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Economic Analysis for Groundwater-Irrigated Oil Sunflower Farming in Konya Region

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ABSTRACT

In this study, economic analysis was conducted for groundwater-irrigated oil sunflower farming in Konya region. This study was conducted over the agricultural fields of 20 oil sunflower farmers operating within the irrigation scheme of groundwater irrigation cooperative of Başgötüren districts of Karatay town of Konya province in 2019. Within the scope of this study, inputs used in oil sunflower farming, input quantities and unit prices, yields and unit sales prices of the farmers were determined. Cost-benefit analysis was performed with the resultant data and economic assessments were performed for irrigated oil sunflower farming. Average total production cost of groundwater-irrigated oil sunflower farming was calculated as 4683.4 TL ha^{-1} (821.6 \$ ha^{-1}). Of such a cost, 50% was constituted by irrigation costs. Electricity constituted the greatest cost item in irrigation costs. Average gross production value was calculated as 8208.3 TL ha^{-1} (1440.1 \$ ha^{-1}). Together with state supports, average net income was calculated as 5057.3 TL ha^{-1} (887.2 \$ ha^{-1}).

1. Introduction

Sunflower is an annual herbaceous plant which has been produced for oil since the beginning of the 18th century. It is among the most important oil crops worldwide. Sunflower is originated from the Central America. Annual oil sunflower production of the world was 26 533 596 ha in 2017. Russia and Ukraine are the leading sunflower producer countries of the world. Among the first 10 countries with the greatest sunflower production lands, Turkey has the 7th place (FAOSTAT, 2019). Turkey is also among the important sunflower producer countries. In Turkey, oil sunflower was cultivated over 648 934 ha land area in 2018. However, only 26.1% of these production lands are under irrigation (TÜİK, 2019). In this sense, Konya province has an important share in sunflower production of Turkey. According to TÜİK data, in 2018, 11.3% of sunflower production and about 16% of oil sunflower production of Turkey was practiced in Konya province. Sunflower farming is generally practiced under irrigated conditions in Konya region and the province alone constitute about 43% of total irrigated sunflower farming lands of Turkey. In Konya region, irrigation is the most significant input in sunflower and other crops farming, and a large ratio of crop water consumption was compensated by irrigation water because of low rainfall. The compensation rate of ET by applied irrigation was determined as at sugarbeet 88% (Topak et al., 2016), at sunflower 80% (Yavuz et al., 2016; Yavuz et al., 2018) and at confectionary pumpkin 82% (Yavuz et al., 2015) for full irrigation conditions. Groundwater-based irrigation operations use quite much energy and thus constitute a significant cost item in agricultural practices. Groundwater resources are used in majority of irrigated lands in Konya region (Topak et al., 2008).

Previous researchers conducted experimental studies for economic analysis of sunflower farming (Das and Rout, 2018; Karaağaç et al., 2018; Sethar et al., 2015; Unakıtan and Aydın, 2018; Semerci et al., 2007). For instance, Sethar et al. (2015) conducted a survey study in Pakistan for economic analysis of oil sunflower farming and indicated total production cost as 481.4 \$ ha^{-1}, gross income as 797 \$ ha^{-1} and net income as 315 \$ ha^{-1}. Das and Rout (2018) conducted an economic analysis of oil sunflower farming in India and reported total production costs as 564 \$ ha^{-1} and net in-

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come as 584 $ ha^{-1}**.** Unakıtan and Aydın (2018) conducted an economic analysis of oil sunflower farming in Thrace region of Turkey and indicated net income as 26 $ ha^{-1}. Karaağaç et al. (2018) conducted a study under provincial conditions of Adana, Turkey and indicated production cost of oil sunflower farming as 3454.7 TL ha^{-1}, gross income as 5040 TL ha^{-1} and net income as 1585.3 TL ha^{-1}.

In this study, economic analysis was conducted for oil sunflower farming practiced under Konya conditions and produced with groundwater irrigations. In this sense, cost-benefit analysis method was used to determine some economic indicators.

