Input usage and gross profit analysis in canola production: a case study of Çanakkale Province, Turkey.

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Abstract

Canola plant is grown worldwide for different purposes, and it ranks second after soybean among oleaginous seeds. Turkey is one of the countries in which its oleaginous oil supply amount dosen’t meet its own demand, therefore, Turkey’s canola production has been increasing in recent years as an alternative oleaginous seed product. According to the data of 2017, Turkey’s import value for oleaginous seeds and derivative products was 3,2 billion USD, in which 1,5 billion USD of it was oleaginous seeds. In other words, after petrol and petroleum products, oleaginous seeds and derivative products are placed on the top of Turkey’s importation product groups. One of the products that can fill Turkey’s oleaginous oil supply gap is the canola plant. According to the Turkish Statistical Institute (TSI) data of 2018, the proportional share of Çanakkale Province in Turkey’s canola production was 7.5%, making it the 5th region in canola production. The economic aspect of canola production was examined in this study and the data were obtained from 83 agricultural enterprises by means of the Complete Inventory Method. According to the research results, canola production took 1st place in the vegetative production pattern with 31.09%. The average canola production area was 8.41 ha, and average productivity was found as 2962 kg ha^{-1}. In the study, the canola production gross output value was 1095.94 USD ha^{-1}, the gross profit value was 293.60 USD ha^{-1}, and the net profit value was found as 80.17 USD ha^{-1}. It was also discovered that some subsidies for canola production such as field size based subsidies (diesel fuel and fertiliser subsidies) and deficiency payment subsidies; increased the gross output value by 27.31%, increased the gross profit value by 101.92%, and decreased production costs by 29.17%. In order to generate 2962 kg ha^{-1} of canola, (which is the production amount average per unit area) 4.5 kg of seed, 260 kg of pure fertiliser, 3,30 lt of agricultural pesticide, 130 lt of diesel fuel, and around 20 hours of man and machinery power were used. In order to increase the canola production amount in the Çanakkale Province it is necessary to; increase the level of irrigated production fields, increase certified seed usage, and revise the amount of deficiency payments according to the present conditions.

Keywords: Canola. Gross Profit. Cost. Subsidy. Çanakkale.

1. Introduction

Since the 2000s', oleaginous oil and derivative product industries have gained considerable momentum in the world and Turkey. Accordingly, oleaginous seed and oil markets have expanded during this time period. An increase in bio-fuel demand in recent years also contributes to oleaginous seed production as a bio-fuel raw material (Onat et.al, 2017).

There has been an increase in demand of bio-diesel fuel in developing countries, and this situation causes a need for the distribution of oleaginous seed production between food and bio-fuel industries. Considering the increase in global food demand, it is foreseen that using oleaginous seeds as fuel can affect the agricultural sector negatively (İlkdoğan ve ark, 2010).

In terms of oleaginous seeds and oil productions; USA, Brazil, Argentina, and China are the most important countries in soybean oil production; China, Indonesia, and Malaysia are the most important countries in palm oil production; and the EU and Canada are the most important rapeseed producers in the world. Besides oil production, these products are also used in flour, forage, bio-diesel, and other industries as raw materials or additives.

The term 'oleaginous seed plant' includes; soybean, peanut, sunflower, canola/rapeseed, maize, olive, sesame, palm seed, oil flax, safflower, coconut, and castor-oil plant. In terms of the global production amount; soybean, canola, cotton seed, peanut, sunflower, and palm seed are the plants produced the most. The problems of the oleaginous oil and derivative product industries show differences globally, nationally, and regionally; however, they all interact with eachother as a whole.

Turkey has an important potential in oleaginous seed production with its suitable climate and soil characteristics. Nontheless, Turkey's oleaginous oil supply amount dosen't meet its demand. Therefore, Turkey's importation value in 2017 was; 1,46 billion USD for of oleaginous seeds, 1,27 billion USD for oleaginous seed derivatives, 481 million USD for oleaginous seed residues, and was 3,21 billion USD in total (Kadakoğlu and Karlı, 2019). Due to the gap between supply and demand, oleaginous seeds and derivative products are the second highest importation product groups in Turkey after petrol and petroleum products (Onat et al., 2017).

The Turkish Government provides some subsidies for oleaginous seed production such as deficiency payments and field size based subsidies (diesel fuel and fertiliser subsidies) in order to fill the gap between supply and demand, and canola is one of the oleaginous seed plants that is increasingly being produced in Turkey and in the world.

Canola is an oleaginous seed plant which is grown worldwide for different purposes. Considering that canola may be grown anywhere cereals are grown, it's an important and alternative product to meet countries' oil needs.

According to the FAO data of 2017, the global oleaginous seed production amount was around 600 million tons, and the proportional distribution of oleaginous products in this amount respectively were; soybean (42.8%), palm (38.5%), and canola (9.2%) (FAO, 2019a). According to the TSI data of 2018, Turkey's oleaginous seed production amount was around 4 million tons. Among those products sunflower was first (48.62%), and canola was 4th (3.12%) after cottonseed and peanut. The contribution of the Çanakkale Province in canola production was 7.09%, and the province took 5th place in Turkey's total canola production (TSI, 2019).

In this study, the general structure of canola production in the Çanakkale Region was presented by means of data that were collected from canola enterprises. Additionally within the study; canola production cost, gross production value, gross profit, net profit, and benefit/cost ratio were calculated, the input usage situation was presented, and affects of subsidies on canola cost and canola income were examined. The research data were analysed by comparing them to similar studies which were conducted before in different countries.

2. Literature Review

During the literary research of the study, it was found that the number of studies about the economic analysis of canola production were quite limited. Therefore, information was utilised from as many as researches as was possible.

