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Research Article

ECONOMIC ANALYSIS OF SUGAR BEET PRODUCTION: A CASE STUDY OF BALIKESİR PROVINCE, TÜRKİYE

Arif Semerci[1 *], Musab Ural[2]

[1]Canakkale Onsekiz Mart University, Faculty of Agriculture, Department of Agricultural Economics, Çanakkale, Türkiye
[2]Bergama, İzmir, Türkiye

*Corresponding Author:
E-mail: arifsemerci@comu.edu.tr

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ABSTRACT. The aim of this study is to make an economic analysis of the enterprises that grow sugar beet in Balıkesir Province. In this context, the cost analysis of sugar beet production was made, and the socio-demographic characteristics of the enterprises were examined. The data used in the research were obtained from 75 sugar beet enterprises which were determined by using 'Full Count Method'. The average cultivation area size of sugar beet was 11,7 da, and the yield per unit area was found as 7.326,49 kg da^{-1}. The average product sales price for the season of 2019-2020 was \$0,06 kg^{-1}, and the average production value of sugar beet was calculated as \$418,67 da^{-1}, and the highest production value was obtained from the third group of the enterprises with \$464,92 da^{-1}. In the research, the production cost of sugar beet per unit area was found as \$242,67 da^{-1}, and the highest production cost was calculated in the second group of the enterprises. When the enterprises are considered in general, the gross profit of sugar beet per unit area was \$240,79 da^{-1}, and net income was \$175,99 da^{-1}, and the highest net income was calcualted as \$222,81 da^{-1} in the third group of the enterprises. The study revealed that the average productivity value of enterprises in sugar beet production is 30.19. However, in the present study, considering the average of enterprises in sugar beet production, it has been determined that relative profit ratio is 1.73 and the highest ratio is 1.92 with the 3rd group enterprises. Results of the study proved that as the enterprise scale increases the productivity gained from the unit area, production value of the products, net profit and relative profit rates also increase whereas the product costs per unit area and kilogram decrease.

Keywords: *Sugar beet, economic analysis, cost, gross profit, relative profit, productivity, Türkiye*

INTRODUCTION

Agriculture is a field of activity that contributes significantly to capital and the economy in the first stage of economic development. These contributions are expressed basically as the contribution of production, market and production factors. Sugar sector also contributes to the country's economy with its by-products in many fields. Having a strategic significance in world's general, sugar, besides being a staple food, is a product that is protected worldwide within the context of its contribution to employment, agricultural production and to the by-products related with this production [2]. Apart from its sociological benefit that it provides, the size of employment and its key role in preventing the rural depopulation and its rendering the farmer to be dependent on agricultural production all makes sugar beet much more important. The main reason why sugar beet is a priority of agricultural policy is that it is an industrial crop. All the products obtained from cultivating sugar beet are strategical products. Some of these are pulp, molasses and ethanol. Although molasses and pulp are used as forage, they are essential raw materials for alcohol production. They are also raw materials for many other products such as sugar, yeast, antibiotics and bioethanol [37].

Sugar beet *(Beta vulgaris var. Saccharifera)* is a biyearly agricultural plant belonging to the amaranth family and from whose fleshy root sugar is obtained. Vegetative organs build up in its life's first year whereas the reproductive organs build up in the second year. Its seeds are in the compound form. It is generally acknowledged that the origin of sugar beet is in the middle east, in the region of Tigris and Euphrates Rivers. Depending on the sugar ratio in the sugar beet's content, which is used in the production of sugar, about 1 kg of white crystal sugar is obtained from approximately 7-8 kg of beetroot. The structure of sugar, which is obtained from both sugar beet and sugar cane, is saccharose and there are not structural differences between the two [3].

In the 2019/2020 period, it has been estimated that the world sugar production amount is 167 million tonne. About 76,1% of the whole world's sugar production is obtained from sugar cane. Within the period of 2019/2020, sugar production from cane amounts to 127 million tonne. And the share of beet sugar production in world's sugar product is 23,9%. In the period of 2019/2020, the amount of sugar produced from beet is 40 million tonne [23]. Türkiye, having a significant place among sugar producing countries from beet, ranks the fourth after Russian Federation, France and Germany in the continent of Europe and is in the fifth place after Russian Federation, France, Germany and USA in the World [23]. In the list of world's sugar producer countries Brazil takes the first place with a total of 32 million tonne of sugar production and India ranks the second with 27 million tonne of sugar production.

In world's general, Eastern Asia is the location where the sugar consumption is the highest. The biggest sugar consuming countries are India, China, EU, Brazil, USA, Indonesia, Russia, Mexico, Pakistan and Egypt. Türkiye ranks the 11th in world's general with a consumption amount near to 3 million tonne. –In 2019/2020 period, Brazil ranks the first in global sugar export with 21,7 million tonne and Thailand ranks the second with 8.4 million tonne. The most sugar importing countries in the world within the 2019/2020 period are Indonesia, China, USA, EU, UAE (United Arab Emirates), Algeria, Malaysia, Korea and Sudan [13].

There are studies in which sugar beet production in the world is evaluated from different aspects [36, 43]. However, in the literature, there are also studies based solely on the economic analysis of sugar beet production [41, 22, 35, 28,10,40]. In their study, Oğuz and Bayramoğlu [30] analyzed the effect of different parcel widths on sugar beet production cost after land consolidation with the data obtained from 150 enterprises. In another study, Fogarasi [15], examined the efficiency and total factor productivity in sugar beet in Hungary after accession to European Union.

Erdal et al. [11], in their study entitled "*Energy use and economical analysis of sugar beet production in Tokat province of Türkiye*" put emphasis on input - output analysis and cost analysis in sugar beet production by the help of the data obtained from 146 enterprises. In their study Albayrak et al. [1] examined input usage and profitability level in sugar beet production in central Anatolia according to irrigation systems. Kumbasaroğlu and Dağdemir [27], analyzed in detail production cost of potato, sugar beet and sunflower in enterprises with and without farm machinery by using data obtained from their studies on 200 agricultural enterprises in 30 locations. In their study entitled "*Energy use efficiency and economic analysis of sugar beet production system in Iran: A case study in Khorasan Razavi province*", Asgharipour et al. [4] made an analysis of energy usage efficiency and economic analysis in the light of the data obtained from 153 enterprises. In the study by Řezbová et al. [32], which is entitled "Sugar beet production in the European Union and their future trends", sugar beet production has been examined at economic points in France, Germany, Poland, United Kingdom and Czech Republic. In the same study, yield, cost, variable costs and fixed costs in sugar beet production are put forward in detail. Gholami ghajelou et al. [16] have evaluated sugar beet producing enterprises in West Azerbaijan Province of Iran 3 different size groups. In the research, energy use efficiency and economic analysis in sugar beet production have

been focused on. In the study entitled "Energy-Use Efficiency and Economic Analysis of Sugar Beet Production in China: A Case Study in Xinjiang Province", Hua et al. [21], emphasized the energy-use efficiency and economic analysis in sugar beet production by the help of the data obtained from 156 enterprises in China. Řezbová et al. [33] have made an economic analysis of sugar beet production in Czech Republic and Slovakia for the period of 2010-2014 and focused on cost in detail in their study entitled "The Economic Aspects of Sugar Beet Production". Bayramoğlu and Ağızan [7] examined the effects of different irrigation systems on sugar beet production with the help of the data they obtained from 115 agricultural enterprises in their study. In the study conducted by Kotyza et al. [25], sugar beet production has been examined and analyzed in Czech Republic and Poland comparatively. Zamani et al. [43] conducted a study in Iran, in which enterprises were divided into 2 main groups as those that are members of agricultural cooperatives and those that are not members. Also, in the same study, sugar beet production was discussed for each group in economic terms.