2. Material and Method

This study was conducted over the agricultural fields of 20 oil sunflower farmers operating within the irrigation scheme of groundwater irrigation cooperative of Başgötüren districts of Karatay town of Konya province in 2019. Başgörüren irrigation cooperative was put into operation in 1978. The cooperative has actively operating 43 wells and total irrigation water discharge is 4 536 m^3 h^{-1}. Total land size opened for irrigation is 1847 ha and pressurized irrigation is practiced over the irrigated lands of the cooperative (KBSKB, 2017). Discharge of operating wells varies between 54 m^3 h^{-1} and 144 m^3 h^{-1}.

Soil analyses revealed that experimental soils were clay-loam in texture with high lime contents. All of the oil sunflower farmers selected in this study were using groundwater in irrigations. Drip and sprinkler irrigation methods are used in irrigations. The research site has a dominant terrestrial climate. Some meteorological data for the research site are provided in Table 1. Climate data were supplied from the nearest climate station located at Esentepe district (Karatay town). Long term average precipitation for sunflower growing season (March – October) is 124.2 mm and the amount realized in the research year was 134.3 mm.

Table 1
Temperature and precipitation data for the research site (MBM, 2019)

		Months												
		1	2	3	4	5	6	7	8	9	10	11	12	Annual Average
Long-term averages	Temperature (^{0}C)	-0.2	1.4	5.6	11.1	15.8	20.1	23.5	23.2	18.5	12.5	6.3	1.7	11.6
	Precipitation (mm)	37.6	28.5	28.9	31.9	43.6	25.5	6.3	4.6	12.3	30.0	32.0	42.1	323.3
2019	Precipitation (mm)	17.1	41.3	14.7	26.2	17.1	71.6	0.0	12.8	6.6	-	-	-	207.4

Within the scope of field works, 20 oil sunflower farmers practicing under groundwater irrigation cooperative were selected randomly. During the growing season of 2019, farmer's practices and required inputs, input quantities and monetary values, products and product unit prices were determined through regular monitoring and face-to-face meetings with the farmers. Within the scope of such works, farmer-scale data were gathered about the basic production inputs such as seed, fertilizer, machine, diesel fuel, electricity for irrigation and irrigation system. Machine and equipment economic lives were taken from ASAE (1999) and economic life values of pressurized irrigation system were considered as farmer's opinion. Product price of oil sunflower varies based on oil content. The criteria considered for product unit prices are provided in Table 2.

Table 2
Sunflower purchase prices (Konya Sugar Co., 2019)

Oil ratio (%)	Price (TL kg^{-1})
52	2.965
51	2.927
50	2.890
49	2.852
48	2.815
47	2.777
46	2.740
45	2.702
44	2.665

Cost-benefit analysis (Layard and Glaister, 1994; Ballestero, 2000) method was used to calculate economic indices in irrigated sunflower farming. In this sense, initially total production costs (irrigation + other costs) and gross income per unit area (ha) were calculated. Then, these values were used to determine some economic assessment indicators. Equations used in such calculations are provided below:

- Irrigation cost (A) (TL ha^{-1}) = Irrigation system cost + energy cost + irrigation labor cost

- The other costs (B) (TL ha^{-1}) = Soil tillage + seedbed preparation + seeding + seed + fertilizer and fertilization + hoeing + chemicals and applications + harvest

- Total production costs (C) (TL ha^{-1}) = A + B

- Contribution of irrigation to total production costs (%) = A /(A + B) x 100

- Gross production value (D) (TL ha^{-1}) = Yield (kg ha^{-1}) × sales price (TL kg^{-1})

- Net income (TL ha^{-1}) = D - C (Ballestero, 2000)

- Economic productivity (EP) (kg TL^{-1}) = Yield (kg ha^{-1})/C (TL ha^{-1})

- Economic irrigation water productivity (EIWP) (TL m^{-3}) = Net income (TL) / amount of applied irrigation water (m^3) (Pereira et al., 2012; Çetin and Kara, 2019)

- Breakeven point (kg ha^{-1}) = (C) / Sales price (TL kg^{-1}) (Layard and Glaister, 1994; García-García et al., 2004).