There are several studies about canola production such as; energy usage and efficiency in canola production (Davoodi and Houshyar, 2009; Mousavi-Avval et.al., 2011; Baran et.al., 2014), canola genetics and breeding (Assefa et.al., 2014; Djaman et.al., 2018), and canola production costs (Painter and Dennis, 2007; Painter et.al., 2009).

There are alot of studies about the economic analysis of canola production, however, only few of them have detailed information about the topic. In this section, literary reviews of canola production economics are summarised.

In a study that was carried out by Farré et.al. (2007) in Australia, canola production was examined depending on different seasonal conditions by considering some factors such as sowing date, soil type, and stored soil water. According to the research results, canola was found as a profitable product for rotation especially in high-rainfall conditions. Also, it could be a tactical product in dry or medium rainfall conditions depending on some factors such as stored soil water, sowing opportunities, seasonal climate outlook, prices, and costs.

In a study, the affects of deficiency payments on cotton, sunflower, soybean, canola, maize, and safflower in Turkey were examined (Erdal and Erdal, 2008). In another study which was conducted in the Thrace Region of Turkey; the costs and net profits of three important products were compared, and canola was found to be the most profitable product with 562.74 USD ha^{-1} of net profit (Kumbar and Unakıtan, 2011).

Bayramoğlu et.al. (2010) carried out a study on canola and the economic analysis results were; the gross output value (GOV) per unit was 2385.56 USD ha^{-1}, the net profit was 659.35 USD ha^{-1}, the canola productivity average was 3214.30 kg ha^{-1}, and the canola cost per kg was 0.53 USD.

In a study conducted in the Thrace Region of Turkey by Unakıtan et.al. (2010), fertiliser cost (192.59 USD ha^{-1}) and diesel fuel cost (116.53 USD ha^{-1}) were found as the highest costs in canola production. Also, the average gross value was 1756.60 USD ha^{-1}, the total cost average was 839.98 USD ha^{-1}, the gross profit was 1193.86 USD ha^{-1}, the net profit was 562.74 USD ha^{-1}, and the benefit-cost ratio was found between 1.94 and 2.38 depending on the size of the farm. It was also mentioned that canola production is a profitable agricultural activity for any farm size.

Taheri-Garavand et.al. (2010) carried out a study about the energy elevation and economic analysis of canola production in Iran. According to the research results the total cost, net income, and benefit-cost ratio were found respectively as; 641.10 USD, 550.00 USD, and 0.86. The highest costs were found as the opportunity cost of land (402.40 USD ha^{-1}) and machinery costs (115.70 USD ha^{-1}).

According to the canola economic analysis in a study conducted by Abbas (2011); the total cost was 1424.59 USD ha^{-1}, the gross income was 1765.44 USD ha^{-1}, net income was 340,85 USD ha^{-1}, and the benefit-cost ratio was found as 1.24.

Mousavi-Avval et.al. (2011) carried out a study about canola cost depending on different farm sizes. According to the research results, the variable costs for small, medium, and large farms were found respectively as; 403.52 USD ha^{-1}, 371.02 USD ha^{-1}, and 358.49 USD ha^{-1}. The fixed costs for small, medium, and large farms were respectively found as; 526.55 USD ha^{-1}, 536.57 USD ha^{-1}, and 571.19 USD ha^{-1}. In addition to this; while the total cost was found lowest in medium size farms (907.60 USD ha^{-1}), the benefit-cost ratio was found highest in medium size farms (1.59) and found lowest in small size farms (1.29).

In a study, the energy and economic analysis of canola production in irrigated and dry farming areas were examined with the data of 57 canola producers (Monjezi and Zakidizaji, 2012). According to the research findings, fertiliser and diesel fuel were found as the highest energy inputs, and the output-input energy ratio was found as 1.28 for irrigated farming, and was found as 0.81 for dry farming. In terms of the economic analysis of canola production, the benefit-cost ratio was found as 1.11 for irrigated farming and as 0.58 for dry farming. The net returns were calculated as 85.55 USD ha^{-1} and -240.31 USD ha^{-1} which indicates that it's a profitable product in irrigated conditions.

Tıraş (2016), examined that the distribution of canola production depended on the regions and areas of Turkey, mentioned marketing problems of canola production, and offered some solutions for those problems.

3. Material and Methods

3.1. Materials

The main material of the study consisted of data gathered from canola enterprises in the Çanakkale Province. The data were gathered by means of survey studies which were carried out between November and December 2018. The secondary data of the study were gathered from sources such as the Food and Agriculture Organisation (FAO), the Republic of Turkey Ministry of Agriculture and Forestry (MAF), the Turkish Statistical Institute (TSI), and the Vegetable Oil Industrialists Association (VOIA). Previous studies and reports from several organisations about the topic were also utilised.

3.2. Methods

3.2.1. Sampling method

In order to determine the sample size, the Farmer Registry System of Çanakkale Provincial Directorate of Agriculture and Forestry was inquired, and province wide 83 canola enterprises were determined. In light of this information it was decided to carry out a Complete Inventory Study, and the data were gathered by means of the face-to-face interview method. This research was carried out by the financial support of the Çanakkale Onsekiz Mart University, Scientific Research Projects Coordination Unit, and by the technical support of the Republic of Turkey, the Ministry of Agriculture and Forestry, and the Çanakkale Directorate of Provincial.

3.2.2. The calculation method of canola production cost

In this section, the method that was used in the canola cost calculation is summarised. In the study, canola cost was calculated by the method below (Özkan and Yılmaz, 1999; Alemdar, 2014):

Total Income: Main Product [Productivity (kg ha^{-1}) x Product Sale Price (USD kg^{-1})

Variable Costs: Soil Cultivation + Planting + Fertilisation + Seed + Pesticide + Fertiliser + Harvest + Transportation.

Fixed Expenses: Ground Rent + Capital Interest + Administrative Expenses.

