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Economic Analysis of Olive Oil Production Costs as Influenced by Farm Size in Syrian Coastal Region

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ABSTRACT

To characterize the olive oil production costs and determine the optimal size of olive oil farm, a total of 130 farmers were interviewed in the region. The obtained data was subjected to regression analysis to formulate a mathematical model suitable for predicting the optimal farm size. Olive oil variable and fixed production costs for the five groups of farm sizes at Lattakia regions were calculated. Descriptive economic analysis indicated that the lowest average cost for producing 1 kg of olive oil was 676.9 SP and the highest one was 917.7 SP. Also, the results indicated that the economically efficient farm size was 32.9 Dunum which represents only 29.1% of the current farm sizes in the region, therefore, decision makers should draw the land uses policies in their future plans, so that, to integrate land areas in such a way to approach the border of 32.9 Dunum.

Keywords: Optimal Farms Size, Olive Oil, Economic Analyses, Variable and Fixed Production Costs
JEL Classifications: D24, D61, Q12

1. INTRODUCTION

Syrian agriculture witnessed a substantial development in the last two decades. Many dams were constructed and large area of lands was reclaimed. Agricultural sector is the corner stone in Syrian economy, as it absorbs more than 21% of the labor force and generates about 25% of the country's gross domestic product (GDP) (FAO, 2014). Among Syrian agricultural sectors, the olive farming sector assures livelihood and jobs for 377 000 families, who are involved in olive tree cultivation, olive oil production and selling.

Numbers of olive tree were increased from 82.29 in 2006 to 96.88 million in 2010 (CBS, 2011). As shown in Table 1, production of olive and olive oil fluctuates from 1 year to another, due to periodicity of olive trees.

Table 1: Olive production and use throughout 2006-2010 (Production: Ton)

Year	Production	Fresh consumption	For oil	Oil production
2006	1190781	293533	897248	252353
2007	495310	156314	338996	98294
2008	827033	157303	669730	156338
2009	885942	177198	708744	168163
2010	960403	172482	787921	194995

Sources: Own compilation based on CBS data 2011

More than two thirds of olive farms in Lattakia have an area range 0.1-1 hectare, which forms a serious constraint in achieving olive oil economic efficiency. This due to high variable costs associated with difficulty of mechanization and high manual labor costs. Because of the war and economic embargo on Syria, olive production declined significantly in all Syrian governorates, including a 40% drop in olive oil production in Dara'a and about 20-30% drop in the other regions (FAO, 2014).

Worldwide, many researchers studied the relationships between farm sizes and production costs:

