (Chakraborty et al. 2002). Technical efficiency on individual farms in Ghana ranged from 0.70 to 0.99, with a mean of 0.88 (Adzawla et al. 2013). Cotton farms specific technical, allocative and economic efficiency on average were 0.80, 0.94 and 0.76 in Punjab, Pakistan (Ahmad and Afzal, 2020). Cotton's estimated mean efficiency score is 83%, implying that producers may cut their costs by 17% to become the most efficient cotton growers in Punjab.

According to the study, fertilizer expenses have the largest coefficient, reducing cotton growers' efficiency, so special attention should be paid to fertilizer use to cut costs (Zulfiqar et al. 2021). Kumar et al. (2019) found that in Palwal district of Haryana (India) Cotton production on large farms was more productive and profitable than on small and medium farms.

Previous studies showed that studies on the economic efficiency of cotton production were very limited. The studies mostly aimed to determine the technical efficiency in cotton production. In order to fill this gap in the literature, it was aimed to determine the economic efficiency in cotton production in this study.

3. Material and Method

3.1. Material

Şanlıurfa province, located in the Southeast Anatolian region, is bordered by Mardin province in the east, Gaziantep province in the west, Adıyaman province in the north, and Syria in the south. Şanlıurfa province has a surface area of 18.765 km². It is the seventh biggest province in Turkey in terms of surface area. The province has a central altitude of 518. The land, featuring wide plains and flatlands, consists of 60.4% plateau, 22% mountainous area, 16.3% plain, and 1.3% tablelands. Harran, Suruç and Viranşehir plains are located in the south of the province. The Euphrates is the most important river. Atatürk Dam Lake is the third largest lake in Turkey. The climate in the province is predominantly continental. The most important agricultural products are wheat, corn, cotton, and barley (Anonymous, 2021).

The main material of the study consists of data obtained from the interviews conducted with the cotton producers in Şanlıurfa province, which produces the most cotton in Turkey, covering 35.8% of the total cotton production area, and 32% of the production quantity. The sample volume was determined by using the proportional sampling method (Newbold, 1995). There are 17,504 cotton producers in the research area (Anonymous, 2017). Accordingly, the sample size was calculated as 165 for the 99% confidence interval and 10% error margin.

$$n = \frac{\mathrm{Np}(1-\mathrm{p})}{(\mathrm{N}-1) * \sigma_{px}^2 + p(1-p)} = 165$$

In the formula; n: Sample volume, N: Population (Number of producers), σ^2_{px}: The variance of the ratio, p: the ratio of cotton producers (p= 0.5 to reach the maximum sample volume).

The interviews cover the 2017 production period. The interview was conducted in Bozova, Eyyübiye, Haliliye, Harran, Suruç and Viranşehir districts, where cotton production is intense (Figure 1).