Aydoğan et al. [5] made a detailed analysis of sugar beet in economic terms. Dimitrijević et al. [9] aimed to conduct an economic analysis of fertilizer usage and the effect of energy use in wheat and sugar beet production in a study in Serbia.

Gromkovskii et al. [18], in their study entitled "*Economic and Mathematical Model of Profit in Sugar Production from Beet*" emphasized that the sugar produced in Russian Federation in the last few years exceeded the country's demand and the need for the related cultivating industries. Krzysiak [26] analyzed the profitability of sugar beet production for the period of 2018-2019. Ertürk and Ağır [12] made analysis of sugar beet production yield, quality features and profitability based on 2 different groups as summerly and wintery types. Firouzi et al. [14], made a 3 directional investigation of sugar beet and sugar cane production, energy use and economic analysis. Haß [20], on the other hand, examined the effects of supports to sugar beet production in EU on the production and market structure. Tudor et al. [39] conducted a cost analysis of sugar beet produced in traditional ways in Romania.

In this study, the inputs and production quantities used in sugar beet production in Balıkesir province, which is located in the Marmara Region of Türkiye, have been examined on the basis of enterprise sizes. The data obtained in the research have been evaluated within 3 size groups. Within the scope of the research, the use of inputs in sugar beet production has been examined in detail. Nevertheless, the factors that make up the cost in sugar beet production have been calculated on the basis of main groups and enterprise sizes. By the help of the data obtained within the scope of the study, in sugar beet production; the production value of the product, variable costs, fixed costs, production cost and ratios of gross profit, net profit, relative profit and productivity have been estimated. In the present study, research findings obtained have been analyzed in comparison with the findings obtained from the studies on production economy in different countries. In the results section of the study, suggestions on how to make sugar beet production more profitable in the enterprises investigated have been made.

MATERIALS AND METHODS

The primary material of the study consists of data obtained from 75 agricultural enterprises producing sugar beet in Susurluk, Manyas, Gönen and Bandırma districts of Balıkesir province. The secondary data of the research consisted of publications on the subject, electronic media (internet) data and especially data from the Food and Agriculture Organization of the United Nations (FAO) and data obtained from the Turkish Statistical Institute (TUIK), Ministry of Agriculture and Forestry (TOB), Under-secretariat of Foreign Trade (DTM), Ministry of Development (KB), Ministry of Customs and Trade (GTB), Chamber of Agricultural Engineers of the Union of Chambers of Turkish Architects and Engineers (TMMOB-ZMO). Within the scope of the study, thesis and research articles on sugar beet have been referred to.

In the study, publications of various national and international institutions and organizations and commission reports on sugar beet have also been used.

Method Used in Sampling

In determining the enterprises to be surveyed within the scope of the research, the horizontal cross-sectional data of 2019 obtained from 75 sugar beet production enterprises in Susurluk, Manyas, Gönen and Bandırma districts of Balıkesir province, which are engaged in sugar beet production activities and determined according to the "Complete Census Method", have been referred to and the producer list obtained from Balıkesir-Bursa Beet Planters Cooperative has been taken into consideration. The sampling list of the study consists of the list obtained from the sugar beet producers' cooperative. A face-to-face survey was conducted with all the businesses in this list. In evaluating the data and analyzing them, basic descriptive statistics have been applied. In the research conducted, only sugar beet production activity has been analyzed in the enterprises examined. The enterprises within the scope of the research are divided into 3 size groups as having 2,00-4,99 decares, 5,00-9,99 decares and 10,00 da and above land, taking into account the standard deviation and coefficients of variation. Accordingly, there are 25 enterprises in the first group, 25 enterprises in the second group and 25 enterprises in the third group.

Method Used in Determining Sugar Beet Cost

In preparing the cost schedules of the sugar beet, schedules used by the Ministry of Agriculture and Forestry Balıkesir Provincial Directorate and the cost schedules used in various studies on the subject have been taken into consideration. Sugar beet production cost has been calculated according to the method indicated below [24, 29, 31, 26].

Product Value (PV) = Yield (kg ha^{-1}) * Sale Price (\$ kg^{-1})

Product Cost (PC) = Variable Costs (CC) + Fixed Costs (FC).

Variable Costs (CC) = Soil Cultivation + Sowing and Seed + Fertilizer and Fertilization + Medication and spraying + Harvest + Rooting + Collection and Transport.

Fixed Costs (FC)= Land Rent (*) + Capital Interest (**) + Management Expense (***).

(*): The rental value of the areas rented by the enterprise owners in sugar beet production or the rental values of their own lands according to the alternative cost principle are taken into consideration.

*(**): Capital Interest= Variable Expenses * 2.75%*

(The annual interest rate applied by Turkish Republic Ziraat Bank to crop production in 2019 is 12%, and after deducting the subsidy part, the share of the remaining 5.5% interest rate for the beet production period is taken into account)

*(***) Management Expenses = Total Costs * 3%*

Gross Profit = Product Value (PV) – Variable Costs (VC)

Net Profit = Product Value (PV) – Variable Costs (VC) + Fixed Costs (FC)]

Relative Profit (Benefit / Cost Ratio) = Product Value (PV) / Production Costs (PC)

Productivity= Sugar Beet Yield (kg da^{-1}) / Total Cost of Production (\$ da^{-1})

The study focused only on sugar beet production. For this reason, depreciation calculations were not considered in the study due to the partial budget analysis. In the research, supports given to sugar beet production were not taken into account. Because the total support does not even reach 1% of the production value, considering the year of production.

As it is known, product costs are calculated by the Ministry of Agriculture and Forestry in Türkiye and this information is not shared with other institutions (except for judicial and expropriation cases). For this reason, in the study, data on the production economy of sugar beet produced in other countries were used in comparisons. In agricultural economics studies, administrative expenses can be between 3% and 7% of the changing costs. In this study, as in

other sugar beet studies in Türkiye, 3% of the variable costs were taken into account as management expenses.

RESULTS AND DISCUSSION

Within the scope of the study, enterprises engaged in sugar beet production activities in Balıkesir province and its districts are analyzed in many socio-economic aspects. Within the scope of the research, enterprises have been divided into 3 size groups (having land of 4,99 da and below, 5,00 da – 9,99 da and 10 da and above). The total population in the analyzed enterprises is 249 people and the population per enterprise is 3,32 people. As the sugar beet production area increases, the population in the enterprises also increases. As for the the gender distribution of the surveyed enterprises, the rate of men is 58,23% and the rate of women is 41,76%. When the age and experience of the enterprise owners in sugar beet production are analyzed within the scope of the study; the average age has been determined as 47,86 years and the average experience in sugar beet production has been found as 11,82 years. The average education period of the enterprise owners within the scope of the research has been calculated as 9,53 years.

Plant Production Pattern of the Investigated Enterprises

The highest crop cultivation in the enterprises within the scope of the study is determined as wheat with a share of 47,65%. This crop is followed by barley cultivation with a share of 30,44%. In the same ranking, sugar beet, which is the subject of the research, ranks 4th after sunflower with a share of 6,81%. Wheat, barley, sunflower and sugar beet have a share of over 90% in the crop production pattern of the enterprises (Table 1).