Total Cost: Variable Costs + Fixed Costs

Capital Interest: Variable Costs x 4,13%*.

Administrative Expenses: Total Cost x 3%

Gross Profit: GOV – Variable Costs

Net Profit: GOV – (Variable Costs + Fixed Expenses)

(*) Per-annum rate of the Republic of Turkey Agricultural Bank for vegetable production was considered after subsidies were subtracted from it.

Benefit / Cost Ratio: Total Production Value (USD ha^{-1}) / Total Production Cost (USD ha^{-1})

Gross profit is considered a strong success criterion in order to determine the competitive power of production activities, and it's being used in enterprise comparisons within the Farm Accountancy Data Network of EU (Keskin and Dellal, 2011). Besides, gross profit is the starting point of agricultural enterprise planning (İnan, 2016).

4. Results and Discussion

4.1. Oleaginous seed production and trade in Turkey and in the world

Within the oleaginous seed plants category; soybean, canola, cotton seed, sunflower, peanut, sesame, and safflower are the ones grown the most. According to the FAO data of 2017, the total production area size of oleaginous seeds in the world was 257 million hectare, and Turkey's proportional share in the global oleaginous seeds production area size was around 0.56%. Considering global oleaginous seeds production area sizes, soybean comes in first place (48.19%), and canola comes in second place after soybean (13.53%) (Table1).

Table 1: Oleaginous Seeds Production Area Size in Turkey and in the World (2017)

Oleaginous Seed Plant	World (million ha)	Turkey (000 ha)	Ratio (%)
Soybean	123.6	38.2	0.03
Canola	34.7	16.5	0.05
Cottonseed	33	501.9	1.52
Sunflower	26.5	779.4	2.94
Peanut	27.9	42	0.15
Sesame	10	28	0.28
Safflower	0.8	27.4	3.43
Total	256.5	1433.4	0.56

Source: FAO, 2019a. Crops Statistics. (Available at: http://www.fao.org/faostat/en/#data/QC, 01.10.2019).

According to the FAO statistics of 2017, the global oleaginous seed production amount was 605 million tons in total, and Turkey's proportional share in the global production amount was 0.64%. In terms of production amount, soybean comes first among oleaginous seeds (58.34%), and canola comes second (12.61%). In addition to this, there was around 2 million tons of difference between the canola and cotton seed production amounts (Table 2).

Table 2: Oleaginous Seed Production Amounts in Turkey and in the World (2017)

Oleaginous Seed Plant	World (million tons)	Turkey (000 tons)	Ratio (%)
Soybean	352.6	140	0.04
Canola	76.2	60	0.08
Cottonseed	74.4	1470	1.98
Sunflower	47.9	1964.4	4.10
Peanut	47.1	165.3	0.35
Sesame	5.5	18.4	0.33
Safflower	0.7	50	7.14
Total	604.4	3868.1	0.64

Source: FAO, 2019a. Crops Statistics. (Available at: http://www.fao.org/faostat/en/#data/QC, 01.10.2019).

In terms of the productivity values per unit area in oleaginous seeds, Turkey has the highest values over the global average in any crop group. Turkey's productivity value in soybean production was 55% higher than the global average, and canola productivity was 66% higher than the global average. In addition, the productivity values of peanut and safflower were 2 times higher than the world average (Table 3). The main reasons for this situation are; irrigated farming, high quality seeds, and fertiliser usage.

Table 3: Oleaginous Seeds Productivity Values in Turkey and in the World (2017)

Oleaginous Seed Plant	World (kg ha^{-1})	Turkey (kg ha^{-1})	Turkey/World
Soybean	2854.2	4420.6	54.88
Canola	2194.5	3637.5	65.76
Cottonseed	2254.5	2930.0	29.96
Sunflower	1803.9	2520.0	39.70
Peanut	1685.4	3941.1	133.84
Sesame	554.1	656.8	18.53
Safflower	821.6	1826.4	122.30

Source: FAO, 2019a. Crops Statistics. (Available at: http://www.fao.org/faostat/en/#data/QC, 01.10.2019).

According to the FAO data of 2016, the global oleaginous seed importation value was around 74 billion USD, and Turkey's proportional share in this value was about 2%. Among the other oleaginous seeds, soybean took first place with 74.58%. The global canola importation value was around 9 billion USD and Turkey's proportional share in this value was about 1% (Table 4).

Table 4: Oleaginous Seed Importation Value of Turkey and the World (2016)

Oleaginous Seed Plant	Importation		
	World (billion USD)	Turkey (million USD)	Turkey's Ratio (%)
Soybean	54.96	885.3	1.61
Canola	9.84	106.64	1.08
Cottonseed	0.31	0.04	0.01
Sunflower	3.62	263.01	7.27
Peanut	2.41	16.86	0.70
Sesame	2.43	235.86	9.71
Safflower	0.12	-	-
Total	73.69	1507.71	2.05

Source: FAO, 2019b. Crops and livestock products.
(Available at: http://www.fao.org/faostat/en/#data/TP, 10.11.2019).

According to the FAO data of 2016, the global oleaginous seed exportation value was around 69 billion USD, and Turkey's proportional share in this value was about 0.4%. Among the other oleaginous seeds, soybean came in first place with 75.04%. Global canola exportation value was around 9 billion USD and Turkey's proportional share in this value was insignificantly low (Table 5).

Table 5: Oleaginous Seed Exportation Value of Turkey and the World (2016)

Oleaginous Seed Plant	Exportation		
	World (billion USD)	Turkey (million USD)	Turkey's Ratio (%)
Soybean	51.95	108.36	0.21
Canola	9.15	0.18	0.00
Cottonseed	0.30	3.78	1.26
Sunflower	3.44	120.42	3.50
Peanut	2.24	0.64	0.03
Sesame	2.07	13.49	0.65
Safflower	0.08	-	-
Total	69.23	246.87	0.36

Source: FAO, 2019b. Crops and livestock products.
(Available at: http://www.fao.org/faostat/en/#data/TP, 10.11.2019).

