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RESEARCH ARTICLE

An analytical study for production and marketing of the olive crop in Egypt

(Case study in Matrouh governorate)

Doaa H.I. Mahmoud [1]*, M.F. El-Dnasury [2] and A.K. El-Noby [2]

[1] *Economics and Agribusiness Department, Faculty of Agriculture, Alexandria University, 21545 Alexandria, Egypt.*
[2] *Agricultural Economics Research Institute, Agricultural Research Center A.R.C., 12511 Giza, Egypt.*

Abstract

The research aimed to study the production and marketing of the olive crop in Matrouh Governorate in Egypt. approach this objective, the research depends on the descriptive and quantitative statistical analysis methods in analyzing the data based on two types of data; published and unpublished secondary data, and the primary data collected through two questionnaires through personal interviews with olive producers, wholesalers, and retailers in Matrouh Governorate 2021/2022, where a Random sample of Olive crop producers has been captured from Siwa (based on a 100 producers in the villages of Abu Shroff and Siwa, and a random sample of traders was selected, consisting of 25 wholesaling shops and 25 retailers who deals with wholesalers. The most important results of the search were as follows:(1) The total production elasticity in the estimated production function of the olive crop was about 0.963, this indicates that olive production is subject to a decreasing returns to scale, (2) The economic efficiency coefficients of the olive crop production resources which are the number of human labor, the quantities used of municipal fertilizer, nitrogenous, phosphate, and potash are about 10.76, 1.46, 14.69, 17.09, and 8.32, respectively, and this indicates that the producers of the olive crop can increase the profits of the olive crop production by increasing the number of human labor, the quantities used from those resources, (3) The marketing efficiency of the olive crop in the research sample reached about 47.19%, which means that a decrease in the marketing efficiency and this is due to the lower price the producers gets on from the price paid by the consumer.

Keywords: Consumer pound distribution; Economic Efficiency; Marketing margin; Matrouh Governorate and Egypt; Olive; Production function.

1. Introduction

Olive trees are perennial fruit trees that are evergreen, and are suitable for cultivation in the Egyptian climate in general, as they withstand different environmental conditions such as heat, drought, so it spreads its cultivated in most desert areas in Egypt (El-Sharkway, 2012), whereas the olive crop is one of the most important agricultural crops that Matrouh Governorate is famous for due to a suitable climate for its cultivation, which depends on its cultivation on rain, Matrouh lands produce the best types of olive, whose fruits are distinguished by their high nutritional value, due to they contain carbohydrates, protein, mineral salts, cellulose, and various vitamins, in addition to their high content of oil, which contains Fatty acids is important in vital functions and chemical reactions that occur in the body (Attia & Abu Al-Naga, 2021). The total area cultivated average with the olive crop in Matrouh Governorate was about 38.29 thousand feddan, representing about 16.57% of the total area planted average with the

.*Corresponding author: Doaa H.I. Mahmoud
Email: doaa.mahmoud@alexu.edu.eg
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olive crop in the new lands in Egypt, which amounted to about 231.04 thousand feddan, and the average of fruitful area of it was about 36.06 thousand feddan, representing about 17.68% of the average of fruitful area of olives in the new lands in Egypt, which is about 203.91 thousand feddan, and the average of total production in the governorate was about 147.21 thousand ton, representing about 15.30% of the average of total production of the olive crop in the new lands in Egypt, amount to about 962.42 thousand ton during (2018-2020), (M.A.L.R., 2020)

By studying the economic efficiency of the use of agricultural productive resources in the cultivation of the olive crop, it is possible to know what the farm unit achieves of finical revenues in order to work on increasing it by directing the use of productive resources to obtain the maximum production at the lowest costs, and by studying the marketing efficiency, it can minimize the marketing costs, which lead to an increase in the producer's share of the consumer's pound, and thus increase the finical revenues of the crop, (El-Dnasury, 2021)

1.1. Context of the problem

Despite the availability of most of the ingredients needed to produce the olive crop in Matrouh Governorate, and an increase in the total area cultivated in it from about 37.68 thousand feddan in 2019 to about 39.51 thousand feddan in 2020, an increase of about 1.83 thousand feddan, (M.A.L.R.,2020), as well as the environmental importance of olive cultivation in the governorate to reduce the phenomenon of desertification and the dependence of the crop on rainwater for irrigation, however, the total production of the olive crop in the governorate decreased from about 154.64 thousand ton in 2019 to about 112.20 thousand ton in 2020, a decrease of about 42.44 thousand ton (M.A.L.R,2020), which requires the need to identify the most important economic variables affecting the production of the olive crop in Matrouh Governorate, and to study the marketing path of the crop, in addition to estimate the margins and its marketing efficiency, in order to improve the level of production and marketing of the olive crop in Matrouh Governorate.