Table 1. *Plant production pattern of the investigated enterprises*

Product	1. Layer		2. Layer		3. Layer		Sum Total	
	Area (da)	Share (%)	Area (da)	Share (%)	Area (da)	Share (%)	Area (da)	Share (%)
Wheat	1.900,00	56,80	1.760,00	53,51	2.480,00	39,68	6.140,00	47,65
Barley	1.095,00	32,74	1.059,00	32,19	1.768,00	28,28	3.922,00	30,44
Sunflower	204,00	6,09	256,00	7,78	595,00	9,52	1.055,00	8,18
Sugar beet	80,50	2,40	162,00	4,92	636,00	10,17	878,50	6,81
Corn	65,00	1,94	52,00	1,58	741,00	11,85	858,00	6,65
Field peas	0,00	0,00	0,00	0,00	30,00	0,48	30,00	0,23
Total	3.344,50	100,00	3.289,00	100,00	6.250,00	100,00	12.883,50	100,00

In another study conducted on the same subject, the products grown by the producers in the research region and the average production areas per enterprise have been listed as follows: While wheat cultivation area ranks first with an average of 73,77 da, corn cultivation area ranks second with an average of 57,82 da. The average sugar beet cultivation area is 54,19 da and it is in the third place. Sugar beet cultivation area is followed by beans with 22,01 da, sunflower with 20,43 da, barley with an average of 13,21 da and lentils with 0,21 da [19].

Plant Production Values of the Investigated Enterprises

In the 2019-2020 production period, the investigated enterprises had a crop production income of approximately $2.2 million. While for this value, wheat ranked first with 40,92%, barley ranked second and sugar beet ranked third. Sugar beet, which is the subject of the study, has shown a rate of 15,93% income equivalent to $353 thousand in return to 6,81% cultivation

area. It is seen that as the cultivation area of sugar beet increases, its share in in-house income also increases. Likewise, in layer 3, the share of sugar beet rises to 20,84% of the total (Table 2).

Table 2. *Plant production values of the investigated enterprises*

Products	1. Layer		2. Layer		3. Layer		Sum Total	
	Revenue ($)	Share (%)	Revenue ($)	Share (%)	Revenue ($)	Share (%)	Revenue ($)	Share (%)
Wheat	275.076	57,12	261.370	51,42	370.168	30,19	906.613	40,92
Barley	134.565	27,94	138.096	27,17	235.197	19,18	507.857	22,92
Sugar beet	31.866	6,61	65.748	12,93	255.479	20,84	353.092	15,93
Sunflower	23.227	4,82	27.294	5,37	81.092	6,61	131.613	5,94
Corn	16.815	3,49	15.731	3,09	280.210	22,86	312.756	14,11
Feed peas	0	0,00	0	0,00	3.601	0,29	3.601	0,16
Total	481.548	100,00	508.239	100,00	1.225.747	100,00	2.215.534	100,00

In a study conducted in Kayseri province, it is seen that field crops accounts for 84,09%, animal husbandry 15,58%, fruit growing 0,23% and vegetable growing 0,10% of the producers' total agricultural income. The group with the highest share of field crops in total income is group 3 with a rate of 92,35%, whereas the group with the lowest share of field crops in total income is group 2 with a share of 77,95%. Inversely proportional to field crops, the group with the highest share of livestock in agricultural income is group 2 with 21,30%, while the group with the lowest share of livestock in total income is group 3 with 7,15% [38].

Sugar Beet Production Areas of the Investigated Enterprises

Sugar beet cultivation areas in the surveyed enterprises have been decreasing over the years. In 2020, the cultivation area, which was 1,077 da decreased to the level of 877,5 da in 2018. The fact that the labor force and input costs are high has a significant effect on the decline of sugar beet cultivation areas over the years. (Table 3).

Table 3. *Sugar beet cultivation areas in the investigated enterprises*

Enterprise Groups	Number of Enterprises	2018 Planting Area (da)	2019 Planting Area (da)	2020 Planting Area (da)	Change between 2018-2019 (%)	Change between 2019-2020 (%)
1	25	154,0	108,0	79,5	-29,87	-26,39
2	25	203,0	162,0	162,0	-20,20	0
3	25	720,0	648,0	636,0	-10,00	-1,85
Total	75	1.077,0	918,0	877,5	-14,76	-4,41

According to the study conducted for the economic analysis of sugar beet producing enterprises in Afşin district of Kahramanmaraş province; while the average cultivation area per producer is 49,12 da in 2016, this value decreased to 48,97 da in 2017 and increased to 54,19 da in 2018. According to TUIK data, whereas sugar beet cultivation area in Türkiye was 3.392.742 da in 2017, this area decreased to 2.921.044 da in 2018 [19].

Sugar Beet Yield Values in the Investigated Enterprises

When the sugar beet yield values obtained in the unit area (decare) of the enterprises surveyed have been examined, it has been determined that the average yield of the 1st layer enterprises is 7.345,91 kg da^{-1}, the yield of the 2nd layer enterprises is 6.728,39 kg da^{-1} and the yield obtained by the 3rd layer enterprises in the unit area is 7.326,49 kg da^{-1}. The average yield value of the enterprises is 7.326,49 kg da^{-1}. High levels of yields of the producers in the 3rd group, which has the highest enterprise size, are due to the fact that they have more labor opportunities and the economically stronger producers do not avoid yield-oriented maintenance operations (Table 4).

Table 4. *Sugar beet yield status of the investigated enterprises*

Enterprise Groups	Area (da)	Production (kg)	Yield (kg da^{-1})
1	79,50	584.000	7.345,91
2	162,00	1.090.000	6.728,39
3	636,00	4.755.000	7.476,41
Total	877,50	6.429.000	7.326,49

In the research conducted by Oğuz and Bayramoğlu [30], sugar beet yield value was determined as 6.100 kg da^{-1}in enterprises with a land under 50 da, 6.620 kg da^{-1} in enterprises between 51-150 da, 7.110 kg da^{-1} in enterprises over 151 da and the average of enterprises was determined as 6.670 kg da^{-1}. Research findings reveal that as the size of the enterprise increases, the yield obtained from unit area increases. In their study Erdal et al. [11] calculated the sugar beet yield value as 6.082 kg da^{-1}, whereas Albayrak et al. [1] have found the sugar beet yield value 7.500 kg da^{-1} with drip irrigation, 6.250 kg da^{-1} with sprinkler irrigation and 6.000 kg da^{-1} with furrow irrigation. In their study, Kumbasaroğlu and Dağdemir [27] determined the sugar beet yield value as 3.064 kg da^{-1} in enterprises without agricultural machinery and 3.077 kg da^{-1} in enterprises with agricultural machinery. In their study, Asgharipour et al. [4] have calculated the sugar beet yield value as 3.355 kg da^{-1} whereas Hua et al. [21] have found it as 8.500 kg da^{-1}. Řezbová et al. [33] have determined the average yield value of sugar beet in Czech Republic as 6.650 kg da^{-1}. This value was calculated as 7.690 € da^{-1} in 2014. Again Řezbová et al. [33], in their study, determined the average yield value for sugar beet in Slovakia for the period of 2010-2014 as 6.250 kg da^{-1} and this value was found as 7.671 kg da^{-1} 2014.