- Sen (1962) was the first to discover that productivity per acre decreased with increase in size of holding in India. He found empirical evidence regarding small farmers' relative superiority with regard to per unit land productivity over large farmers largely based on aggregated data. Technique-based, labor-based, and fertility-based three alternative lines of explanation for this phenomenon.
- Carter (1984), analyzed the inverse relationship between farm size and farm productivity in India and found differences between small and large farms that could not be explained by factors correlated with farm size. Carter showed that small farms were technically inefficient and, in addition, that small farms allocated labor beyond the optimal level defined by profit maximization at market prices.
- Giannakas et al. (2000) attributed the low efficiency levels of olive oil production in Greek olive growing farms to the small farms size, and their extensive fragmentation.
- Vadivelu et al. (2001), in India, concluded that, the inverse relationship between land size and productivity remains both among the owner-operated and the share cropped farms and the evidence presented here is additional evidence to prove the endemic nature of this relationship in Indian agriculture. The emergence of the newer forms of share cropping contract provides additional evidence on the exploitative nature of the share cropping contracts.
- Tzouvelekas et al. (2001), in Greece, argued that, large organic (conventional) farms were in a position to reduce their actual costs by 23.7% (44.7%), medium sized farms by 26.5% (47.5%) and small farms by 29.4% (49.6%) if they could operate at 100% technical efficiency levels. It was noted the larger farms (both conventional and organic) exhibited lower technical inefficiency than smaller farms. Traditional, family-farming practices in olive growing were less efficient than farms operating with more hired labor. Favorable environmental conditions affected farm's technical efficiency levels positively.
- Shively and Zelek (2003), using panel data from rice farms in the Philippines, similarly argued that, from a profit maximization perspective, small farms over applied labor and under applied fertilizers and pesticides.
- Thapa (2003) in a study on Nepal, shows that the IR (Inverse Relationship) between farm size and output per hectare is perhaps due to the result more of other inputs used by small farms rather than diseconomies of scale.
- Helfand and Edward (2004) in a study in Brazil, concluded that, the relationship between farm size and efficiency is non-linear, with efficiency first falling and then rising with size. Type of land tenure, access to institutions and markets, and modern inputs are found to be important determinants of the differences in efficiency across farms.
- Shenggen and Chan-Kang (2005), said that: "The inverse relationship is typically explained by the deference in factor endowments between small and large farms: By using family labor smaller farms face lower labor transaction costs than larger farms. As a result, smaller farms have higher labor/land ratios and can achieve higher yields per hectare. The inverse relationship has important implication for land reform policy, as it is argued that any type of land reform that reduces inequality in landholdings will likely have positive effects on productivity."
- Rios and Shively (2005), studied coffee farms in Vietnam and his results indicate that small farms were less efficient than large farms. Inefficiencies observed on small farms appear to be related, in part, to the scale of investments in irrigation infrastructure.
- Bhandari (2006) shows a positive relationship between land inequality and productivity, rejecting the argument that in Nepal, small farms appear to be more efficient than large farms.
- Duffy (2009) concluded that: "As the farm increases in size the cost per unit of output remains relatively flat. As the number of units of output increases and there is no significant difference in the cost of production, income will increase; decrease was due to the changes in technologies available, especially seed and fertilizers."
- Nkengne (2010) in Tajikistan suggests that: "An inverse relationship between productivity and cotton farm size does not hold. The relationship between farm size and technical efficiency is more complex than what is normally believed."
- Chen et al. (2011) in China found that "small farms are more efficient than their larger counterparts, efforts to promote consolidation should not be pursued."
- Maqbool et al. (2012), in Pakistan, confirmed the inverse farm size and productivity relationship in the sample area, due to relative use of inputs and resulting output differ along farm size.
- Bakucs et al. (2013) investigated the relationship between size and farm growth, and concluded that smaller farms grew faster than larger ones over the studied period 2001-2007 for France, 2001-2008 for Hungary, and 2004-2008 for Slovenia. Conversely, the results for Slovenia suggest that the rate of growth of crop farms in terms of its land is independent from its size.
- Hassanpour (2013) in his work entitled "Determining the Optimal Size and Economic Efficiency of Paddy Farms in KB Province, Iran." "The found that the optimal size of paddy farm is 1.6 ha and his results were consistent with the microeconomic theory, the larger the size of the plant or farm, the more the average cost of production; and when the unit size is smaller, the average cost will decrease to some extent and then it will increase."
- Bojnec (2014), in Slovenia explain that, "the differences between farm sizes (small, medium and large farms) leads to different costs and benefits for farmers, and it play an important role in decision-making process for adoption of agri-environmental measures."
- FAOSTAT (2014) said "regarding the size of olive groves for oil production in Spain, 54% corresponds to farms of <5 hectares, ranging from an average of 0.12 and 2 hectares, whereas in Greece, small farms of <5 hectares (covering about 60% olive plantations) operate with losses; medium farms of 5-50 hectares achieve a profit margin of about 22 per and larger farms of more than 50 hectares are more productive and achieve profits. So, the small and dispersed nature of Greek farms limits potential profits and increases dependence on subsidies."

It can be concluded that a relationship does exist between production costs and farms size, but it differs from one case to another, from one country to another. Some authors found an inverse relationship between production costs and farm sizes while others observed that small farms are less production cost per unit of land than large farmers. Therefore the relationship between farm size and olive oil production costs in Lattakia region were considered for the first time in Syria, in addition, some economic indicators were calculated and analyzed. This study is important for agricultural leader, administrative and policy decisions makers in future agricultural planning for this strategic agriculture crop.