As a general assessment, there is a gap of 1.25 billion USD in Turkey's oleaginous seed plants trade. This situation clearly indicates the self sufficiency problem of Turkey (Table 6).

Table 6: Turkey's Self Sufficiency Rate in Canola

Years	Self Sufficiency Rate (%)	Index (2011=100)
2011	30.90	100.00
2012	49.60	160.52
2013	44.00	142.39
2014	27.70	89.64
2015	21.30	68.93
2016	26.90	87.06
2017	76.70	248.22

Source: TSI, 2020. (databases/statistical tables/crop production statistics/statistical tables/ Crop Products Balance Sheets/ Cereals and Other Crop Products Balance Sheets/, Access: http://tuik.gov.tr/PreTabloArama.do, date: 20.04.2020)

According to the TSI data; excluding the year 2017, Turkey's self sufficency rate in canola was below 50%. The main reasons for this situation are that the canola plant dosen't take enough of a priority in Turkey's crop pattern, and with farmers' unfamiliarity with the canola plant there is not enough subsidy support for canola production.

4.2. Canola production in the research area

The proportional share of Turkey in global canola production fields in 2016 was 0.11%, and was 0.18% in the global production amount. The same values respectively were 0.05% and 0.08% in 2017 (FAO, 2019a). According to the 2016 data, Turkey's share in global canola import was 1.08% (9.8 billion USD), and was 0.04% (6 billion USD) in canola oil import (FAO, 2019b). Turkey's share in global canola export was at a low level that was negligible.

Çanakkale Province is one of the important canola production field areas of Turkey. The contribution of Çanakkale Province in Turkey's canola production in 2018 is given in Table 7.

Table 7: Canola Production in Turkey (2018)

City	Production Area (ha)	Ratio (%)	Production Amount (ton)	Ratio (%)	Productivity (kg ha^{-1})
Tekirdağ	18303.4	48.36	58429	46.74	3192.2
İstanbul	4687.5	12.39	16199	12.96	3455.8
Konya	3237.3	8.55	13030	10.42	4025.0
Edirne	3136.1	8.29	10810	8.65	3447.0
Çanakkale	**2873.3**	**7.59**	**8865**	**7.09**	**3085.3**
Diğer	5608.0	14.82	17667	14.13	3150.3
Total	37845.6	100.00	125000	100.00	3302.9

Source: TSI, 2019. Vegetable Production Statistics.

(Available at: https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr, 05.05.2019)

According to Table 7; Çanakkale Province's proportional share in Turkey's canola production fields in 2018 was 7.59%, and was 7.09% in the total canola production amount, which was 5th countrywide.

4.3. Vegetative production pattern in the research area

In the research area, the total vegetative production field size in 2018 was 2244,7 ha. Distribution of the five main products in the vegetative production pattern respectively were; canola (31,09%), wheat (30,73%), paddy (10,37%), sunflower (10,03%), and barley (6,60%) (Table 8).

Table 8: Vegetal Production Pattern in the Research Area

Products	The Number of Enterprises (Unit)	Production Area (ha)	Ratio (%)
Canola	83	697.8	31.09
Wheat	74	689.7	30.73
Paddy	20	232.8	10.37
Sunflower	32	225.2	10.03
Barley	25	148.2	6.60
Walnut	7	51.3	2.29

Maize (Silage)	14	45.0	2.00
Rye	4	30.0	1.34
Oat	5	21.5	0.96
Clover	9	13.9	0.62
Peach	10	13.5	0.60
Sweet Corn	4	12.0	0.53
Vetch	4	11.0	0.49
Forage Pea	6	10.0	0.45
Italian Ryegrass	2	9.5	0.42
Olive	5	9.0	0.40
Tomato	3	8.0	0.36
Pepper	3	4.5	0.20
Triticale	1	2.5	0.11
Cherry	3	2.3	0.10
Vine	2	1.9	0.08
Plum	4	1.8	0.08
Apple	2	1.8	0.08
Pear	1	1.0	0.04
Almond	1	0.5	0.02
Total	-	2244.7	100.00

4.4. Canola production in the research area

According to the research findings, during the year 2018 the total canola production amount was 2066878 kg in 697.8 ha. The canola production area size average was 8.41 ha, and the productivity average was found as 2962 kg ha^{-1} (Table 9).

Table 9: Information About Canola Production in the Research Area

Criterion	Amount
Production Area Size (ha^{-1})	697.8
Production Amount (kg)	2066878
Productivity (kg ha^{-1})	2962

In a similar study, the production area size average was found as 12.35 ha, and the productivity average was found as 3214.3 kg ha^{-1} (Bayramoğlu et.al., 2010). Also, in two other studies productivity per unit area was found as 3100 kg ha^{-1} (Kumbar and Unakıtan, 2011), and as 1350 kg ha^{-1} (Monjezi and Zakidizaji, 2012). These productivity values show parallelism with this study's findings (2962 kg ha^{-1}).

In the research area; income average per enterprise was 9922.43 USD, sale price average per unit was 0.37 USD kg^{-1}, and GOV per unit area was calculated as 1095.94 USD ha^{-1} (Table 10).

Table 10: Information About Canola Income in the Research Area

Criterion	Amount/Value
GOV (USD)	763929.32
Production Amount (kg)	2066878
Income Average Per Enterprise (USD)	9922.43
Income Per Unit Area (USD ha^{-1})	1095.94
Sale Price Per Unit (USD kg^{-1})	0.37

In some previous studies about canola production the GOV per unit area were; 2385.56 USD ha^{-1} (Bayramoğlu et.al., 2010), 1756.60 USD ha^{-1} (Unakıtan et.al., 2010), 1765.44 USD ha^{-1} (Abbas, 2011), 1288.02 USD ha^{-1} (Kumbar and Unakıtan, 2011), and 843.75 USD ha^{-1} (Monjezi ve Zakidizaji, 2012). It could be said that differences in the GOV values were caused by differences in productivity levels and product sale prices.