In a research conducted, the sugar beet yield values obtained per unit area of the producer groups were calculated as; for the 1st group 6.548 kg da^{-1}, 2nd group 6,628 kg da^{-1}, 3rd group 6.782 kg da^{-1}, 4th group 6.434 kg da^{-1} and 5th group 6.721 kg da^{-1}. The average yield value was found to be 6.617 kg da^{-1} in the investigated enterprises. As the enterprise size of the producers in group 1, group 2 and group 3 increases, the beet yield per decare also increases [38]. Bayramoğlu and Ağızan [7] calculated the sugar beet yield value as 7.956,36 kg da^{-1} with sprinkler irrigation and 8.256,36 kg da^{-1} with drip irrigation in their research. Gül [19] determined the average yield in sugar beet production as 8.844,21 kg da^{-1} in his research.

In their research Kotyza et al. [25] calculated the average yield value for sugar beet as 6.926 kg da^{-1} in Czech Republic for the 2017 production period and they also found it for the same period as 6.403 kg da^{-1} in Poland. Zamani et al. [43] determined the sugar beet yield in West Azerbaijan Province in Iran as 6.055,8 kg da^{-1} whereas 5.326 kg da^{-1} for the country's general. Aydoğan et al. [5] calculated the yield value for sugar beet as 5.400 kg da^{-1} in their study. Ertürk and Ağır [12] determined the yield value of summer types of sugar beet as 8.470 kg da^{-1} and 6.710 kg da^{-1} for winter types. Firouzi et al. [14] found the yield value for sugar beet as 4.613,5 kg da^{-1} in their study.

Sale Price of Sugar Beet in the Investigated Enterprises

When setting beet prices, the Sugar Board takes into account the regional cost of beet from all sugar factories as well as WPI and CPI rates. The price of beet containing 16% polar sugar was set at $56,47 per ton by the Sugar Board in 2020. Sugar beet sales prices are determined depending on the polar ratio. In the enterprise groups examined, it has been found that sugar beet prices increase in direct proportion to the cultivation area. It has also been found that there is a direct proportional relationship between the productivity of the enterprises and beet prices. When the average sugar beet price of all enterprises is analyzed, it has been found as $0,06 kg^{-1}. It has been determined that the 1st and 2nd layer enterprises are below the average sugar beet price and the 3rd layer enterprises are higher than the average sugar beet price.

Table 5. *The case of sugar beet sale prices in the surveyed enterprises*

Enterprise Groups	Sugar Beet Sale Price ($ kg^{-1})
1	0,05
2	0,06
3	0,06
Average	0,06

Rental Values of Sugar Beet Production Lands in the Investigated Enterprises

When the average rental values of the lands where sugar beet is produced in the surveyed enterprises are examined; It was determined that it was $55,46 da^{-1} in the 1st layer enterprises, $58,82 da^{-1} in the 2nd layer enterprises and $64,71 da^{-1} in the 3rd layer enterprises. Average land rent value for the enterprises examined has been determined as $59,66 da^{-1} (Table 6).

Table 6. *Average rental values in sugar beet production areas*

Enterprise Groups	Number of Enterprises (units)	Total Sugar Beet Plant Area (da)	Average Sugar Beet Production Area (da)	Average Land Rental Value ($ da^{-1})
1	25	79,50	3,18	55,46
2	25	162,00	6,48	58,82
3	25	636,00	25,40	64,71
Total	75	877,50	35,10	59,66

Sugar Beet Production Value in the Investigated Enterprises

Information regarding the production value obtained by the analyzed enterprises as a result of their activities for sugar beet production is given in Table 7. When we examine the relevant table, it is understood that yield and product sales prices are effective on the production value obtained from unit area.

Table 7. *Sugar beet production value in the investigated enterprises*

Enterprise Groups	Production Area(da)	Production Amount (kg)	Yield (kg da^{-1})	Price ($ kg^{-1})	Production Value ($ da^{-1})
1	79,5	584.000	7.345,91	0,05	382,73
2	162	1.090.000	6.728,39	0,06	395,79
3	636	4.755.000	7.476,41	0,06	464,92

Total	877,5	6.429.000	7.326,49	0,06	418,67

According to Table 7, it is understood that the highest sugar beet production value obtained from unit area is in the 3rd group with \$464,92 da^{-1} and the lowest value is in the first group with \$382,73 da^{-1}. The average beet production value per unit area has been found as \$418,67 da^{-1} in the examined enterprises.

Unit Prices for Diesel Fuel and Fertilizer Subsidies (2020)

The Ministry of Agriculture and Forestry makes additional payments to producers for diesel fuel and fertilizers used in agricultural production in the amount specified in the "Other goods" category for all goods other than oil sunflower, soy bean, cotton, safflower, rapeseed, corn, grain, barley, wheat, oats, rye, paddy, triticale, lentils, beans, fresh tea, chickpeas, fodder crops, olives, hazelnuts, onions and potatoes. In the 2019/2020 production period for sugar beet, diesel support was set at \$2,52 da^{-1} and fertilizer support at \$1,34 da^{-1}. In other words, the amount of area-based support provided to sugar beet producers in Türkiye amounted to \$3,86 da^{-1} in 2019 [34].

Input Use in Sugar Beet Production

When we examine Table 8 regarding the input use of the enterprises in sugar beet production per unit area (da), it is seen that the first plowing in October and November constitutes the highest input in the tillage section, and the input rate decreases in other tillage sections.

Table 8. *General input utilization case in sugar beet production in the investigated enterprises*

Production Operations	Operation Time	Number of Operations	Labor Force (min. da^{-1}) Human	Machine	Material (kg-gr-cc-lt da^{-1})	Type	Description
(A)Tillage and Planting							
1st Plough	October-November	1	30,73	30,73	3,149	Diesel (lt da^{-1})	Plow
2nd Plough	March-April	1	21,56	21,56	1,941	Diesel (l lt da^{-1})	Hoeing
3rd Plough	April	1	17,24	17,24	1,667	Diesel (lt da^{-1})	Crowbar
4th Plough	April	1	13,76	13,76	1,143	Diesel (lt da^{-1})	Rake
Planting	April	1	14,67	14,67	1,194	Diesel (lt da^{-1})	Sowing
Total			98,1	98,1	9,094		
(B)Maintenance Works							
Fertilization	April	1	21,3	21,3	0,551	Diesel (lt da^{-1})	min da^{-1}
Fertilization	May-June	2				Diesel (lt da^{-1})	
Drippage Fertilization	June-July	1	37,22	37,22	1,009	Diesel (lt da^{-1})	Water Engine
Hoeing	May	1	321,6	0	0	Labor force (h.da^{-1})	
Hoeing by hand	June	1	7,19	7,19	1.207	Diesel (lt da^{-1})	Interval Hoeing Machine
Spraying (Herbicide)	May	1			0,256	Diesel (lt da^{-1})	
Spraying (Fungicide)	June	1	11,04	11,04	0,256	Diesel (lt da^{-1})	Pulverizator
Spraying (Insecticide)	June	1			0,256	Diesel (lt da^{-1})	
Irrigation	May - August	-	6,3	6,3	10	Diesel (lt da^{-1})	lt da^{-1}
Total			404,65	86,45			
(C) Harvest							
Harvest (Pulling, Topper)	September-October	1	68,33	68,33	2,88	Diesel (lt da^{-1})	Pulling Machine
Loading	September-October	1	25	25	1.10	Diesel (lt da^{-1})	Tractor Bucket
Transportation-Dumping	September-October	1	65	65	4,43	Diesel (lt da^{-1})	Trailer-Lorry
Total			158,33	158,33	21,94		
(C) Various Inputs							
Seed (sowing machine)	April	1	0	0	0,40	gr da^{-1}	da (enterprise total)
Chemical Fertilizers							