2. RESEARCH OBJECTIVES

The main objective of this study is to achieve a descriptive economic analysis of olive oil production costs in relation with olive farm sizes, under rain-fed farming in Lattakia, Syrian Arab Republic. Specific objectives: To identify optimal olive farm size which realize economic efficiency.

3. METHODOLOGY

3.1. The Study Area

Lattakia is situated on the northern - west part of Syria, along Mediterranean Sea. This region was chosen to be the study area, as it represents most of olive rain-fed agriculture areas in Syrian coastal ranges. Olive tree in Latakia region are found at several meters above sea level up to 800 m altitudes, with an average annual rainfall of 1000 mm and temperature. Olive farms are prevailed on plateau and steep mountainous areas in red Mediterranean soils. Most of them are not suitable for agricultural mechanization. Trees density is ranged between 150 and 200 tree/ha. The total agricultural land is about 101 705 hectares, of which olive farms amounts 34436.5 hectares (33.9%) (NAPC, 2009).

3.2. The Sample Size

The sample population consists of all olive farmers in rain-fed areas in Lattakia governorate. The sample size was determined by the following equation (Cochran, 1963):

$$n = (P) \times (1 - P) \times \left[\frac{Z}{e} \right]^2 \qquad (1)$$

Where:
n = sample size
P = is the probability =0.50
Z = Confidence level, at 95% = 1.960 and 2.58 at 99%
σ = Standard deviation of the population
e = the maximum acceptable error is 1/2 of a standard deviation.

3.3. Methodology of Data Collection

According to Agriculture and Agrarian Reform Act, which was issued in 1967, the state limited the maximum allowable agricultural land ownership by 50 and 300 ha for irrigated and no irrigated land respectively. Land owned by feudal (more than those areas), were seized and distributed to landless peasants. During lands distribution processes to peasants, they were assessed according to their degree of farming applicability. The lower farming suitability the more land area attributed to farmer and *vice versa*. Accordingly, large holdings is centered at steep, stony and low productivity lands, while small holdings is centered at flat land viable for cultivation of most agricultural crops.

Based on this fact, we divided the areas planted with olive trees economically into five categories. Those five group of farm sizes were: - the 1th group = 0.1-1 ha, - the 2th group = 1.1-2 ha, - the 3th group = 2.1-3 ha, the 4th group = 3.1-4 ha, and the 5th group =4.1-5 ha.

Primary data was obtained through direct interviews with olive farmers in Lattakia region. A number of 30 questionnaires were addressed to each one of the five area groups, where farmers were asked in addition to olive oil production variable and fixed costs, the oil total production and selling prices. The data from 150 questionnaires were transformed into Excel format and subjected to ANOVA test using “CoStat” and “SPSS18” software. However, secondary data were collected from literature review, Lattakia Agricultural Directorate, Central Bureau of Statistics in Syria, and Olive Bureau in Idleb.

3.4. Methodology of Data Analysis

Data were collected during 2013-2014, from rain fed farms, with mature trees (more than 15 years), and the following economic parameters were calculated:

Total cost=Fixed costs (FC)+variable costs (VC)	(2)
Average variable cost (AVC)=VC/Q	(3)
Average fixed cost (AFC)=FC/Q	(4)
Average total cost=AFC+AVC	(5)
Gross margins (GM)=Gross revenues - total variable costs (TVC)	(6)
Net return (profit)=Total revenue - total cost	(7)
Break-even yield=Total costs/production unit price	(8)
Average cost of 1 kg of oil=Total costs per Dunum/ productivity per Dunum	(9)

Also, ANOVA test were used to check the significance of differences in production costs, between the five groups of farms.

To obtain the optimal size of the farm, we used a second order polynomial function to explain production cost relationships as used by Hosseinzad et al. (2009):

$$y = a - \beta_1 X + \beta_2 X^2 \qquad (10)$$

where:
X: is the farm size;
a: is intercept;
β_1 and β_2: Are constants to determined

Then, the derivative of function (10) yields the optimal amount of land by minimum average:

$$\frac{\delta y}{\delta x} = 0 - \beta_1 + 2\beta_2 \times X \qquad (11)$$

Also, ANOVA test were used to check the significance of differences in production costs, between the five groups of farm sizes.