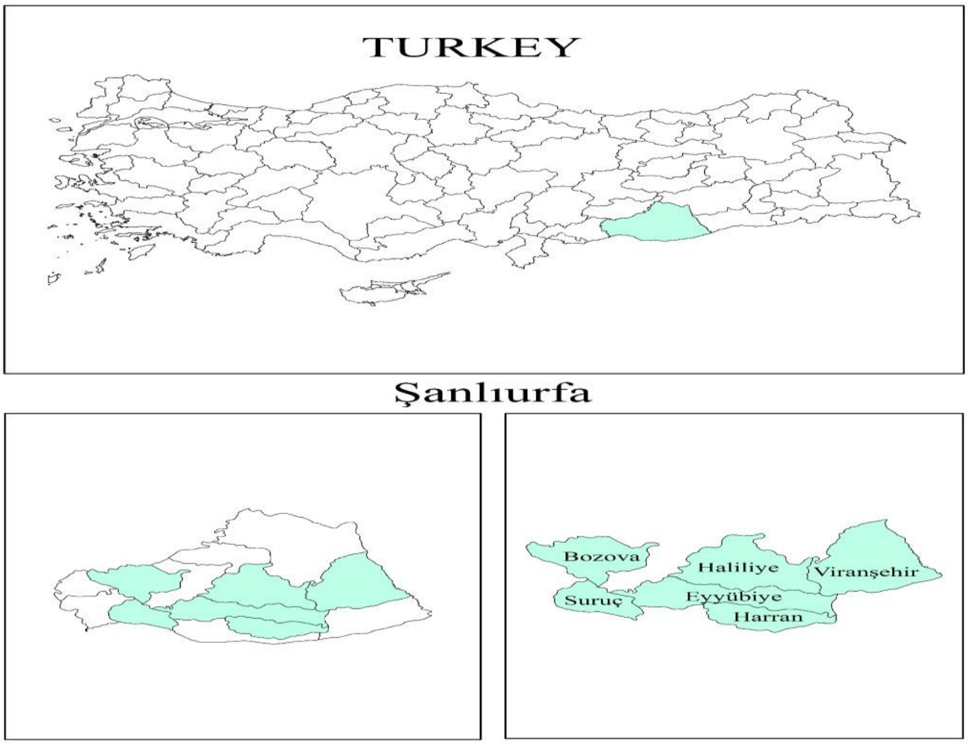

Figure 1: Research area

3.2. Method

Descriptive statistics, the single product budget analysis and Data Envelope Analysis (DEA) were used in the analysis of the data.

The single product budget analysis method used by Kıral et al. (1999) was used to calculate the cost of agricultural enterprises involved in cotton production. Operating cost and income were calculated for the field crops grown as well. While calculating the family labor force, the foreign labor wage, which is valid in the research area, was taken into account. Labor charges were also added to the expense items. The revolving fund interest rate was calculated based on half (5%) of the 2017 Ziraat Bank interest rate, and the general administration expenses were calculated based on 3% of the total variable costs. Variable costs were calculated by summing up the soil preparation, planting, hoeing, fertilization, spraying, irrigation, harvesting cost, and revolving fund interest rates. Fixed costs were found with the sum of general administrative income and land rent. The sum of production cost was obtained with the sum of variable costs and fixed costs. The gross production value was calculated by multiplying the cotton yield by the selling price, with the addition of supports to this value. Gross profit is obtained by subtracting the variable costs from the gross production value found. Net profit, on the other hand, was calculated by subtracting the production cost from the gross production value. Proportional profit was obtained by dividing the gross production value by the production cost.

Fixed costs = general administration expenses + land rent

Sum of production cost = Variable costs + Fixed costs

Gross production value = Yield * selling price + supports

Gross profit = Gross production value – Variable costs

Net profit = Gross production value - Sum of production cost

Proportional profit = Gross production value / Sum of production cost

Data envelopment analysis was used to determine the economic efficiency in cotton production. The model is tested under constant returns to scale (CRS) and variable returns to scale (VRS) situations to reduce operating costs. Input orientation was used to determine the return to scale (Charnes et al., 1978). Input-oriented work aims to minimize the input levels used for the production of this output in order to achieve a certain output. Assuming that there are N inputs and M outputs for an enterprise I in the model, vector x_i and q_i is determined for each enterprise. For each enterprise data, *MxI* creates the output matrix, while *NxI* represents the input matrix of the enterprise. The formula to minimize the inputs is given below.

Subject to $Min_{\theta,\lambda}\, \theta, \quad -qi + Q\lambda \geq 0$

$$\theta xi - X\lambda \geq 0$$

$$\lambda \geq 0,$$

In the CRS model, θ represents a scale, while λ represents a vector *(Ix1)*. The model uses inputs and outputs to minimize X_i inputs (Xλ, Qλ) and generate a new efficiency score (θ). Calculated efficiency scores range from 1 to zero ($0 \leq \theta \leq 1$). Also, the VRS model studied by Banker et al. (1984) is more tolerant for some inefficient businesses.

Using the convexity constraint ($I1'\lambda=1$), it adds a new constraint λ ≥ 0 and argues that the increase in output will not always be proportional to the increase in input, businesses cannot always operate at optimum scale, and generally calculates new efficiency scores higher than CRS.

In this study, it was determined that 7 inputs and 2 outputs were obtained in cotton production enterprises in DEA. In the determination of the inputs and outputs, the activities realized in a production period were taken as a basis and all the inputs and outputs of the enterprises within this period were transferred to the analysis.

Inputs and outputs were X_1 Soil Preparation cost (TL/ha), X_2 Planting Cost (TL/ha), X_3 Fertilization Cost (TL/ha)I X_4 Spraying Cost (TL/ha), X_5 Hoeing Cost (TL/ha), X_6 Harvesting Cost (TL/ha), X_7 Irrigation Cost (TL/ha), Y_1 Gross Production Value (except supports) (TL/ha) ,Y_2 Agricultural Supports.