Bottom Fertilizer (pure)	April	1	0	0	31,41	kg da^{-1}	da (ent. total)
2nd Fertilization	May-June	1	0	0	29,75	kg da^{-1}	da (ent. total)
3rd Fertilization	May-June	1	0	0	28,21	kg da^{-1}	da (ent. total)
2nd Fertilization	May-June	1	0	0	5,5	kg da^{-1}	da (ent. total)
Agricultural pest chem. (fung.)	June-July	1	0	0	0,234	lt da^{-1}	da (ent. total)
Agricultural pest chem. (herb.-nar-broad leaved.)	May	1	0	0	0,256	lt da^{-1}	da (ent. total)
Agricultural pest chem. (hum.)	June-July	1	0	0	0,46	lt da^{-1}	da (ent. total)
Water Fee (Cooperative)	April-September	1	0	0	80	lt da^{-1}	da; (13 ent.)
Energy Use in Irrigation	April-September	1	0	0	9,5	lt da^{-1}	da (irrigation energy consumption)

Fertilization processes carried out in April, May and June in sugar beet cultivation generally constitute a significant input. These inputs are followed by spraying and irrigation inputs. When sugar beet is harvested in September and October, the important input elements are harvest, draper, loading, transportation and unloading.

Cost Analysis in Sugar Beet Production

The research conducted revealed that the production cost of one decare of sugar beet is approximately $243. Variable costs accounted for 73,30% and fixed costs for 26,70% within the total costs. In their study, Oğuz and Bayramoğlu [30] determined that variable costs and fixed costs accounted for 81,01% and 18,99% of total costs, respectively. Erdal et al. [11] determined that variable costs had a rate of 46,41% and fixed costs had a share of 53,59% out of the total costs in sugar beet production.

In the research conducted by Albayrak et al. [23], it was determined that in sugar beet production with drip irrigation, variable costs had a share of 49,71% and fixed costs had a share of 50,29% in total costs, while in sugar beet production with sprinkler irrigation, variable costs had a share of 64,87% and fixed costs had a share of 35,13% in total costs. Again, Albayrak et al. [1] revealed in their study that in sugar beet production with furrow irrigation, variable costs accounted for 68,51% and fixed costs accounted for 31,49% out of total costs.

In their research, Kumbasaroğlu and Dağdemir [27] found that in sugar beet production in enterprises that did not have agricultural machinery, variable costs accounted for 86,68% and fixed costs accounted for 13,32% out of total costs, while in enterprises with agricultural machinery, variable costs accounted for 81,55% and fixed costs accounted for 18,45% out of total costs in sugar beet production. Asgharipour et al. [4], in their study, determined that variable costs had a share of 59,68% and fixed costs had a share of 40,32% out of total costs in sugar beet production whereas Hua et al. (2016) determined that variable costs had a share of 37,43% and fixed costs had a share of 62,57% out of total costs in sugar beet production. Bayramoğlu and Ağızan [7] revealed in their study that variable costs had a share of 74,29% and fixed costs had a share of 25,71% out of total costs in sugar beet production with sprinkler irrigation while with drip irrigation variable costs had a share of 68,77% and fixed costs had a share of 31,23% out of total costs in sugar beet production.

In the research conducted by Aydoğan et al. [5], it was determined that the share of variable costs in total costs in sugar beet production was 84,30% and the share of fixed costs was 15,70%. Dimitrijević et al. [9], on the other hand, determined in their study that variable costs had a share of 74,61% and fixed costs had a share of 25,39% in total costs in total costs. Krzysiak [25] found that in the 2018-2019 production period, variable costs and fixed costs accounted for 80,39% of the production value in sugar beet production. In their study, Ertürk and Ağır [12], however, found that variable costs accounted for 74,20% and fixed costs accounted for 25,80% of the total costs in summer type sugar beet production. In the same study, for winter type sugar beet production, it has been determined that variable costs accounted for 68,40% and fixed costs accounted for 31,60% out of total costs.

Detailed information on the cost of sugar beet in the enterprises is given in Table 9. When we compare the costs between the layers in the examined enterprises, it has been determined that the average cost of tillage and sowing was \$25,55 da^{-1}, the enterprises in the 3rd layer are below the average with a cost of \$23.14 da^{-1}, while the enterprises in the 1st and 2nd layer had a cost above the average. The average cost of maintenance works was \$31 da^{-1}, and it was determined that the enterprises in the 3rd layer were below the average with a cost of \$30,40 da^{-1}, while the enterprises in the 1st and 2nd layer were above the average.

Table 9. *Sugar Beet Production Cost Table*

Production Operations	Operation Time	Number of Operations	Cost per Unit Area (\$ da^{-1})			
			Layers			
			1	2	3	Avr.
(A) Soil Cultivation and Planting						
1st Plough	October-November	1	11,04	10,12	8,95	10,04
2nd Plough	March-April	1	5,50	5,03	4,66	5,07
3rd Plough	April	1	4,34	4,17	3,46	3,99
4th Plough	April	1	2,66	2.45	2,34	2,48
Planting	April	1	4,14	4.05	3,73	3.97
Total			27,68	25,82	23,14	25,55
(B)Maintenance Works						
Fertilization	April	1	2,79	2,86	2.83	2.83
Fertilization	May June	2	2,13	1,43	1,85	1,81
Dripping Fertilization	June-July	1	1,65	1,69	1,67	1,67
Hoeing (by hand)	May	1	10,17	10,45	9,75	10,12
Hoeing (Machine)	June	1	2,69	2,66	2,57	2,64
Spraying (Herbicide)	May	1	1.10	1.08	1,12	1.10
Spraying (Fungicide)	June	1	1,14	1,13	1,13	1,13
Spraying (Insecticide)	June	1	1.04	1,05	1.04	1,05
Irrigation	May- August	-	8,66	8.87	8,44	8,65
Total			31,38	31,23	30,40	31,00
(C) Harvest						
Harvest (Pulling, Topper)	September-October	1	18,68	18,61	18,95	18,75
Loading - Transportation - Dumping	September-October	1	14.41	14,20	14,37	14,33
Total			33,09	32,82	33,32	33,08
(D) Various Inputs						
Seed	April	1	21,06	21,67	21,03	21,26
Chemical Fertilizers						
Bottom Fertilizer (pure)	April	1	10,67	10,33	9,37	10,12
1st Fertilization	May-June	1	9,34	9,12	8,45	8,97
2nd Fertilization	May-June	1	6,09	5,97	5,96	6,01
Dripping Fertilization	July - August	1	4.29	4,39	3,49	4.05
Agricultural Pesticides						
Agricultural Pest chemical (herb. narr.+broad leaved)	May	1	4,18	4,14	3,56	3,96
Agricultural Pest Chemical (fungicide)	June-July	1	5,07	4,42	5,14	4,87
Agricultural Pest Chemical (insecticide)	June-July	1	0,34	0,73	0,88	0,65
Water Fee (Cooperative)	April-September	1	13,53	13,53	13,53	13,53
Energy Use in Irrigation	April-September	8	10,08	10,08	10,08	10,08
Total (\$ da^{-1})			84,65	84,37	81,49	83,50
Total Costs (A+B+C+D) (\$ da^{-1})			176,79	174,23	168,34	173,12
Revolving Fund Interest (%2,75) (\$ da^{-1})			4,86	4.79	4,63	4,76
Variable Costs Total (D) (\$ da^{-1}**)**			**181,66**	**179,02**	**172,97**	**177,88**
General Administrative Costs (3%) (\$ da^{-1})			5.45	5,37	5,19	5,34
Field Rent (\$ da^{-1})			55,48	58,92	63,95	59,45
Sum of Fixed Costs (E) (\$ da^{-1}**)**			**60,93**	**64,29**	**69,14**	**64,79**
General Sum of Costs (D+E) (\$ da^{-1}**)**			**242,59**	**243,30**	**242,11**	**242,67**