4. RESULT AND DISCUSSIONS

4.1. Profitability Indicators of the Rain-fed Areas Cultivated by Olive Trees in Lattakia

4.1.1. Profitability indicators for the first group of farms 1-10 Dunum

In the 1th first group of farm size (Table 2), the average production of oil was 61.33 kg, with a gross revenues of 76049.2 SP, whereas, margin profit and net profit were 31553.7, and 9752.39 SP respectively. Average cost for producing 1 kg of oil was 917.9 SP and a Break-even yield of 45.4 kg were attained at this group of farm size.

4.1.2. Profitability indicators for the 2nd group of olive trees farms (11-20 Dunum)

In the 2th group of farm size (Table 3), the average production of oil was 68.45 kg, with a gross revenues of 84878 SP, whereas, the margin profit and net profit were 41861.16, and 30383.97 SP respectively. Average cost for producing 1 kg of oil was 796.11 SP and a Break-even yield of 43.95 kg were attained at this group of farm size.

4.1.3. Profitability indicators for the 3th group of olive trees farms (21-30 Dunum)

In the 3th first group of farm size (Table 4), the average production of oil was 73.12 kg, with a gross revenues of 90668.8 SP, whereas, the margin profit and net profit were 49243.54, and 38320.37 SP respectively. Average cost for producing 1 kg of oil was 42.22 SP and a Break-Even Yield of 715.92 kg were attained at this group of farm size.

4.1.4. Profitability indicators for the 4th group of olive trees farms (31-40 Dunum)

In the 4th first group of farm size (Table 5), the average production of oil was 75.23 kg, with a gross revenues of 93285.2 SP, whereas, the margin profit and net profit were 53073.05, and 42385.14 SP respectively. Average cost for producing 1 kg of oil was 41.05 SP and a break-even yield of 676.59 kg were attained at this group of farm size.

4.1.5. Profitability indicators for the 5th group of olive trees farms (41-50 Dunum)

In the 5th first group of farm size (Table 6), the average production of oil was 79.45 kg, with a GM of 98518 SP, whereas, the margin profit and net profit were 53073.1 and 42385.1 SP, respectively. Average cost for producing 1 kg of oil was 41.1 SP and a break-even yield of 676.6 kg was attained at this group of farm size.

4.2. Production and Costs

1. Production mean increased with the increase of farm size (Table 7). The differences between all groups were significant, except the 4th and 5th. This result is inconsistent with Bhandari (2006) who found in Nepal, that small farms are more efficient than large farms. And confirm the inverse relationships between farm size and production, which was supported by Maqbool et al. (2012) in Pakistan

Table 2: Average costs of the 1th group of olive farm with an area 1-10 Dunum*

Items	Units	Volume	Price	Value (SP)
Production	Kg.	61.33	1240	76049.2
Variable costs				
Plowing	Dunum	1	2300	2300
Organic fertilizers	Kg.	425.3	20	8506
Nitrogen fertilizers	Kg.	5.1	50	255
Phosphate fertilizer	Kg.	2.5	60	150
Insecticides	Liter	0.28	2800	784
Fungicides	Liter	0.17	3000	510
Pruning	Kg/Dunum	245.32	1	245.3
Harvest costs	Kg/Dunum	245.32	105.2	25807.7
Transport from farm to mill	Kg.	245.32	1.5	367.98
Milling costs	Kg.	245.32	2.3	564.24
Vessels	Cans	3.41	600	2044.33
Transport	SP	245.32	1	245.32
Interest (6.5%)	SP			2715.7
Fixed costs				
Establishment	SP			5000
Carburant and maintenance	SP			0
Machinery depreciation	SP			0
Building depreciation	SP			0
Permanent employee	SP			0
Land rent	SP			3081
Family labor	SP			3000
Interest (6.5%)	SP			720.265
Total fixed cost	SP			11801.3
TVC	SP			44495.5
Total costs	SP			56296.8
Profit margin	SP			31553.7
Net profit	SP			19752.4
Break-even yield	SP			45.4
Average cost for producing 1 kg of oil	SP			917.9