3. Results and Discussion

3.1. Irrigation and yield values

Seasonal amount of irrigation water applied to sunflower was determined and provided in Table 3. Amount of applied irrigation water varied from one farmer to another. The lowest amount of applied irrigation water was 2304 m^3 ha^{-1} and the greatest value was 6352 m^3 ha^{-1} and average of research sites was calculated as 4004 m^3 ha^{-1}. There were differences in yields of farmers as provided in Table 3. Yields of participant farmers varied between 2200 - 4000 kg ha^{-1} with an average value of 3256 kg ha^{-1}. As can be inferred from the table, the greatest yields were not obtained by the farmers applying the greatest amount of irrigation water and vice versa. A two-year field experiment conducted by Yavuz et al. (2019) in the same region, reported that seed yield for oil sunflower irrigated at different irrigation levels was between 3243 (3412 m^3 ha^{-1}) and 5445 kg ha^{-1} (6900 m^3 ha^{-1}) and, the maximum yield was achived at full irrigation condition.

Table 3
Amount of applied irrigation water and yields of farmers

Farmers	Field size (ha)	Well discharge (m^3 h^{-1})	Irrigation duration (h)	Amount of applied irrigation water (m^3 ha^{-1})	Yield (kg ha^{-1})	Number of irrigations	Irrigation method
1	4.75	144	133	4032.00	3728	4	SI
2	3.00	144	132	6336.00	2660	4	SI
3	5.25	72	208	2852.57	3000	4	SI
4	10.00	108	260	2808.00	2200	3	SI
5	10.00	54	1040	5616.00	2600	4	SI
6	5.00	144	80	2304.00	3680	6	DI
7	2.50	108	96	4147.20	3600	4	SI
8	2.35	144	63	3860.43	3770	5	SI
9	7.50	108	357	5140.80	3600	4	DI
10	3.00	108	95	3420.00	3480	4	SI
11	7.50	108	209	3009.60	2800	4	SI
12	2.30	108	88	4132.17	2200	4	SI
13	5.00	90	165	2970.00	3800	5	SI
14	6.90	144	220	4591.30	4000	4	DI
15	3.25	108	75	2492.31	3000	3	SI
16	1.70	90	120	6352.94	2400	4	SI
17	6.25	108	258	4458.24	3800	6	DI
18	7.50	144	168	3225.60	3400	4	SI
19	6.00	144	200	4800.00	3400	4	DI
20	4.75	108	156	3546.95	4000	6	DI
Avrg.	5.23	114	206	4004.81	3256		

SI: Sprinkler irrigation; DI: Drip irrigation

3.2. Economic analysis

3.2.1. Irrigation costs

Irrigation costs of each farmer were calculated for oil sunflower cultivation with groundwater irrigations and resultant values are provided in Table 4. The lowest cost of irrigation was calculated as 1207.7 TL ha^{-1} (211.9 $ ha^{-1}) and the greatest value was calculated as 4404 TL ha^{-1} (772.6 $ ha^{-1}) and average of the research site was calculated as 2383 TL ha^{-1} (418 $ ha^{-1}).

Table 4
Irrigation costs of oil sunflower cultivation

Farmers	Land size (ha)	Hourly price of well (TL h^{-1})	Total operation duration of well (h)	Electricity cost (TL ha^{-1})	Irrigation system cost (TL ha^{-1})	Labor cost (TL ha^{-1})	Total irrigation cost (TL ha^{-1})	Total irrigation cost ($ ha^{-1})	Ratio of electricity cost to irrigation costs (%)
1	4.75	64	133	1792	50	0	1842.0	323.2	97
2	3.00	64	132	2816	60	400	3276.0	574.7	86
3	5.25	32	208	1268	38	0	1305.8	229.1	97
4	10.00	48	260	1248	69	1000	2317.0	406.5	54
5	10.00	24	1040	2496	55	0	2551.0	447.5	98