In sugar beet production, the average cost per unit area of the enterprises was \$242,67 da^{-1}, and it was determined that the 3rd layer enterprises were below the average with a cost of \$242,11 da^{-1}. In general, there is no significant difference in the average cost of sugar beet production per unit area between enterprise sizes (Table 9). In their study Erdal et al. [11]

determined that variable costs in sugar beet production for unit area were $167,66 da^{-1}, fixed costs were 191.31$/da and the total production cost was $356,97 da^{-1}. Albayrak et al. [1], in their study calculated that variable costs per unit area in sugar beet production with drip irrigation were $226,70 da^{-1}, fixed costs were $229,30 da^{-1} and total production cost was $456,01 da^{-1} while in sprinkler irrigation variable costs accounted tor $264,70 da^{-1}, fixed costs accounted for $143,38 da^{-1} and total production cost accounted for $408,04 da^{-1}. On the other hand, in sugar beet production with furrow irrigation, variable costs were $299,30 da^{-1}, fixed costs were $136,76 da^{-1} and total production cost was $436,90 da^{-1}.

In their research, Kumbasaroğlu and Dağdemir [27] determined the variable costs of sugar beet per unit area as $200,68 da^{-1}, fixed costs as $30,84 da^{-1} and total production cost as $321,52 da^{-1} in enterprises without agricultural machinery, while in enterprises with agricultural machinery, variable costs were $169,43 da^{-1}, fixed costs as $38,34 da^{-1} and total production cost as $207,77 da^{-1}. Asgharipour et al. [4] revealed in their study that variable costs in sugar beet production per unit area were $172,85 da^{-1}, fixed costs were $116,81 da^{-1} and total production costs were $289,66 da^{-1} whereas, Hua et al. (2016) found that variable costs were $108,17 da^{-1}, fixed costs were 180,85$ da^{-1} and the total production costs were $289,03 da^{-1}. Řezbová et al. [32] determined the average sugar beet production cost as €214,72 da^{-1} in the Czech Republic for the period of 2010-2014. This value was determined as €228,53 da^{-1} in 2014. Again, in the study conducted by Řezbováet al. [32], the average production cost of sugar beet in Slovakia in the period 2010-2014 was determined as €197,39 da^{-1}. This value was calculated as €194,24 € da^{-1} in 2014.

Bayramoğlu and Ağızan [7], in their research, determined the variable costs of sprinkler irrigation in sugar beet per unit area as $235,43 da^{-1}, fixed costs as $81,48 da^{-1} and total production cost as $316,91$ da^{-1}, while the variable costs of drip irrigation were $227,99$ da^{-1}, fixed costs were $103,53$ da^{-1} and total production cost was $331,52 da^{-1}. In the study on the economic analysis of sugar beet producing enterprises in Afşin district of Kahramanmaraş province, average variable costs were calculated as $168,74 da^{-1} average production costs were calculated as $213,78 da^{-1} according to 2019 data. Variable costs constitute the largest share in production costs with 67,60% and fixed costs constitute a share of 32,40%. Among the production costs, fertilizer costs used in production rank in the first place with a share of 21,11% [19]. Kotyza et al. [25] determined the total production cost per unit area of sugar beet in the Czech Republic as €217,30 da^{-1} and in Poland as €137,10 da^{-1}in the production period of 2017. In the study conducted by Aydoğan et al. [5], it was determined that variable costs in the sugar beet production per unit area were $151,08 da^{-1}, fixed costs were $28,17 da^{-1} and the total production cost was $179,25 da^{-1}.

Ertürk and Ağır [12] calculated the total production cost of summer type sugar beet as $131,30 da^{-1}, fixed costs as $45,58 da^{-1}and variable costs as $131,23 da^{-1} and total production cost as $176,81 da^{-1}, while the total production cost of winter sugar beet as $96,52 da^{-1}, fixed costs as $44,54 da^{-1} and total production cost as $141,06 da^{-1}. Firouzi et al. [14] determined the variable costs in sugar beet per unit area as $222,54 da^{-1}, fixed costs as $143,73 da^{-1}and total production cost as $366,27 da^{-1}.

Gros Profit, Net Profit and Relative Profit Values in Sugar Beet

When we examine the profitability status of the enterprises subject to the study, it was found that the average net profit of the enterprises was $175,99 da^{-1}. While the 3rd layer enterprises were above the average net profit with $222,81 da^{-1}, the 1st and 2nd layer enterprises were below the average net profit (Table 10).

Table 10. *Gross Profit, Relative Profit and Net Profit Values of Enterprises*

Criteria	Layers			
	1	2	3	Average
Yield (kg da^{-1})	7.345,91	6.728,39	7.476,41	7.326,49
Product Sales Price ($ kg^{-1})	0,05	0,06	0,06	0,06
Production Value ($ da^{-1})	382,73	395,79	464,92	418,66
Production Cost ($ da^{-1})	242,59	243,30	242,11	242,67
Production Cost ($ da^{-1})	0,03	0,04	0,03	0,03
Gross Profit ($ da^{-1})	201,07	216,77	291,95	240,79
Net Profit ($ da^{-1})	140,138	152,484	222,81	175,99
Relative Profit ($ da^{-1})	1,58	1,63	1,92	1,73
Productivity	30,28	27,65	30,88	30,19

Erdal et al. [11] determined the production value of sugar beet per unit area as $417,65 da^{-1}, gross profit value as $249,99 da^{-1}and net profit value as $58,68 da^{-1}. In the study conducted by Albayrak et al. [1], it was found that the production value per unit area of sugar beet with furrow irrigation was $440,00 da^{-1}, gross profit value was $140,70 da^{-1}, net profit value was $3,94 da^{-1}, the production value per unit area of sugar beet with drip irrigation was $550,00 da^{-1}, gross profit value $323,30 da^{-1}, net profit value $94, 00 da^{-1} and production value $458,33 da^{-1}, gross profit value $193,63 da^{-1}, net profit value $50,25 da^{-1} for sugar beet with sprinkler irrigation. In the study conducted by Topçu [40], net profit value was found negative in sugar beet production.

Asgharipour et al. [4] in their research, found that the production value of sugar beet per unit area was $385,45 da^{-1}, gross profit value was $212,61 da^{-1}, net profit value was $95,81 da^{-1}, whereas Hua et al. [21] determined that production cost in sugar beet production was $595,00 da^{-1}, gross profit value was $486,83 da^{-1} and the net profit value was $305,97 da^{-1}. Bayramoğlu and Ağızan [7] calculated the production value of sugar beet with sprinkler irrigation as $442,02 da^{-1}, gross profit value as $206,59 da^{-1}, net profit value as $125,11 da^{-1}, and production value with drip irrigation as $458,69 da^{-1}, gross profit value as $230,69 da^{-1}and net profit value as $127,16 da^{-1}. In the research conducted, the net profit value obtained from the unit area was calculated as $175,99 da^{-1}. In a study conducted in Kahramanmaraş province, net profit in sugar beet production was calculated as $169,47 da^{-1} [19]. Aydoğan et al. [5], in their study, determined the production value of sugar beet per unit area as $216,00 da^{-1}, gross profit value as $64,92 da^{-1} and net profit value as $36,75 da^{-1} while Dimitrijević et al. [9] found the gross profit value as $90,55 da^{-1} and net profit value as $51,35 da^{-1}.