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 3: Average costs of the 2th group of olive farm with an area an area 11-20 Dunum*

Items	Units	Volume	Price	Value (SP)
Production	Kg.	68.45	1240	84878
Variable costs				
Plowing	Dunum	1	2200	2200
Organic fertilizers	Kg.	270.2	19.1	5160.82
Nitrogen fertilizers	Kg.	12.6	50	630
Phosphate fertilizer	Kg.	5.7	60	342
Insecticides	Liter	0.26	2500	650
Fungicides	Liter	0.16	3000	480
Pruning	Kg/Dunum	1	214	214
Harvest costs	Kg/Dunum	273.8	100	27380
Transport from farm to mill	Kg.	273.8	1.45	397.01
Milling costs	Kg.	273.8	2.2	602.36
Vessels	Cans	3.8	550	2091.53
Transport	SP	273.8	0.89	243.7
Interest (6.5%)	SP			2625.4
Fixed costs				
Establishment			SP	4200
Carburant and maintenance			SP	888
Machinery depreciation			SP	245.5
Building depreciation			SP	260.2
Permanent employee			SP	0
Land rent			SP	2496
Family labor			SP	2687
Interest (6.5%)			SP	700.49
Total fixed cost			SP	11477.19
TVC			SP	43016.84
Total costs			SP	54494.03
Profit margin			SP	41861.16
Net profit			SP	30,383.97
Break-even yield			SP	43.95
Average cost for producing 1 kg of oil			SP	796.11

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 4: Average costs of the 3th group of olive farm with an area 21-30 Dunum*

Items	Units	Volume	Price	Value (SP)
Production	Kg.	73.12	1240	90668.8
Variable costs				
Plowing	Dunum	1	2100	2100
Organic fertilizers	Kg.	85.3	18.1	1543.93
Nitrogen fertilizers	Kg.	13.4	50	670
Phosphate fertilizer	Kg.	5.2	60	312
Insecticides	Liter	0.25	2400	600
Fungicides	Liter	0.12	3000	360
Pruning	Kg/Dunum	1	2100	2100
Harvest costs	Kg/Dunum	292.48	95.2	27844.1
Transport from farm to mill	Kg.	292.48	1.25	365.6
Milling costs	Kg.	292.48	2.1	614.21
Vessels	Cans	4.062222	525	2132.67
Transport	SP	292.48	0.87	254.46
Interest (6.5%)	SP			2528.3
Fixed costs				
Establishment	SP			3900
Carburant and maintenance	SP			579
Machinery depreciation	SP			234.2
Building depreciation	SP			222.2
Permanent employee	SP			1820.1
Land rent	SP			2001
Family labor	SP			1500
Interest (6.5%)	SP			666.67
Total fixed cost	SP			10923.2
TVC	SP			41425.3
Total costs	SP			52348.4
Profit margin	SP			49243.5
Net profit	SP			38320.4
Break-even yield	SP			42.22
Average cost for producing 1 kg of oil	SP			715.92

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 5: Average costs of the 4th group of olive farm with an area 31-40 Dunum*

Items	Units	Volume	Price	Value (SP)
Production	Kg.	75.23	1240	93285.2
Variable costs				
Plowing	Dunum	1	2000	2000
Organic fertilizers	Kg.	85.7	20	1714
Nitrogen fertilizers	Kg.	18.8	50	940
Phosphate fertilizer	Kg.	7.18	60	430.8
Insecticides	Liter	0.19	2800	532
Fungicides	Liter	0.19	3000	570
Pruning	Kg/Dunum	1	2050	2050
Harvest costs	Kg/Dunum	300.92	87.02	26186.1
Transport from farm to Mill	Kg.	300.92	1.15	346.058
Milling costs	Kg.	300.92	2.01	604.849
Vessels	Cans	4.179444	515	2152.41
Transport	SP	300.92	0.77	231.71
Interest (6.5%)	SP			2454.26
Fixed costs				
Establishment	SP			3750
Carburant and maintenance	SP			536
Machinery depreciation	SP			298.8
Building depreciation	SP			289.8
Permanent employee	SP			1761
Land rent	SP			1975
Family labor	SP			1425
Interest (6.5%)	SP			652.31
Total fixed cost	SP			10687.9
TVC	SP			40212.2
Total costs	SP			50900.1
Profit margin	SP			53073.05
Net profit	SP			42385.14
Break-even yield	SP			41.05
Average cost for producing 1 kg of oil	SP			676.59