Table 4 (Continuation)
Irrigation costs of oil sunflower cultivation

6	5.00	64	80	992	680	0	1672.0	293.3	59
7	2.50	48	96	1843	220	0	2063.2	362.0	89
8	2.35	64	63	1716	247	480	2442.7	428.6	70
9	7.50	60	357	2856	888	660	4404.0	772.6	65
10	3.00	48	95	1520	153	400	2073.0	363.7	73
11	7.50	48	209	1338	20	0	1357.6	238.2	99
12	2.30	48	88	1837	91	630	2557.5	448.7	72
13	5.00	40	165	1320	100	0	1420.0	249.1	93
14	6.90	64	220	2041	1014	0	3054.6	535.9	67
15	3.25	48	75	1108	100	0	1207.7	211.9	92
16	1.70	40	120	2824	20	0	2843.5	498.9	99
17	6.25	64	258	2642	704	770	4115.9	722.1	64
18	7.50	64	168	1434	56	0	1489.6	261.3	96
19	6.00	64	200	2133	753	500	3386.3	594.1	63
20	4.75	48	156	1576	715	0	2291.4	402.0	69
Avrg.	5.23	52.1	206.2	1839.9	301.7	242.0	2383.5	418.2	80.12

Total irrigation cost was mostly constituted by electrical energy cost. The ratio of electrical energy cost to irrigation cost varied between 54 – 99% and average of the research site was 80.1%.

3.3. The other production costs

The other production costs apart from irrigation was also determined and provided in Table 5. The lowest other costs were 1437.1 TL ha^{-1} (252.1 $ ha^{-1}), the greatest value was 3573.8 TL ha^{-1} (627.0 $ ha^{-1}) and the average of the research site was calculated as 2263.0 TL ha^{-1} (397.0 $ ha^{-1}). As can be inferred from Table 5, fertilizer cost had the greatest ratio in the other costs apart from irrigation. Fertilizer costs of the farmers varied between 00.0 TL kg^{-1} (0.0 $ kg^{-1}) – 1240 TL ha^{-1} (217.5 $ ha^{-1}) with an average value of 704.2 TL ha^{-1} (123.1 $ ha^{-1}). Such differences were mostly resulted from unit price and quantity of the seeds used since the seeds are usually priced based on their yield potentials and resistance to pests and diseases.

Table 5
The other production costs

Farmrs	Soil Tillage cost (TL ha^{-1})	Seedbed preparation cost (TL ha^{-1})	Seed Cost (TL ha^{-1})	Seeding Costs (TL ha^{-1})	Chemical cost (TL ha^{-1})	Hoeing cost (TL ha^{-1})	Fertilizer cost (TL ha^{-1})	Harvest cost (TL ha^{-1})	Total cost (TL ha^{-1})	Total cost ($ ha^{-1})
1	82.5	60.4	283.5	120.0	0.0	117.3	0.0	280.0	1943.7	341.0
2	113.8	164.7	360.0	120.0	0.0	0.0	504.0	280.0	1542.5	270.6
3	123.4	177.4	540.0	120.0	400.0	120.0	1020.0	240.0	2740.8	480.8
4	122.2	158.4	440.0	160.0	60.0	0.0	724.0	240.0	1904.6	334.1
5	106.5	136.7	408.0	160.0	0.0	160.0	1240.0	280.0	2491.2	437.1
6	107.5	160.3	640.0	120.0	36.0	140.0	1000.0	280.0	3573.8	627.0
7	107.2	168.9	384.0	120.0	0.0	65.5	1040.0	280.0	2165.6	379.9
8	149.3	614.3	378.0	82.0	0.0	69.9	462.0	280.0	2035.5	357.1
9	100.3	141.2	720.0	120.0	0.0	64.5	1040.0	320.0	2506.0	439.6
10	87.9	175.5	400.0	120.0	0.0	32.6	420.0	280.0	1516.0	266.0
11	84.6	85.4	383.0	140.0	0.0	44.1	420.0	280.0	1437.1	252.1
12	81	163.2	425.0	160.0	104.0	51.7	260.0	280.0	1524.9	267.5
13	200	160.0	640.0	120.0	0.0	120.0	642.0	240.0	3452.0	605.6
14	141.2	175.5	585.0	160.0	35.2	160.0	780.0	320.0	2356.9	413.5
15	101.9	159.5	338.0	120.0	50.5	32.6	1200.0	280.0	2282.5	400.4
16	116.3	81.9	360.0	120.0	71.6	0.0	1100.0	280.0	2129.8	373.6
17	112.1	211.2	480.0	70.0	52.1	35.3	768.0	280.0	3408.7	598.0
18	100.1	159.0	627.0	120.0	0.0	41.1	440.0	240.0	1727.2	303.0
19	113.4	147.9	424.0	66.0	0.0	48.6	764.0	280.0	1843.9	323.5
20	117.6	88.8	640.0	82.0	0.0	48.6	260.0	240.0	2677.0	469.6
Avrg.	113.4	169.5	472.8	120.0	40.5	67.6	704.2	274.0	2263.0	397.0