The data were analyzed with the Frontier program, and the economic efficiency of all farms was calculated, and suggestions were made to the inefficiently operating farms by estimating the optimum input levels that would make the farms effective.

4. Results and Discussion

Information on the socio-demographic characteristics of the producers interviewed is given in Table 1. The average age of producers is 47.5 years. Majority of the producers (38.2%) are 51 years old and over, 91.5% of the producers are male and 89.1% are married. The most of cotton producers (63.6%) received 5 years or less education and the average education period was 5.8 years. The agricultural production experience of the producers is 24.1 years on average. The average number of households is 7 people, and 45.5% of them have 6-9 people in their family. The average number of people engaged in agriculture in the family is 4.58, and 49.1% of the producers have non-agricultural income

Table 1: Socio-demographic characteristics of the individuals interviewed

Demographics Properties	**Frequency**	**%**	**Demographics Properties**	**Frequency**	**%**
Age (years)			**Education (years)**		
≤ 40	49	29.7	≤ 5	105	63.6
41-50	53	32.1	6-10	38	23.0
≥ 51	63	38.2	≥ 10	22	13.4
Total	165	100.0	Total	165	100.0
Gender			**Marital status**		
Female	14	8.5	Single	18	10.9
Male	151	91.5	Married	147	89.1
Total	165	100.0	Total	165	100.0
Experience of farmers (years)			**Number of people in the household**		
1-20	73	44.2	≤ 5	57	34.5
21-30	41	24.8	6-9	75	45.5
31-50	51	31.0	≥ 10	33	20.0
Total	165	100.0	Total	165	100.0
Number of people in agriculture in the household			**Non-agricultural income**		

1-4	86	52.1	No	84	50.9
5-7	54	32.7	Yes	81	49.1
8-15	25	15.2	Total	165	100.0
Total	165	100.0			

The farms in the research area have an average land width of 21.6 hectares, 72.6% of the lands consist of property, 18.7% were rented, and 8.7% were cultivated under sharecropping. In addition, 95.2% of the cultivated land consists of irrigated lands. The most produced products by producers were cotton (75.4%), wheat (9.8%) and corn (6.0%), respectively, while the least produced were sugar beet (0.5%), pepper (1.4%), and barley (2.1%), respectively. In a study conducted in Harran Plain, Şanlıurfa province, the cultivation land consisted of 72% cotton, 19% wheat, 7% corn, 2% vegetable, and 0.8% soybeen (Çelik and Bayramoğlu, 2007).

Table 2, which was created to determine the cost of cotton production, includes information about the operations performed in cotton production, the equipment used, labor force, pull power, materials and cost.

The total variable cost was determined to be 2388.99 $/ha, with the total fixed costs 892.38 $/ha, and the general total production cost 3281.37 $/ha. The selling price of cotton was 0.54 $/kg. This price was 0.76 $/kg including supports. The product unit cost was 0.61 $/kg. The average yield from production is 5357.2 kg/ha, and the income from the sale of the product is 4086.27 $/ha.

72.8% of the total production costs were variable costs and 27.2% are fixed costs. Similar to the results of the research, in a study conducted in the Çukurova region, 70.82% of the production costs of cotton farms consist of variable costs and 29.18% of fixed costs (Alemdar et al., 2014).

Soil preparation in cotton production includes the first plough, which was carried out with a crushing machine between October and December, the second plough, which was carried out using a subsoiler in December, and the third plough, which was carried out with a cultivator in February-April, as well as the levelling operations, performed with the harrow in March-April. The average cost of soil preparation per hectare of cotton production was determined as 186.67 $, with the ratio of these costs to production costs at 5.69%. The ratio of soil preparation costs to variable costs was 7.82%.

Seed sowing starts on March 10 and ends at the beginning of May. The amount of seeds used for 1 hectare varies between 20-30 kg. In a study conducted in the Çukurova region, the average seed used for 1 hectare of cotton production was found to be 26.4 kg

(Alemdar et al., 2014). A seeder was used during the sowing process, and an average of 229.9$ seed and planting costs were made for 1 hectare of cotton production in a production period. The share of this cost to production costs was calculated as 7.01%. The ratio of seed and planting costs to variable costs was 9.62%. Hoeing was done by machine or by hand in May-June. In a cotton production process, producers hoe an average of 2.53 times by machine, and an average of 1.23 times manually. The average hoeing cost for the production per hectare of cotton was 358.18 $, while the share of this cost in the production costs was calculated as 10.92%. The ratio of hoeing costs to variable costs was 14.99%.