Ertürk and Ağır [12], on the other hand, determined the production value of summer type sugar beet per unit area as $327,75 da^{-1}, gross profit value as $196,52 da^{-1} and net profit value as $150,94 da^{-1}. They also found the production value for winter type sugar beet as $293,56 da^{-1}, gross profit value as $197,04 da^{-1} and net profit value as $152,50 da^{-1}. Firouzi et al. (2022) determined the production value of sugar beet as $385,45 da^{-1}, gross profit value as $162,91 da^{-1} and net profit value as $19,20 da^{-1}. In the present study, the cost per kg in sugar beet production was calculated as $0,03. Erdal et al. [11] determined the cost per kg in sugar beet as $0,0587 kg^{-1}. in their study, while Albayrak et al. (2010) determined it as $0,0608 kg^{-1} in drip irrigation, $0,0653 kg^{-1} in sprinkler irrigation and $0,0728 kg^{-1} in furrow irrigation. In their research, Kumbasaroğlu and Dağdemir [27] calculated the cost per kg of sugar beet as $0,0675 kg^{-1} in enterprises with agricultural machinery and $0,0756 kg^{-1} in enterprises without agricultural machinery. Asgharipour et al. [4] determined the cost per kg of sugar beet as $0,0863 kg^{-1} while Hua et al. [21] found it as $0,0340 kg^{-1}. Topçu [40] determined the production cost of sugar beet as $0,07 kg^{-1}. Řezbová et al. [33], in their research, determined the average production cost of sugar beet as €0,0323 kg^{-1} in the Czech Republic for the period of 2010-2014. This value was €297 da^{-1} in 2014. Again Řezbová et al. [33] determined the

average production cost of sugar beet as €0,0326 kg^{-1} in Slovakia for the period of 2010-2014. This value was calculated as €0,0253 kg^{-1} in 2014.

Bayramoğlu and Ağızan [7] found that the cost per kg of sugar beet production with drip irrigation was $0,04 kg-1 and the cost per kg with sprinkler irrigation was $0,04 kg^{-1}. Kotyza et al. [25] found that in the production period of 2017, the cost per kg of sugar beet in the Czech Republic was €0,0314 kg^{-1}, while in Poland it was €0,0214 kg^{-1}. Aydoğan et al. (2020) calculated the cost per kg of sugar beet as $0,033 kg^{-1}. Ertürk and Ağır [12] determined the cost as $0,0202 kg^{-1} for summer type sugar beet and $0,0210 kg^{-1} for winter type sugar beet. Firouzi et al. [14] calculated the cost per kg of sugar beet as $0,0482 kg^{-1} whereas Tudor et al. [39] found the production cost of sugar beet produced in the traditional ways as €0,0345 kg^{-1} for the product of 2019. When we examine the relative profit rates of the enterprises, it is seen that the 1st layer has a rate of 1,57 whereas 2nd layer has 1,63 and the 3rd layer has a rate of 1,92. The average relative profit rate in the analyzed enterprises was determined as 1,73. In the studies by Çiçek and Sayılı [8] and by Göktolga and Karkacıer [17], relative profit value of sugar beet was determined as 1,12, while Erdal et al. [11] found it as 1,17.

Albayrak et al. [1] determined the relative profit rate of sugar beet with drip irrigation as 1,21, with sprinkler irrigation as 1,12 and with furrow irrigation as 1,01. Asgharipour et al. [4] determined the relative profit rate of sugar beet as 1,33. Gholami ghajelou et al. [16] calculated the benefit / cost ratio in sugar beet production according to the enterprise size groups and found that in small sized enterprises (smaller than 1 ha) as 1,02, in medium sized enterprises (between 1-2 ha) as 1,42 and in large sized enterprises (bigger than 2 ha) as 1,56. Hua et al. [21] determined the relative profit rate in their study as 2,06. Bayramoğlu and Ağızan [7] determined the relative profit rate in sugar beet production with drip irrigation as 1,38 and with sprinkler irrigation as 1,39 in their research. Relative profit rate in sugar beet has been calculated as 1,79 by Gül [19], as 1,21 by Aydoğan et al. [5] and as 1,24 by Krzysiak [26]. Ertürk and Ağır [12] found the relative profit rate in summer type sugar beet as 1,85 and in winter type sugar beet as 2,08, while Firouzi et al. [14] determined it as 1,05.

The net profit value calculated in the current study ($175,99 da^{-1}) was found to be very close to the value obtained by Gül [19] in the study conducted in Kahramanmaraş province. In the research conducted, the average productivity (kg $\$^{-1}$) value was calculated as 30,28 for the enterprises in the first layer. This value was found to be 27,65 for the enterprises in the second layer, 30,88 for the enterprises in the third layer and 30,19 for the average of the enterprises. Erdal et al. [11] determined the productivity rate of sugar beet as 17,04 in their study. In their research, Albayrak et al. [1] calculated the productivity rate of sugar beet with drip irrigation as 16,45, in production with sprinkler irrigation as 15,32 and in production with furrow irrigation as 13,73. In their research, Kumbasaroğlu and Dağdemir [27] reported the productivity rate of sugar beet as 14,81 in enterprises with agricultural machinery and 13,23 in sugar beet in enterprises without agricultural machinery. Asgharipour et al. [4] found the productivity rate of sugar beet in their study as 11,58 while Hua et al. [21] determined it as 29,41. Bayramoğlu and Ağızan [7] determined the productivity rate of sugar beet with drip irrigation as 24,90 and in sprinkler irrigation production as 25,11. Kotyza et al. [25] calculated the productivity rate of sugar beet in their study in the Czech Republic for the production period of 2017 as 31,87 while they found it as 46,70 for the sugar beet production in Poland.

Aydoğan et al. [5] determined the productivity rate for sugar beet production as 30,13, while Dimitrijević et al. [9] found it as $31,39 kg^{-1} and Krzysiak [26] found it as 14.33 (1 dt in PLN). Ertürk and Ağır [12] determined the productivity rate for summer type sugar beet as 49,03 and for winter type sugar beet as 47,57. Firouzi et al. [14] calculated the productivity rate in sugar beet production as 9,15.

General Review

This section includes a comparison of the data obtained from sugar beet production with other research findings.

Yield in Sugar Beet (kg da^{-1})

In the research conducted, the net profit value obtained from the unit area was calculated as 7.326,49 da^{-1}. It has been determined that this value is higher than the values obtained by Oğuz and Bayramoğlu [30], Erdal et al. [11], Albayrak et al. [1] (for the sprinkler and furrow irrigation), Kumbasaroğlu and Dağdemir [27], Asgharipour et al. [4], Kotyza et al. [25] (values of the Czech Republic and Poland), Zamani et al. [43], Aydoğan et al. [5], Ertürk and Ağır [12] (for the winter type yield values) and Firouzi et al. [14]. Also, it seems that the value is at a lower level than the values obtained by Albayrak et al. [1] (for the drip irrigation), Hua et al. [21], Řezbová et al. [33] (yield values of 2014), Bayramoğlu and Ağızan [7], Ertürk and Ağır [12] (yield values for summer type).