4.5. Canola production costs in the research area

Canola production costs in the research area are given in Table 11. In the table, usage amount of production factors and expense items per unit area of canola are presented in detail. Within the study, gross profit per unit was 293.60 USD, net profit was 80.17 USD, and sale price average was calculated as 0.37 USD kg^{-1}.

Table 11: Canola Production Costs in Çanakkale Province (USD ha^{-1})

	Production Process	Process Month	The Number of Applications	Workpower (minute/ha^{-1})		Material	Unit	Value (USD ha^{-1})
				Human	Machinery			
Soil Preparation and Planting								
1	Plowing	September	1-2	234.2	234.2	26.2	ha^{-1}	78.46
2	Duplexing	October	1-2	190.0	190.0	17.8	ha^{-1}	43.03
3	Seeding (Spreader)	October	1	150.0	150.0	7.1	ha^{-1}	28.19
4	Seeding and Fert. Labor.	October	1	100.0	-		ha^{-1}	2.65
5	Harrow	October	2-3	217.1	217.1	11.3	ha^{-1}	18.84
Total				891.3	791.3			**171.17**
Care Works								
1	Fertilisation	February	3				ha^{-1}	28.29
2	Foliar Fertilisation		1	240.0	140.0		ha^{-1}	15.35
3	Pesticide Application	February	4	160.0	160.0		ha^{-1}	50.45
4	Boron Application	March	1	100.0	100.0		ha^{-1}	9.44
5	Weeding	March	1	80.0	0.0		ha^{-1}	136.12

Total				580.0	400.0				**239.65**
Harvest+Transportation									
1	Harvest	June	1	92.2	92.2			ha^{-1}	56.66
2	Transportation	June	1	71.1	71.1			ha^{-1}	14.79
Total				163.3	163.3				**71.45**
Input Usage									
1	Seed	October	1				4.46	kg ha^{-1}	37.77
2	Bottom Fertiliser (Pure)	October	1			0.00	115.80	kg ha^{-1}	58.00
	2nd Fertilisation (Pure)	February	1			2.49	88.30	kg ha^{-1}	50.69
	3rd Fertilisation (Pure)	February	1			2.08	64.60	kg ha^{-1}	38.38
	4th Fertilisation (Pure)	February	1			2.29	64.30	kg ha^{-1}	30.83
	Foliar Fertilisation	February	0			2.25	1.38	kg ha^{-1}	9.22
3	Pesticide (fung.)	February	1			2.29	1.32	kg ha^{-1}	20.51
	Pesticide (herb.-narrow leaved)	February	1			2.55	1.41	kg ha^{-1}	24.57
	Pesticide (herb.-broad leaved)	February	1			2.40	0.98	kg ha^{-1}	32.99
	Pesticide (ins.)	February	1			2.28	0.40	kg ha^{-1}	9.40
4	Boron Application	March	1			1.51	1.09	kg ha^{-1}	6.72
Total									**288.25**
Total Cost									**770.52**
Circulating Capital Interest							4.13%	Interest	31.82
Total Variable Costs									**802.34**
General Administrative Expenses							3.00%	Interest	24.07
Ground Rent									189.36
Total Fixed Costs									**213.43**
Total General Costs									**1015.77**

In this study, the proportional share of variable costs and fixed costs in the total cost were 78% and 22% respectively. In comparsion to smilar previous studies, these values were found as; 68%-32% (Bayramoğlu et.al., 2010); 67%-33% (Kumbar and Unakıtan, 2011); and 60%-40% (Monjezi and Zakidizaji, 2012). According to the research findings, the proportional share of variable costs in the total cost was relatively higher than the other studies.

The distribution of costs in the research area in descending order were; input usage, care works, ground rent, soil preparation, and planting. According to importance level, distribution of the costs in some previous studies about canola were found as; machinery costs, input costs, and ground rent (Bayramoğlu et.al., 2010); ground rent and machinery costs (Taheri-Garavand et.al., 2010); and fertiliser costs and diesel fuel cost (Unakıtan et.al., 2010). These different results indicate that the distribution of cost factors according to their importance levels, show differences depending on the country.

Canola cost per unit area of the study was calculated as 1015.77 USD ha^{-1} (Table 12). In comparison to similar previous studies, canola cost per unit areas were; 1726.21 USD ha^{-1} (Bayramoğlu et.al., 2010), 839.98 USD ha^{-1} (Unakıtan et.al., 2010), 641.10 USD ha^{-1} (Taheri-Garavand et.al., 2010), 1424.59 USD ha^{-1} (Abbas, 2011), 887.26 USD ha^{-1} (Kumbar and Unakıtan, 2011), 758.20 USD ha^{-1} (Monjezi and Zakidizaji, (2012), and 907.60 USD ha^{-1}

(lowest cost as medium size enterprises) (Mousavi-Avval et.al., 2011). The canola cost per kg of the study was calculated as 0.34 USD, this value was found as 0.53 USD by Bayramoğlu et.al (2010). After all, canola cost per unit area of the study shows parallelism with the previous canola studies.