A fertilizer machine was used in the fertilization process, which started on March 10 and ends at the beginning of May. In a production period, the average fertilization cost per hectare of cotton production was 430.86 $, with an average fertilization process of 2.44 times. The fertilization process in cotton production involved the use of urea and 26% ammonium nitrate as top fertilizer, DAP, 20.20.20+Zn+SO_3, composite (20.20.0) and compound (15.15.15) base fertilizer, organic mineral fertilizer as base and top fertilizer depending on the type. It was stated that they use 222.6 kg/ha of urea, 128.6 kg/ha of DAP, 74.7 kg/ha of 20.20.20+Zn+SO_3, 128.9 kg/ha of 26% ammonium nitrate, 153.8 kg/ha of composite (20.20.0), 52.7 kg/ha of compound (15.15.15), and 321.0 lt/ha of organic mineral fertilizers in cotton production. The ratio of this cost in variable costs was calculated as 18.04%, and its share in production costs was calculated as 13.13%. In a study conducted on the economic analysis of chemical fertilizers in the Çukurova region, Gul et al. (1995) determined the rate of fertilization cost to the total variable costs as 10.37% On the other hand, in the study conducted in Kahramanmaraş, the share of fertilization cost in variable costs in cotton production was calculated as 14.8% (Candemir et al., 2017).

The spraying process covers a period of four months between May and August. The farmers sprays an average of 4.95 times during a production process using a holder. In a similar study conducted on cotton-producing farms in the lower Seyhan Plain, it was reported that during a production period, 6.6 sprayings were carried out per hectare, with a minimum of 4 sprayings, and a maximum of 9 (Akbay and Yurdakul, 1993). In another study conducted in the Çukurova region, it was determined that the spraying process in cotton production is generally carried out 4-5 times (Alemdar et al., 2014). The average cost of spraying per decare of cotton production in the research was 163.64 $, with the share of this cost in production costs calculated as 4.99%. The ratio of spraying costs to variable costs was determined as 6.85%. In another study conducted in the Çukurova region, the ratio of spraying costs to variable costs was determined as 9.76% (Alemdar et al., 2014).

Irrigation is done between May and August. The producer performs irrigation an average of 8.45 times during a production process. While flood irrigation was preferred at the beginning of production, sprinkler irrigation was preferred near the end of production. The average cost of irrigation calculated per hectare of cotton production was calculated as 376.52 $. The share of this cost in production costs was determined as 11.47%. The ratio of irrigation costs to variable costs was determined as 15.76%. Considering the districts interviewed in Şanlıurfa province structurally, while irrigation was performed via irrigation channels in the Bozova, Suruç, Haliliye, Eyübiye, and Harran districts, irrigation in Viranşehir district is carried out using well water. Furthermore, since each district differs in terms of unevenness, the use of machinery is not the same in each district. These factors affecting the cotton yield differentiate the yield in each district.

The harvesting process generally covers the months of October-November but can continue until December, depending on the weather conditions. Harvesting is done both manually or using a harvester. In the event the excess cotton remains in the field in machine harvesting, then harvesting is done manually. The average cost of harvesting per hectare of cotton production was 584.95 $, and the share of this cost in production costs was calculated as 17.83%, which constitutes the highest cost among production items. The ratio of harvesting cost to variable costs was 24.49%. The transportation process was done by the wholesalers and ginning factories that buy the cotton after the harvest.

Production cost consist of harvesting cost (17.83%), fertilization cost (13.13%), irrigation cost (11.47%), hoeing costs(10.92%), planting cost (7.01%), soil preparation cost (5.69%), pesticide cost (4.99%), revolving fund interest rate (1.78%), land rent (25.02%), and general administrative revenues (2.16%). In a similar study conducted in the Çukurova region, it was determined that 29.18% of the production cost consisted of land rent (Alemdar et al., 2014).

Table 2: Cotton physical production inputs, production cost

	Average	%
1-Soil Preparation cost ($/ha)	186.67	5.69
2- Planting Cost ($/ha)	229.90	7.01
3- Hoeing Cost ($/ha)	358.18	10.92
4- Fertilization Cost ($/ha)	430.86	13.13
5- Spraying Cost ($/ha)	163.64	4.99
6- Irrigation Cost ($/ha)	376.52	11.47
7- Harvesting Cost ($/ha)	584.95	17.83
8- Revolving capital interest rate (1+2+ … 10)*(0.025)	58.27	1.78
A- **VARIABLE COSTS**+	2388.99	72.80
9- General Administrative Expenses(A*0.03)	71.67	2.18
10- Land Rent ($/ha)	820.71	25.01

B- FIXED COSTS	892.38	27.20
C- PRODUCTION COSTS	3281.37	100.00
11- Yield (kg/ha)	5357.2	
12- Sale Price ($/kg)	0.54	
13-Agricultural Supports ($/ha)	1193.38	
14- Gross Production Value ($/ha)	4086.27	

+: Labor costs are included.