3.4. Total production costs

Total production costs of the oil sunflower farmers using groundwater irrigations were calculated and provided in Table 6. The lowest total production cost was 2794.7 TL ha^{-1} (490.3 $ ha^{-1}), the greatest value was 7524.6 TL ha^{-1} (1320.1 $ ha^{-1}) and the average of the research site was calculated as 4646.5 TL ha^{-1} (815.2 $ ha^{-1}). About 29-68% of total production costs were constituted by irrigation cost. As can be seen in Table 6, there were two groups for the ratio of irrigation costs in total costs (the first group had a ratio of between 29.15 - 34.61% and the second group had a ratio of between 46.13 - 68.00%). The group with the lowest ratio of irrigation costs (4 farmers) was composed of the farmers using the least amount of irrigation water (230 - 290 mm) and not paying for irrigation labor. The group with greater ratios of irrigation costs generally composed of the farmers using greater quantities of irrigation water and paying for irrigation labor. The average ratio of irrigation costs in total costs was identified as 50%. In other words, about half of total production costs was constituted by irrigation costs.

3.5. Gross production value

Gross production values of the oil sunflower farmers of the research site were calculated and results are provided in Table 7. As can be seen from the table, the lowest gross production value was calculated as 5500.0 TL ha^{-1} (964.9 $ ha^{-1}), the greatest gross production value was calculated as 10070.0 TL ha^{-1} (1766.7 $ ha^{-1}) and the average value was calculated as 8208.3 TL ha^{-1} (1440.1 $ ha^{-1}). As can be inferred from Table 7, the net incomes gained from harvested yields varied between 906.7 TL ha^{-1} (159.1 $ ha^{-1}) and 6371.2 TL ha^{-1} (1117.8 $ ha^{-1}) with an average value of 3561.8 TL ha^{-1} (624.9 $ ha^{-1}).

Table 6
Total production costs

Farmers	Irrigation Cost (TL ha^{-1})	The other Costs (TL ha^{-1})	Total Production Cost (TL ha^{-1})	Total Production Cost ($ ha^{-1})	Ratio of irrigation cost to total production cost (%)
1	1842.0	1943.7	3785.7	664.2	48.7
2	3276.0	1542.5	4818.5	845.4	68.0
3	1305.8	2740.8	4046.6	709.9	32.3
4	2317.0	1904.6	4221.6	740.6	54.9
5	2551.0	2491.2	5042.2	884.6	50.6
6	1672.0	3573.8	5245.8	920.3	31.9
7	2063.2	2165.6	4228.8	741.9	48.8
8	2442.7	2035.5	4478.2	785.7	54.5
9	4404.0	2506.0	6910.0	1212.3	63.7
10	2073.0	1516.0	3589.0	629.6	57.8
11	1357.6	1437.1	2794.7	490.3	48.6
12	2557.5	1524.9	4082.4	716.2	62.6
13	1420.0	3452.0	4872.0	854.7	29.1
14	3054.6	2356.9	5411.5	949.4	56.4
15	1207.7	2282.5	3490.2	612.3	34.6
16	2843.5	2129.8	4973.3	872.5	57.2
17	4115.9	3408.7	7524.6	1320.1	54.7
18	1489.6	1727.2	3216.8	564.4	46.3
19	3386.3	1843.9	5230.2	917.6	64.7
20	2291.4	2677.0	4968.4	871.7	46.1
Avrg.	2383.5	2263.0	4646.5	815.2	50.6