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 6: Average costs of the 5th group of olive farm with an area 41-50 Dunum*

Items	Units	Volume	Price	Value (SP)
Production	Kg.	79.45	1240	98518
Variable costs				
Plowing	Dunum	1	1900	1900
Organic fertilizers	Kg.	80.4	20	1608
Nitrogen fertilizers	Kg.	20.7	50	1035
Phosphate fertilizer	Kg.	10.06	60	603.6
Insecticides	Liter	0.23	2800	644
Fungicides	Liter	0.2	3000	600
Pruning	Kg/Dunum	1	2000	2000
Harvest costs	Kg/Dunum	317.8	84.1	26727
Transport from farm to mill	Kg.	317.8	1.1	349.58
Milling costs	Kg.	317.8	2	635.6
Vessels	Cans	4.4	500	2206.94
Transport	SP	317.8	0.67	212.93
Interest (6.5%)	SP			2503.97
Fixed costs				
Establishment	SP			3660
Carburant and maintenance	SP			800
Machinery depreciation	SP			240.5
Building depreciation	SP			236.7
Permanent employee	SP			1533
Land rent	SP			1800
Family labor	SP			1600
Interest (6.5%)	SP			641.6
Total fixed cost	SP			10511.8
TVC	SP			41026.6
Total costs	SP			51538.4
Profit margin	SP			53073.1
Net profit	SP			42385.1
Break-even yield	SP			41.1
Average cost for producing 1 kg of oil	SP			676.6

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 7: Means of production (kg) and costs (SP) for each farm size (Dunum)*

Group	Area	Production mean	TVC	Total fixed cost	Total costs
1	01-10	61.33[d]	44495.54[a]	11801.26[a]	56296.80[a]
2	11-20	68.45[c]	43016.84[b]	11477.18[b]	54494.02[b]
3	21-30	73.12[b]	41425.26[c]	10923.17[c]	52348.43[c]
4	31-40	75.23[a]	40212.15[d]	10687.91[d]	50900.06[d]
5	40-50	75.45[a]	41356.35[c]	10511.76[e]	51868.11[c]
LSD=0.05		0.795	472.36	124.35	596.7

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, TVC: Total variable cost

Table 8: Average costs indicators for 1 kg of olive oil in SP

Group	Area*	AFC	AVC	ATC
1	01-10	192.42	725.51	917.9
2	11-20	167.67	628.44	796.1
3	21-30	149.39	566.54	715.9
4	31-40	142.07	534.52	676.6
5	41-50	139.32	548.13	683.1

Source: Own calculation based on questionnaire data, *1 Dunum=0.1 ha, AFC: Average fixed cost, ATC: Average total cost, AVC: Average variable cost

2. TVC decreased with the increase of farm size till the minimum TVA at the 4th group of farm area then raised again. This result is consistent with economic logics and theories. It is believed that large farms use production inputs more efficiently than smaller one (Bakucs et al., 2013). Also, total costs have the same trend as TVA, so the minimum total cost is observed in the 4th group of farm sizes
3. However, means of total fixed costs decreased slightly (least significant difference=124.35) with the increase of area and production. Those my suggest that the 4th group is the most efficient among farm sizes, as it has the least total costs among the other groups and more production per Dunum than all groups except the 5th one, which did not differ significantly.

4.2.1. Average costs indicators for 1 kg of olive oil

- Table 8 showed that the value for producing 1 kg of olive oil decreased from 917.9 to 676.6 SP with increase of farms sizes from 1 to 10 (1th group) to 31-40 Dunum (4th group) in the first stage, thereafter, this value increased again to 683.1 SP at the 5th group of farm size (41-50 Dunum). This result is consistent with the economic theory and supports the results of Helfand and Edward (2004), in their study in Brazil, concluded that, the relationship between farm size and efficiency is non-linear, with efficiency first falling and then rising with farm size.