Ratios of costs in sugar beet cost (Variable Costs, Fixed Costs)

In this study, it was determined that variable costs and fixed costs accounted for 73,30% and 26,70% of the total cost of sugar beet production, respectively. It has been found that the share of variable costs in the total costs determined in this study is below the rate determined by Oğuz and Bayramoğlu [30], Kumbasaroğlu and Dağdemir [27] and Aydoğan et al. [5] whereas it is higher than the rate determined by Erdal et al. [11], Asgharipour et al. [4], Hua et al. [21] and it is quite close to the rate found by Ertürk and Ağır [12].

Sugar beet production cost ($ da^{-1})

In the research conducted, the cost of sugar beet was calculated as $242,67 da^{-1} per unit area. This value is higher than the values calculated by Kumbasaroğlu and Dağdemir [27] (for the enterprises having agricultural machinery), Řezbová et al. [33] (for the value of Slovakia), Kotyza et al. [25] (for the value of Poland), Aydoğan et al. [5], Ertürk and Ağır [12]. It has been determined that it is lower than the values obtained by Erdal et al. [12], Albayrak et al. [1] (for drip and sprinkler irrigation), Kumbasaroğlu and Dağdemir [27] (enterprises that do not have agricultural machinery), Asgharipour et al. [4], Hua et al. [21], Řezbová et al. [33] (for the Czech Republic), Bayramoğlu and Ağızan [7], Kotyza et al. [25] (the Czech Republic value) and Firouzi et al. [14].

Sugar beet production value ($ da^{-1})

In the present study, production value obtained from the per unit area is $418,66 da^{-1} and it is determined that this value is larger than the values obtained by Erdal et al. [11], Asgharipour et al. [4], Aydoğan et al. [5] while it is lower than the values found by Albayrak et al. [1], Hua et al. [21], Bayramoğlu and Ağızan [7].

Cost in sugar beet ($ kg^{-1})

In the research conducted, the cost per kg in sugar beet production was determined as $0,0331 kg^{-1}. This value is lower than the values obtained by Erdal et al. [11], Albayrak et al. [1], Kumbasaroğlu and Dağdemir [27], Asgharipour et al. [4], Firouzi et al. [14] and Tudor et al. [39] whereas it is very close to the values found by Řezbová et al. [33], Kotyza et al. [25] (for the Czech Republic) and it is higher than the values obtained by Kotyza et al. [25], Aydoğan et al. [5], Ertürk and Ağır [12].

Relative Profit Rate in sugar beet production (%)

In the study conducted, the relative profit rate in sugar beet production was determined as 1,73. This rate has been found higher than the rates obtained by Çiçek and Sayılı [8], Göktolga and Karkacıer [17], Erdal et al. [11], Albayrak et al. [1], Asgharipour et al. [4], Gholami ghajelou et al. [16], Bayramoğlu and Ağızan [7], Aydoğan et al. [5], Krzysiak [26] and Firouzi et al. [14] whereas it is lower than the rates determined by Bayramoğlu et al. [6], Hua et al. [21], Ertürk and Ağır [12].

Productivity in sugar beet production (kg $\$^{-1}$)

As a result of the research, productivity in sugar beet production was determined as 30,19 kg $\$^{-1}$. It has been concluded that this value is higher than the values obtained by Erdal et al. [11], Albayrak et al. [1], Kumbasaroğlu and Dağdemir [27], Asgharipour et al. [4], Bayramoğlu and Ağızan [7], Firouzi et al. [14], it is very close to the values found by Hua et al. [21], Kotyza et al. [25] (for the Czech Republic), Aydoğan et al. [5], Dimitrijević et al. [9] and it is lower than the values found by Kotyza et al. [25], Ertürk and Ağır [12].

The results of research on sugar beet production in different countries around the world have revealed that yield, production value, variable costs, fixed costs, production cost, gross profit, net profit, relative profit rate and productivity values of the product are quite different. The reason for this is that besides the inputs used in sugar beet production, the prices of the inputs and the product price differ in each country. This could directly affect the yield and profitability of the product. Considering the yield, production value, variable costs, fixed costs, production cost, gross profit, net profit, relative profit ratio and productivity values calculated as a result of the research in general, it is revealed that sugar beet production per ton or kg is lower than the EU countries especially in terms of cost. However, it is possible to say that the yield value in sugar beet production in Türkiye is still below the desired level.

CONCLUSION

Sugar is one of the products with the highest level of state intervention worldwide. Therefore, some restrictions are imposed on trade in the product through tariff quotas, production quotas, preferential trade agreements and high protection measures. In 2019/20 period, world sugar production decreased by 4,80% from 175 million tons to 166 million tons. In 2019/20 period, world sugar production decreased by 8,4 million tons compared to the previous year to 166.7 million tons. In 2019/2020 period, 76% of world sugar production came from sugar cane and 24% from sugar beet. Sugar beet is produced in 56 countries around the world. In sugar beet production worldwide, Türkiye ranks 5th after the Russian Federation, France, the USA and German with a share of 6,38%. Türkiye is among the countries that produce only sugar beet due to its climatic conditions. In the country, for the period of 2019/2020 period, 2,5 million tonnes of sugar was produced. The total population in the examined enterprises is 249 people and the population average per enterprise is 3,32 people. In the research, the average number of households in the enterprises in the first layer is 3,28 people, this value is determined as 3,32 people in the second layer and 3,36 in the third layer. When we examine the educational status of the business owners, it is found that the rate of high school graduates is 50,66%, the rate of primary school graduates is 45,33% and the rate of university graduates is 2,66%.

The highest crop cultivation in the enterprises within the scope of the study is determined as wheat with a share of 47,65%. This crop is followed by barley cultivation with a share of 30,44%. Sugar beet, the subject of the research, ranks 4th with a share of 6,81%. In the study, the average yield in sugar beet production is 7.326,49 kg da^{-1}. It has been determined that the

yield value of the enterprises in the first and third groups is above the average of the enterprises, while the enterprises in the second group are below the average. The yield in sugar beet production has been calculated as 7.345,91 kg da^{-1} in the enterprises in the first group, 6.728,39 kg da^{-1} in the enterprises in the second group, and 7.476,41 kg da^{-1} in the enterprises in the third group. In this research it has been determined that the product selling price is \$0,006 kg^{-1}, production value is \$418,66 da^{-1}, production cost is \$242,67 da^{-1} and \$0,03 kg^{-1}, gross income is \$240,79 da^{-1}, net profit is \$179,99 da^{-1}, relative profit ratio is 1,73 and productivity is 30,19 kg $\$^{-1}$. These data show that sugar beet production in Balıkesir province is more profitable compared to the cost and profitability indicators of other products. Literature reviews and studies have revealed that Türkiye is not competitive with imported sugar due to the low cost of cane sugar, which dominates the world trade. Therefore, it is compulsory to revisit the existing quotas on especially Türkiye's starch-based sugar trade. The research conducted has revealed that in order to reduce sugar beet production costs, beet agriculture needs to be supported and the principle of sustainability must be followed for this situation. In this context, in order to ensure a permanent balance and stability in sugar beet and sugar production in the country, the purchase prices announced for sugar beet should be calculated in real terms and sugar beet production should be given special importance in agricultural production supports.

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