Table 7
Gross production value

Farmers	Yield (kg ha^{-1})	Sales price (TL kg^{-1})	Gross production value(TL ha^{-1})	Gross production value($ ha^{-1})	Net income (TL ha^{-1})	Net Income ($ ha^{-1})
1	3728.0	2.64	9841.9	1726.7	6056.2	1062.5
2	2660.0	2.40	6384.0	1120.0	1565.5	274.6
3	3000.0	2.50	7500.0	1315.8	3453.4	605.9
4	2200.0	2.50	5500.0	964.9	1278.4	224.3
5	2600.0	2.30	5980.0	1049.1	937.8	164.5
6	3680.0	2.45	9016.0	1581.8	3770.2	661.4
7	3600.0	2.70	9720.0	1705.3	5491.2	963.4
8	3770.0	2.60	9802.0	1719.6	5323.8	934.0
9	3600.0	2.42	8712.0	1528.4	1802.0	316.1
10	3480.0	2.65	9222.0	1617.9	5633.0	988.2
11	2800.0	2.45	6860.0	1203.5	4065.3	713.2
12	2200.0	2.50	5500.0	964.9	1417.6	248.7
13	3800.0	2.65	10070.0	1766.7	5198.0	911.9
14	4000.0	2.37	9480.0	1663.2	4068.5	713.8
15	3000.0	2.51	7530.0	1321.1	4039.8	708.7
16	2400.0	2.45	5880.0	1031.6	906.7	159.1
17	3800.0	2.46	9348.0	1640.0	1823.4	319.9
18	3400.0	2.82	9588.0	1682.1	6371.2	1117.8
19	3400.0	2.48	8432.0	1479.3	3201.8	561.7
20	4000.0	2.45	9800.0	1719.3	4831.6	847.6
Avrg.	3255.9	2.52	8208.3	1440.1	3561.8	624.9

3.6. Economic indicators

Some economic indicators calculated within the scope of this study are provided in Table 8. In Turkey in 2018, fertilizer and fuel support were implemented as 230 TL ha-1 and direct yield support was implemented as 0.40 TL kg-1. State supports were added to net incomes provided in Table 7 and resultant net incomes per unit area are provided in Table 8. The lowest net income for oil sunflower production was calculated as 2096.7 TL ha^{-1} (367.8 $ ha^{-1}), the greatest net income was calculated as 7961.2 TL ha^{-1} (1396.7 $ ha^{-1}) and average of the research site was calculated as 5094.1 TL ha^{-1} (893.7 $ ha^{-1}).