4.3. Profit Indicators

Table 9 shows the following results for revenue and profit indicators for one kg of olive oil in Lattakia region:

1. The 1th group of olive farm size showed 31553.7, 19752.39 and 322.07 SP for margin profit, net profit per Dunum and net profit per 1 kg of olive oil respectively, while, the Break-even yield amounted 45.4 kg per Dunum
2. The 2th group of olive farm size showed 41861.2, 30383.97 and 443.89SP for margin profit, net profit per Dunum and net profit per 1 kg of olive oil respectively, while break-even yield amounted 43.95 kg per Dunum
3. The 3th group of olive farm size showed 49243.54, 38320.37and 524.08 SP for margin profit, net profit per Dunum and net profit per 1 kg of olive oil respectively, while break-even yield amounted 42.22 kg per Dunum
4. The 4th group of olive farm size showed 53073.0, 42385.14 and 563.41 SP for margin profit, net profit per Dunum and net profit per 1 kg of olive oil respectively, while break-even yield amounted 41.05 kg per Dunum
5. The 5th group of olive farm size showed 53441.6, 42929.88 and 561.54 SP for margin profit, net profit per Dunum and net profit per 1 kg of olive oil respectively, while Break-Even Yield amounted 41.83 kg per Dunum.

Although the maximum net profit (42929.88SP/Dunum) were recorded in the 5th group of area, the minimum even broken revenue and the maximum net profit per 1 kg olive oil were recorded in the 4th group. It can be concluded that the increase in farm size may maximize the net profit, but not the economic efficiency.

4.4. Optimal Farm Size for each Studied Group

To obtain the optimal farm size for each group of areas, a mathematical function (10) were used to estimate the average optimum cost of production (Hosseinzad et al., 2009).

In this model Y is the average cost for production of 1 kg of olive oil and X is the farm size used for olive tree. Then, the derivative of this function yields the optimal farm size by minimum average:

Optimal farm sizes:

$$Y = 980.792666667 - 34.114412121 \times X + 0.51939393939 \times X^2$$

t: (10.6) (–4.43) (3.81)

$R^2 = 0.781$ F=12.4 Significant = 0.000

Then the derivative is:

$$\frac{\delta y}{\delta x} = 0 - 34.11 + 2 * 0.519 \times X \ggg X = \frac{34.11}{1.038} = 32.9 Dunum$$

The optimal size of olive tree farming at Lattakia region is 32.9 Dunum (Figure 1). Unfortunately, according to statistics obtain from the sample, more than 70.8% of olive farmers have more or less than this amount of land.

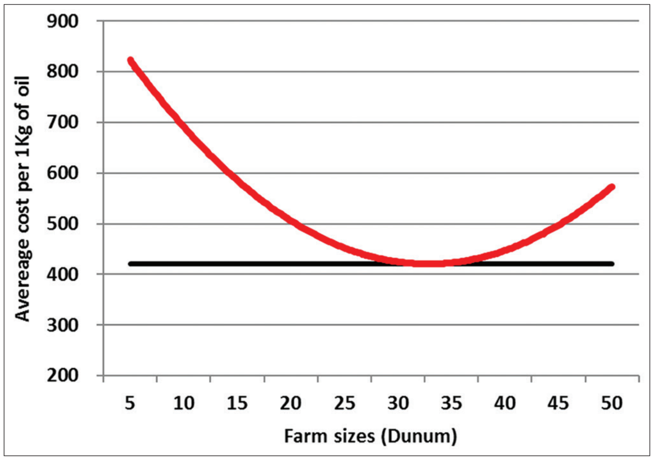
To identify the number of olive farmers operating under increasing, constant and decreasing returns to scale, estimating the scale efficiency would be important. This is valuable because firms which are operating under increasing returns to scale have the

Table 9: Revenue and profit indicators for 1 kg of olive oil

Group	Area	Gross revenue	Gross margin	Net profit (Dunum)	Even broken revenue	Net profit per 1 kg oil
1	01-10	76049.2	31553.7	19752.4	45.4	322.07
2	11-20	84878	41861.2	30384	43.95	443.89
3	21-30	90668.8	49243.5	38320.4	42.22	524.08
4	31-40	93285.2	53073	42385.1	41.05	563.41
5	40-50	94798	53441.6	42929.9	41.83	561.54