The profitability of cotton production was discussed in Table 3. The average cotton yield was 5357.2 kg/ha. This value is approximately 467 kg higher than Turkey's 2017 average yield of 4890 kg/ha. This difference was found to be statistically significant according to the One sample t-test ($p<0.01$). The cost of 1 kg of cotton was calculated as 2.42 TL. The average selling price of cotton was 0.61 $/kg and the average selling price of cotton including support was 0.76 $/kg. Gross production value was 4086.27 $/ha, and gross profit was 1697.28 $/ha. Net profit per hectare is 804.9 $. The profit margin per kilogram is found to be 0.15. A profit of 1.25 $ was made for 1 $ of expense in cotton production.

Table 3: Profitability of cotton production

	Value
Gross Production Value ($/ha)	4086.27
Variable cost ($/ha)	2388.99
Production cost ($/ha)	3281.37
Production cost ($/kg)	0.61
Sales Price+Supports ($/kg)	0.76
Gross profit ($/ha)	1697.28
Net Profit ($/ha)	804.90
Profit margin ($/kg)	0.15
Proportional profit	1.25

In this study, DEA was used to generate economic efficiency scores under assumptions of both constant returns to scale (CRS) and variable returns to scale (VRS). The average economic efficiency score was 0.96 under CRS and 0.99 under VRS.

Estimated Economic efficiency (EE) scores are presented in Table 4. Under CRS the mean efficiency score across the 165 farms was 0.96 ranging from a minimum of 0.65 to a maximum of 1.00 with a standard deviation of 0.07.

Table 4: Economic efficiency of under the constand return scale (CRS) and variable return scale (VRS)

	CRS	**VRS**
Mean	0.96	0.99
Std Devation	0.07	0.02
Min	0.65	0.85
Max	1.00	1.00

According to CRS, Mean EE score was 0.88 for the economicially inefficient farms (n=55) compared to a mean score of 1.000 for the EE farms (n= 110). In a similar study in Ghana, technical efficiency score of cotton farms was 0.88 (Adzawla et al. 2013). Cotton farms' specific technical, allocative and economic efficiency on average were 0.80, 0.94 and 0.76 respectively in Punjab, Pakistan (Ahmad and Afzal, 2020).

Inefficient farms' hoeing cost is 27.2%, irrigation cost is 12.6%, harvesting cost is 11.4%, soil preparation cost is 10.7% more than efficient farms. Efficient farms earn 17.5% more income and receive 11.2% more agricultural support than inefficient ones (Table 5).

Table 5: Efficient and inefficient farms' current input use and outputs

Variable Input Output		CRS				
		TE < 1 (n = 55)		**TE = 1 (n = 110)**		
		Mean	**S.d.**	**Mean**	**S.d.**	**Percent %**
	Economic efficiency	0.88	0.08	1.00	0.00	-12.0
X1	Soil Preparation cost ($/ha)	199.49	55.18	180.25	50.96	10.7
X2	Planting Cost ($/ha)	235.00	15.83	227.35	22.07	3.4
X3	Fertilization Cost ($/ha)	439.85	180.33	426.39	186.94	3.2
X4	Spraying Cost ($/ha)	167.65	33.48	161.69	39.60	3.7
X5	Hoeing Cost ($/ha)	417.68	218.74	328.41	220.58	27.2
X6	Harvesting Cost ($/ha)	627.65	384.17	563.59	324.42	11.4
X7	Irrigation Cost ($/ha)	406.79	150.81	361.34	144.09	12.6
Y1	Gross Production Value (except supports) ($/ha)	2526.54	488.36	3064.17	561.19	-17.5
Y2	Agricultural Supports ($/ha)	1098.54	134.02	1236.46	115.35	-11.2

In the case of reducing hoeing costs by 74.2%, harvesting costs by 54.4%, soil preparation costs by 33.3%, fertilizing costs by 32%, irrigation costs by 27.9%, spraying costs by 25.5% and planting costs by 19.3% in inefficient farms. It is expected that income will increase by 13.6% and agricultural supports will increase by 0.02%. Gul et al, (2009) found that in Cukurova Region cotton farmers can make the same production by reducing their input costs by 21%.