Table 8
Economic Assessment Indicators

Farmers	Production supports		Fertilizer + fuel support		State-supported net income		Economic productivity		Economic irrigation water productivity		Breakeven point
	TL kg^{-1}	$ kg^{-1}	TL ha^{-1}	$ kg^{-1}	TL ha^{-1}	$ ha^{-1}	kg TL^{-1}	kg $$^{-1}$	TL m^{-3}	$ m^{-3}	kg ha^{-1}
1	1491.2	261.6	230.0	40.4	7777.4	1364.5	0.98	5.61	1.93	0.34	1434.0
2	1064.0	186.7	230.0	40.4	2859.5	501.7	0.55	3.15	0.45	0.08	2007.7
3	1200.0	210.5	230.0	40.4	4883.4	856.7	0.74	4.23	1.71	0.30	1618.6
4	880.0	154.4	230.0	40.4	2388.4	419.0	0.52	2.97	0.85	0.15	1688.6
5	1040.0	182.5	230.0	40.4	2207.8	387.3	0.52	2.94	0.39	0.07	2192.3
6	1472.0	258.2	230.0	40.4	5472.2	960.0	0.70	4.00	2.38	0.42	2141.1
7	1440.0	252.6	230.0	40.4	7161.2	1256.4	0.85	4.85	1.73	0.30	1566.2
8	1508.0	264.6	230.0	40.4	7061.8	1238.9	0.84	4.80	1.83	0.32	1722.4
9	1440.0	252.6	230.0	40.4	3472.0	609.1	0.52	2.97	0.68	0.12	2852.1
10	1392.0	244.2	230.0	40.4	7255.0	1272.8	0.97	5.53	2.12	0.37	1354.3
11	1120.0	196.5	230.0	40.4	5415.3	950.1	1.00	6.30	1.80	0.33	1034.6
12	880.0	154.4	230.0	40.4	2527.6	443.4	0.54	3.07	0.61	0.11	1633.0
13	1520.0	266.7	230.0	40.4	6948.0	1218.9	0.78	4.45	2.34	0.41	1838.5
14	1600.0	280.7	230.0	40.4	5898.5	1034.8	0.74	4.22	1.28	0.23	2281.6
15	1200.0	210.5	230.0	40.4	5469.8	959.6	0.86	4.90	2.19	0.39	1390.5
16	960.0	168.4	230.0	40.4	2096.7	367.8	0.48	2.40	0.33	0.04	2029.9
17	1520.0	266.7	230.0	40.4	3573.4	626.9	0.51	2.88	0.80	0.14	3058.8
18	1360.0	238.6	230.0	40.4	7961.2	1396.7	1.06	6.02	2.47	0.37	1140.7
19	1360.0	238.6	230.0	40.4	4791.8	840.7	0.65	3.71	1.00	0.13	2109.0
20	1600.0	280.7	230.0	40.4	6661.6	1168.7	0.81	4.59	1.88	0.33	2027.9
Avrg.	1302.4	228.5	230.0	40.4	5094.1	893.7	0.73	4.18	1.44	0.25	1856.1

Economic productivity (EP) values varied between 0.48 - 1.06 kg TL^{-1} with an average value of 0.73 kg TL^{-1}. These values revealed that the lowest values belonged to the farmers applying more than 400 mm irrigation water. As can be inferred from Table 8, net income per unit of irrigation water varied from one farmer to another. Economic irrigation water productivity (EIWP) of the farmers varied between 0.33 TL m^{-3} - 2.47 TL m^{-3} with an average value of 1.44 TL m^{-3}. Again, the farmers applying greater than 400 mm irrigation water had low EIWP values. In this study, production quantities corresponding to production costs of oil sunflower cultivation were also determined. This indictor so called as breakeven point varied between 1034.6 - 3058.8 kg ha^{-1} with an average value of 1856.1 kg ha^{-1}.

4. Conclusion

In this study, economic analysis was conducted for groundwater-irrigated oil sunflower farming in Konya region. Present findings revealed that irrigation was the most significant input, thus constituted the greatest cost item in oil sunflower production. Electricity had the greatest ratio in irrigation costs. Electricity cost of groundwater-irrigated oil sunflower farming constituted 80.12% of irrigation costs and 39.6% of total production cost. Some farmers of the research site had low net incomes because of excessive or high quantities of irrigation water they used. It was observed that there were not significant differences in yields of the farmers applying the lowest irrigation water quantities (2304 m^3 ha^{-1}) and the greatest irrigation water quantities (6352.94 m^3 ha^{-1}). It was concluded based on present findings that farmers applying high quantities of irrigation water did not get high yield level and vice versa. It was also concluded that under provincial conditions of Konya, 250 - 350 mm irrigation water was sufficient and such a quantity provided the greatest net income.

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