Table 12: Income and Expense Situation in Canola Production

Productivity (kg ha^{-1})	2962,0
Sale Price (USD kg^{-1})	0.37
GOV (TL ha^{-1})	1095.94
Cost (USD ha^{-1})	1015.77
Cost (USD kg^{-1})	0.34
Gross Profit (USD ha^{-1})	293.60
Net Profit (USD ha^{-1})	80.17
Benefit / Cost Ratio	1.08

Within the study, the gross profit value per unit area was determined as 293.60 USD ha^{-1}. In previous studies about canola production, gross profit values were found as follows; Bayramoğlu et.al. (2010) 1203.75 USD ha^{-1}, Monjezi and Zakidizaji (2012) 546.23 USD ha^{-1}, Kumbar and Unakıtan (2011) 400.76 USD ha^{-1}, and Unakıtan et.al. (2010) ise 1193.86 USD ha^{-1}.

In the research area, the net profit value per unit area of canola production was found as 80.17 USD ha^{-1}. Net profit values of similar previous studies were; Bayramoğlu et.al. (2010) 659.35 USD ha^{-1}, Kumbar and Unakıtan (2011) 400.76 USD ha^{-1}, Unakıtan et.al. (2010) 562.74 USD ha^{-1}, Taheri-Garavand et.al. (2010) 550 USD ha^{-1}, Abbas (2011) 340.85 USD ha^{-1}, and Monjezi and Zakidizaji (2012) ise 85.55 USD ha^{-1}. Differences between studies about gross and net profit values were caused by method differences in the calculations of those values.

According to the research analysis results, the benefit/cost ratio was found as 1.08. In the previous studies about canola production, the benefit/cost values were found as follows; Unakıtan et.al. (2010) between 1.94 and 2.38 (depending on farm size), Taheri-Garavand et.al. (2010) 0.86, Abbas (2011) 1.24, Mousavi-Avval et.al. (2011) 1.59 (medium farms) and 1.29 (small farms), and Monjezi and Zakidizaji (2012) 1.11 for irrigated farming and 0.58 for dry farming.

Gross profit, net profit, and the benefit/cost ratio values of the study generally differ from the previous canola studies. The main reason for this situation is due to differences in productivity values, product sale prices, and input usage amounts and their unit prices.

4.6. Effects of agricultural subsidies on canola ıncome and cost

The subsidies that provided for canola production in 2018 are given in Table 13. According to the table, deficiency payment is the most important subsidy among the others. The field size based subsidies (diesel fuel, fertiliser, and certified seed usage) per hectare were 33.58 USD in total.

Table 13: Canola Subsidies in Turkey (2018)

Subsidies	Unit	Unit Price
Diesel Fuel	(USD ha^{-1})	18.15
Fertiliser	(USD ha^{-1})	7.26
Deficiency Payment	(USD kg^{-1})	0.09
Certified Seed Usage	(USD ha^{-1})	7.26
Soil Analysis	(USD/sample)	72.60

Source: TOB, 2019. Agricultural Subsidies. (Available at: https://www.tarimorman.gov.tr/Konular/Tarimsal-Destekler/Fark-Odemesi-Destekleri, 18.04.2019)

In the case of subsidy utilisation; the field size based subsidies (diesel fuel and fertiliser subsidies) and deficiency payments increase GOV by 27,31%, increase gross profit value by 101,92%, and decrease costs by 29,47% (Table 14).

Table 14: Effects of Agricultural Subsidies on Canola Production

Agricultural Subsidies	(TL, %)
Deficiency Payment (0,09 USD kg^{-1} * 2962 kg ha^{-1})	266.58
Diesel Fuel (USD ha^{-1})	18.15
Fertiliser (USD ha^{-1})	7.26
Certified Seed Usage (USD ha^{-1})	7.26
Subsidy Income Total (USD ha^{-1})	299.25
Effects on Cost	1015.77
Cost Total-Subsidy Total (USD ha^{-1})	716.42
Decrease (%)	29.47
Effect on GOV	1095.94
GOV+Subsidy Total (USD ha^{-1})	1395.19
Increase (%)	27.31
Effect on Gross Profit	293.60
Gross Profit+Subsidy Total (USD ha^{-1})	592.85
Increase (%)	101.92
Effect on Net Profit	80.17
Net Profit+Subsidy Total (USD ha^{-1})	379.42
Increase	4.73

In a study that was conducted about canola, a two-way causation was found between deficiency payments and product prices, and it was concluded that deficiency payments are an affective tool for protecting producers in terms of market prices (Erdal and Erdal, 2008).

Within the study, the gross output value was found as 1095.94 USD ha^{-1}. The total subsidy value that provided for canola production was calculated as 299.25 USD ha^{-1}. In a research that was carried out by Kumbar and Unakıtan (2011), contribution of subsidies to the GOV was found as 480.20 USD ha^{-1}. In another study that was carried out by Bayramoğlu et.al. (2010), contribution of subsidies to the GOV was found as 573.59 USD ha^{-1}.

4.7. Input usage in canola production

Input usage values of the research area are given in Table 15. According to analysis results, in order to gain the productivity average of the research area (2962 kg ha^{-1}); 4.46 kg ha^{-1} of seed, 258.64 kg ha^{-1} of pure fertiliser, 3.29 lt ha^{-1} of agricultural pesticide, 131.72 lt ha^{-1} of diesel fuel, and 22 hours of labor force and 20.42 hours machinery force were used.

Table 15: Input Usage in Canola Production

Input	Unit	Usage Level
Seed	(kg ha^{-1})	4.460
Fertiliser	Pure (N) (kg ha^{-1})	188.43
	Pure (P) (kg ha^{-1})	65.32
	Pure (K) (kg ha^{-1})	4.89
	Pure Total (kg ha^{-1})	258.64
	Total (kg ha^{-1})	626.99
Pesticide	Fungicide (lt ha^{-1})	1.04
	Herbicide (lt ha^{-1})	2.00
	Insecticide (lt ha^{-1})	0.25
	Total (lt ha^{-1})	3.29
Diesel Fuel	(lt ha^{-1})	131.72
Labor/Machinery Force	Labor Force (min. ha^{-1})	1317.20
	Machinery Force (min. ha^{-1})	1225.00

In a different research that was carried out in three regions of Turkey, data were gathered from 100 canola enterprises. According to the economic analysis results, input usage values per unit area were as follows; 21.9 hour ha^{-1} of labor force, 79.4 lt ha^{-1} of diesel fuel, 650.50 kg ha^{-1} of fertiliser, 2.71 lt ha^{-1} of pesticide, and 4.427 kg ha^{-1} of seed (Kubar and Unakıtan, 2011).