Table 6: Suggestion to inefficient farms

Variable Input Output		**Current Values**		**Suggested Values**		
		Mean	**S.d.**	**Mean**	**S.d.**	**Percent %**
	Economic efficiency	0.88	0.08	1.00	0.00	-12.0
X1	Soil Preparation cost ($/ha)	199.49	55.18	149.62	30.20	33.3
X2	Planting Cost ($/ha)	235.00	15.83	196.97	20.86	19.3
X3	Fertilization Cost ($/ha)	439.85	180.33	333.23	127.42	32.0

X4	Spraying Cost ($/ha)	167.65	33.48	133.54	29.90	25.5
X5	Hoeing Cost ($/ha)	417.68	218.74	239.75	109.60	74.2
X6	Harvesting Cost ($/ha)	627.65	384.17	406.46	199.95	54.4
X7	Irrigation Cost ($/ha)	406.79	150.81	318.06	116.77	27.9
Y1	Gross Production Value (except supports) ($/ha)	2526.54	488.36	2923.91	462.60	-13.6
Y2	Agricultural Supports ($/ha)	1098.54	134.02	1100.78	134.97	-0.2

5. Conclusion and Recommendations

This study, which was conducted with the objective to determine the cost and profitability of cotton production in Şanlıurfa province, includes data obtained as a result of interviews with 165 producers carrying out cotton production in the Bozova, Harran, Suruç, Viranşehir, Haliliye, and Eyübiye districts.

According to results, 33% of the cotton farmers in Şanlıurfa, which meets the largest part of Turkey's cotton production, do not operate economically effectively. Ensuring economic efficiency in the cotton plant, which is an important raw material of the textile and oil industry, is extremely important for the sustainability of cotton production.

Cotton production is an important source of income in the research area. Irrigation of the lands is an important factor in the preference of cotton production. The use of chemical fertilizers and chemical pesticides in the research area is quite high. Most of the producers perform irrigation by flood irrigation and sprinkler irrigation. The low unevenness of the land and the large scale of the land are partially effective in using these irrigation techniques. Farmers do not prefer drip irrigation systems because they are costly and make hoeing difficult. Producers stated that they irrigate every 15 days. Irrigation cost is very high, because flood irrigation and sprinkler irrigation are performed in an uncontrolled manner and for long time periods. This cost can be reduced if irrigation is done in an adequate and controlled manner. Ensuring the sustainability of water resources is important for future production. Similarly, production methods should be applied in a way that reduces the use of chemical pesticides and chemical fertilizers, and causes minimal damage to the environment. Necessary training should be provided on these issues.

In the interviews conducted with 165 cotton farms in the research area, it was determined that 25% of the enterprises incurred a loss when the producers did not benefit from the supports, while only 4% of the farms suffered a loss when they benefited from the supports. This result reveals the importance of the support given. In addition, it has been determined that the farms that suffer losses are small-scale farms, which are not suitable for the use of machinery, and thus rely on labor-intensive production. It has also been determined that the costs of harvesting, hoeing, fertilizing and irrigation are higher than those of other farms, respectively. In cotton production, the producers make profit with agricultural supports only. Agricultural supports not only encourage cotton producers to produce, they also prevent the producer from incurring losses. In this context, it is thought that the continuation of the supports is very important for the sustainability of cotton production.

During the harvest phase, the producer experiences problems due to early harvest and late harvest, and this causes loss of time, loss of yield, and poor cotton quality. Therefore, it should be harvested on time. Producers should be trained on issues such as conscious harvesting, maintaining quality, and post-harvest storage. The trainings to be given will increase the number of conscious producers in cotton production. In addition, the inadequacy of harvesting machines is among the factors delaying the harvest time. Policies aimed at increasing the number of harvesting machines will be a partial solution to the employment problem in the research area.

Increased fertilizer and fuel prices in recent years cause an increase in production costs. High input prices increase production costs, which means it affects production in the following year later. As Turkey is dependent on foreign inputs, the production cost is quite high. Besides cotton farms, this situation adversely affects the textile and apparel industries as well. To solve this problem, cotton production sustainability should be ensured with cost-reducing practices, policies to increase production, technical and economic studies.

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