Source: Own calculation based on questionnaire data

Figure 1: The curve represents the relationships between farm sizes and average cost of 1 Kg of olive oil



opportunity to increase their efficiency by increasing their olive farm size. In contrary, firms operating under a decreasing return to scale would increase efficiency by decreasing their olive farm size. However, farmers operating under a constant return to scale do not benefit by neither decreasing nor increasing the olive farm size. Nonetheless, fortunately the result of the estimation of scale efficiency does not affect the optimum size of land required for olive oil production what we found under pure technical efficiency.

To further confirm the optimal farm size for each group of areas, a scale efficiency mathematical function (12) were used to estimate the average optimum cost of production (Vasiliev et al., 2008).

$$Y = a - \frac{\beta - 1}{X} + \beta_2 X \quad (12)$$

Then, the derivative of function (12) yields the optimal amount of land by minimum average:

$$\frac{\delta y}{\delta x} = 0 - \frac{\beta - 1}{X^2} + \beta_2 \quad (13)$$

Where in the same vain as the pure technical efficiency, the scale efficiency here represents the same variables. Y indicates the average cost and X the farm size. In similar, fashion the derivative of the above scale efficiency estimation gives us the optimum size of olive oil farm in lattika region. However, the coefficient we find from this estimation and the R-square could be significantly differs since coefficients represent different variables. Therefore, based on the findings from the pure technical efficiency result and the scale efficiency result we can say that 32.9 Dunum is the optimal olive farm size. Farmers with a land size below 32.9 can increase their efficiency since they are producing on the increasing returns to scale. Similarly, olive oil farmers producing in a land size of more than 32.9 Dunum increase their efficiency by decreasing the land covered by olive plants.

Then the derivative is:

$$\frac{dy}{dx} = 0 + \frac{1634.845}{X^2} - 1.099418 = 0$$

The result indicates that farmers in the fourth category are operating in the constant return to scale and farmers in the fifth category are operating in decreasing return to scale (Table 10). Therefore, the 5th group has to decrease the farm size while the fourth keeping constant the land size. Further, the first three groups are operating under increasing return to scale and they have to increase their farm size in order to gain from efficiency.

5. CONCLUSIONS AND RECOMMENDATIONS

Farm size affected all economic parameters, so, variable costs which amounted about 79% of total costs, were decreased with the increase of olive oil farm sizes until the farm size 31-40 Dunum, then it raises again. Also, fixed costs decreased slightly with the increase of farm size.

All of the considered farm sizes were profitable. The farms of 31-40 Dunum have the highest profitability indicators, whereas the lowest ones is found in farms of 1-10 Dunum. The most efficient farm size amounted 32.9 Dunum. Based on this result, farmers should integrate their olive farming management to approach this economic farm size. Unless this recommendation is adopted, the olive oil production costs will continue to be high.

Since the objective of the paper is to determine the optimal size of olive farm the study did not compare the technical, allocative and economic efficiency of olive farms with other efficient type of farms. However, in a future studies this paper could be extended to examine the overall technical, allocative and economic efficiency of farming. Further, the paper could be extended in a way it identifies the factors affecting the efficiency of olive farming. Methodologically, this extension will be undertaken using the data envelopment analysis method and Tobit model to study the risk taking habit of farmers and demographic characteristics.

Table 10: Scale efficiency coefficients

|ATC|	Co-efficient	SE	t	p>|t|	95% confidence interval
|x|	−1.099418	1.122515	−0.98	0.431	−5.929211-3.730375
|1/X|	1634.845	351.9399	4.65	0.043	120.5695-3149.12
|Cons|	688.2351	49.79831	13.82	0.005	473.9702-902.4999
F (2, 2)=64.46, P>F=0.0153, R^2=0.9847, Adj R^2=0.9694					
Y=688.2351-1634.845/X-1.099418X					

ATC: Average total cost, SE: Standard error

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