In a study it was found that 13.0 hours of labor force and 10.3 hours machinery power were used in a 1 hectar canola farm. The detailed proportional distribution of labor force was;

52% in soil preparation and planting, 34% in care works, and 14% was in harvest. In terms of the machinery power usage that was 10.3 hours, 61% was in soil preparation and planting, 23% was in care works, and 16% was in harvest (Bayramoğlu et al., 2010).

According to the research results the findings about input usage per unit area in canola production differ from the previous canola studies due to; different time periods of the researches, different production methods and conditions (technology, dry or irrigated farming, etc.), and differences in farmers' experience levels.

5. Conclusions and Recommendations

Changes in the feeding habits of a growing global population have caused an increase in oleaginous oil production. Therefore, the total global oleaginous seed production amount has increased to over 600 million tons. Among oleaginous seeds, soybean and canola are the plants grown the most. Canola oil is not only consumed as human nutrition but is also used in bio-diesel production as a raw material.

Turkey is one of the countries where the oleaginous oil supply dosent't meet its demand. Therefore, there have been some subsidies provided (diesel fuel, fertiliser, certificated seed usage, deficiency payments) since the early 2000's in order to increase oleaginous oil production. Almost half of the oleaginous oil demand of Turkey is obtained from sunflower production. However, the importance of canola in oleaginous seed production has increased during recent years.

Canola is an important oleaginous seed plant that could be used as an alternative to fill Turkey's vegetable oil gap. In terms of production amount, canola is the second product in the world after soybean, and is the fourth product in Turkey. According to the data of 2018, Çanakkale province holds 7.59% of the canola production fields, and contributes 7.09% of the total canola production amount in Turkey. Within the study, economic aspects of canola production in the Çanakkale province were examined by means of data from 83 canola enterprises.

In the research area; canola, wheat, paddy, sunflower, and barley are the commonly produced products. Canola production is a main product among the others with a proportional share of 31.09%. The average canola production area was 8.41 ha, and the average productivity was found as 2962 kg ha^{-1}. In the study, the canola production gross output value was 1095.94 USD ha^{-1}, the gross profit value was 293.60 USD ha^{-1}, and net profit value was found as 80.17 USD ha^{-1}. Canola production is a profitable production branch according to the findings of previous studies about some economic indicators of canola production such as; GOV, gross profit, net profit, costs, and benefit/cost ratios. Specific to Turkey, the canola productivity average is quite higher than the global average. Considering all these findings of productivity, sale price, and gross profit; canola is an important oleaginous seed alternative for the producers of the province.

There has been a considerable contribution of subsidies to increase the canola production amount through out the years. Likewise, this situation was also presented clearly in other studies which were conducted by Bayramoğlu (2010), Kumbar and Unakıtan (2011), and Unakıtan et.al. (2010). Within this research, it was concluded that subsidies have a great importance to decrease production costs, and accordingly to increase producers' income. If some subsidies such as field size based subsidies and deficiency payment subsidies were utilised; the gross output value of canola production would increase by 27.31%, the gross profit value would increase by 101.92%, and the production costs would decrease by 29.47%.

In the enterprises of the research area, it was observed that they mostly use modern tools and equipment in canola production. Dry farming was determined as the biggest problem of the production process. The other important problem of canola production was that the increase in input prices like fertiliser, pesticides, and diesel fuel were higher than the increase in product sale prices. The main reason for this problem is the high external dependence level of the inputs mentioned above which are imported from abroad.

In order to increase the canola production amount in the Çanakkale Province; irrigated production areas should be expanded, certified seed usage should be encouraged, deficiency payment amounts should be increased, and other subsidy amounts such as diesel fuel, fertiliser, and certified seed usage should be revised according to the present conditions.

6. References

ABBAS, D. Energy Use Efficiency and Economic Analysis of Canola Production in Three Different Areas in Iran. *Journal of Agricultural and Biological Science*, v. 6, n. 11, p. 54-61. 2011.

ALEMDAR, T.; SEÇER, A.; DEMİRDÖĞEN, A.; ÖZTORNACI, B.; AYKANAT, S. Çukurova Bölgesinde Başlıca Tarla Ürünlerinin Üretim Maliyetleri ve Pazarlama Yapıları. GTHB Tarımsal Ekonomi Ve Politika Geliştirme Enstitüsü (TEPGE) (Proje No: Ç.Ü.-ZF2011BAP7). *TEPGE Yayın* No: 230. Haziran. Ankara. 134 s. (http://arastirma.tarim.gov.tr/tepge/Lists/Duyuru/Attachments/10/CukurovaBolgeBaslicaTarlaMaliyetPazarlamaYap%C4%B1.pdf). 2014.

ASSEFA, Y.; ROOZEBOOM, K.; STAMM, M. Winter Canola Yield and Survival as a Function of Environment, Genetics, and Management. *Crop Science*, v. 54, n. 5, p. 2303-2313. 2014.

BARAN, M.F.; GÖKDOĞAN, O.; KARAAĞAÇ, H.A. Kanola Üretiminde Enerji Kullanım Etkinliğinin Belirlenmesi (Kırklareli İli Örneği). *Türk Tarım ve Doğa Bilimleri Dergisi*, v.1, n. 3, p. 331-337. 2014.

BAYRAMOĞLU, Z.; AKTÜRK, D.; TATLIDİL, F.F. Kaynakların Rasyonel Kullanımının Üretim Maliyetleri Üzerine Etkisi: Kanola Yetiştiriciliği Örneği. Selçuk Üniversitesi. *Selçuk Tarım ve Gıda Bilimleri Dergisi*, v. 24, n. 3, p. 62-68. 2010.

DAVOODİ, M.J.Ş.; HOUSYAR, E. Energy consumption of canola and sunflower production in Iran. *American-Eurasian J. Agric. & Environ. Sci.*, v. 6, n. 4, p. 381-384. ISSN 1818-6769, IDOSI Publications. 2009.

DJAMAN, K.; O'NEİLL, M.; OWEN, C.; SMEAL, D.; WEST, M.; BEGAY, D.; ANGADİ, S.V.; KOUDAHE, K.; ALLEN, S.; LOMBARD, K. Seed Yield and Water Productivity of Irrigated Winter Canola (Brassica napus L.) under Semiarid Climate and High Elevation. *Agronomy*: v. 8, n. 90. 2018.

ERDAL, G.; ERDAL, H. Türkiye'de Tarımsal Desteklemeler Kapsamında Prim Sistemi Uygulamalarının Etkileri. *GOÜ Ziraat Fakültesi Dergisi*, v. 25, n. 1, p. 41-51. 2008.

FAO. Bitkisel üretim istatistikleri. (Available at: http://www.fao.org/faostat/en/#data/QC, 01.10.2019). 2019a.

FAO. Bitkisel ve hayvansal ürünler ticareti istatistikleri. (erişim: http://www.fao.org/faostat/en/#data/TP, 10.11.2019). 2019b.

FARRÉ, I.; ROBERTSON, M.; ASSENG, S. Reliability of Canola Production in Different Rainfall Zones of Western Australia. *Australian Journal of Agricultural Research*. v. 58, n. 4, p. 326-334. 2007.

İLKDOĞAN, U. Dünya ve Avrupa Birliği'nde Yağlı Tohum Ticaretinde Gelişmeler Türkiye Bağlamında Değerlendirme, (ANKARA). 2008.

İNAN, İ.H. Tarım ekonomisi ve işletmeciliği (güncellenmiş 8. Baskı). İdeal Kültür Yayıncılık, İstanbul. s.262. 2016.

KADAKOĞLU,B.; KARLI,B. Oilseeds Production and Foreign Trade in Turkey. *The Journal of Academic Social Science*, v. 7, n. 96, p. 324-341, 2019.

KESKİN, G.; DELLAL, İ. Trakya bölgesinde süt sığırcılığı üretim faaliyetinde brüt kâr analizi. Kafkas Un. Vet. Fak. Derg. v. 17, n. 2, p. 177-182. 2011.

KUMBAR, N.; UNAKITAN, G. An Economic Analysis of Canola Production in Trakya Region. *Journal of Tekirdag Agricultural Faculty*, v. 8, n. 1, p. 75-80. 2011.

MOUSAVI-AVVAL, S.H.; RAFIEE, S.; JAFARI, A.; MOHAMMADI, A. Energy Efficiency and Cost Analysis of Canola Production in Different Farm Sizes. *International Energy and Environment*, v. 2, n. 5, p. 845-852. 2011.

MONJEZİ, N.; ZAKİDİZAJİ, H. Energy and Economic Analysis of Canola Production in Iran a Case Study: Khuzestan Province. *Research Journal of Applied Sciences, Engineering and Technology*. v. 4, n. 3, p. 227-231. 2012.

MOUSAVİ-AVVAL, S.; RAFİEE, H.; JAFARİ, S.; MOHAMMADİ, A. Energy flow modeling and sensitivity analysis of inputs for canola production in Iran. *Journal of Cleaner Production*, v. 19, p. 1464-1470. 2011.

ONAT, B.; ARICIOĞLU, H.; GÜLLÜOĞLU, L.; KURT, C.; BAKAL, H. Dünya ve Türkiye'de Yağlı Tohum ve Ham Yağ Üretimine Bakış . *KSÜ Doğa Bilimleri Dergisi*, v. 20, (Özel Sayı), p. 149-153, 2017.

ÖZKAN, B.; YILMAZ, İ. Tek Yıllık Bitkiler İçin Maliyet Hesaplamaları: Mevcut Durum, Sorunlar Ve Öneriler. Tarım Ekonomisi Dergisi, Sayı 1999/4: 64-80. 1999.

PAINTER, K.; DENNIS, R. Economics of Canola Production in the Pacific Northwest (WP 2007-17). Working Paper Series. Washington State University. School of Economic Sciences. Pullman WA,USA. 11 pgs. 2007.

PAINTER, K.; HINMAN, H.; DENNIS, R. Economics of Spring Canola Production in Dryland Eastern Washington (EB2009E). Washington State University. School of Economic Sciences. Pullman WA,USA. 22 pgs. 2009.

TAHERI-GARAVAND, A.; ASAKEREH, A.; HAGHANI, K. Energy Elevation and Economic Analysis of Canola Production in Iran a Case Study: Mazandaran Province. *Internatıonal Journal of Environmental Sciences*, v. 1, n. 2, p. 236-242. 2010.

TIRAŞ, M. Türkiye'de Kanola Tarımı. *Eastern Geographical Review*. v. 14, n. 21, p. 159-172. 2016.

TSI. Türkiye İstatistik Kurumu Veritabanı, Bitkisel Üretim İstatistikleri. (yağlı tohumlu bitkiler üretim bilgileri). (Available at: https://biruni.tuik.gov.tr/medas/?kn=92&locale=tr, 05.05.2019). 2019.

UNAKITAN, G.; HURMA, H.; YILMAZ, F. An Analysis of Energy Use Efficiency of Canola Production in Turkey. Energy 35(2010) 3623-3627. 2010.

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