1.2. Research objectives

The research aims to study the production and marketing of the olive crop in Matrouh Governorate in Egypt, and this can be achieved through the following sub-objectives: (1) Studying the development of the fruitful area, yield and production of the olive crop in Egypt and Matrouh Governorate during (2005-2020), (2) Analysis the structure of production and marketing costs and a review of the relative importance of its items and revenue of the olive crop in the research sample of producers in Matrouh Governorate 2021/2022, (3) Estimation of the most important features of the production and economic indicators of the olive crop in the research sample, (4) Statistical estimation of the production function of the olive crop in the research sample, (5) Identification the marketing path of the olive crop in the farms of the research sample, whether the producer is for pickling or for oil presses, (6) Estimation the marketing margins and the share of the producer, wholesaler and retailer from the consumer pound distribution, in addition to an estimate the of marketing efficiency of the olive crop, (7) Identification of the production and marketing problems that faced the producers of the olive crop in the research sample, and suggest a set of appropriate solutions from their point of view to overcome these problems.

2. Research method

In achieving its objectives, the research depends on the use of some methods of descriptive and quantitative statistical analysis in analyzing the data related to the research, and specifically the following methods were used:

2.1. Some statistical methods such as

arithmetic averages, percentages, and annual growth rates for the economic variables in question, and the growth rate can be calculated

from the growth function, which takes the following formula, (El-Sharkway, 2012):

$Y = e^{(a+bx)}$

It is a logarithmic function to the exponent, that is, it is raised to the natural base e, and by inserting the logarithm into it, the function becomes the following form (El-Sharkway, 2012): Ln Y= a + bX

This exponential function is called in economics the growth function if it is calculated for time series, where the regression (X) which is (b) indicates the annual growth rate, which if multiplied by (100) becomes a percentage.

2.2. Some production and economic indicators to measure profitability, which are as follows (El-Dnasury, 2021), (Shafey,2007):

-Net Revenue = Total Revenue - Total Costs.

- Marginal Income =
Total Revenue - Total Variable Costs.

-Value Added =
Total Revenue - Value of Production Inputs.

- Profit Margin Ratio =
(Net Revenue / Total Revenue) * 100

-Relative profitability =
(Net Revenue / Total Variable Costs) * 100

-Return on the pound invested =
Net revenue / Total costs.

-Benefit-Cost Ratio =
Total Revenue / Total Costs.

2.3. Stepwise multiple regression to estimate

the production function of the olive crop to identify the most important economic variables that affect production using different mathematical formulas and trade-off between them according to the extent to which the obtained results agree with both the economic and statistical logic. The multiple regression equation takes the following form (Aguinis, 2004), (Heady, 1961);

$Yi = b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n + e$

Where;

Yi = response variable.

$x_1, \ldots . , x_n$ = Predictor variables (fixed, nonrandom).

b_i's (i= 1, 2, 2…..n) = Regression coefficients.

E = Model' serror (also known as the residuals).

2.4. Some laws and mathematical equations

to calculate the absolute and relative marketing margins, the distribution of market shares of the consumer pound, and the marketing efficiency of the olive crop, which are as follows (Khalil et al, 2019) (Sabbouh, 2020):

-The relative marketing margin (wholesale-product) = {(wholesale price - producer price) / wholesale price}* 100

- The relative marketing margin (retail-wholesale) = {(retail price - wholesale price) / retail price} * 100

-The relative marketing margin (retail - product)= {(retail price - producer price) / retail price}* 100

-The producer's share of the consumer's pound = (producer price / retail price)* 100

-The wholesaler's share of the consumer's pound = {(wholesale price - producer price) / retail price}* 100

-The retailer's share of the consumer's pound = {(retail price - wholesale price) / retail price}* 100

-The total of intermediaries' share of the consumer's pound = the wholesaler's share + the retailer's share

-Marketing Efficiency = 100– {(retail price - farm price) / (retail price - farm price) + Production Costs per unit) x 100}

Where:

Production costs per unit (pound / ton) = Production costs (pounds / feddan) / yield (ton / feddan).

2.5. Chi-square test,

which is done to check if there is any difference between the observed frequency and expected frequency. The formula for statistic chi-square (λ^2) can be written as (Hansen, 2014), (William, 2019): Both of Pearson's chi-square tests use the same formula to calculate the test statistic, chi-square (λ^2):

$$\lambda^2 = \Sigma \frac{(O_i - E_i)^2}{E_i}$$

Where:

λ^2 = Chi-square test statistic.

Σ = Summation operator (it means "take the sum of")

O = the observed frequency

E =the expected frequency

2.6. Data sources

The research depends on two main sources of data: (1) Primary data collected through two questionnaire forms through personal interviews with the olive producers, wholesalers, and retailers in Matrouh Governorate in Egypt, (2) Published and unpublished secondary data derived among the agricultural statistics bulletins issued by the Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation, the Information and Decision Support Center, the Statistics Department and the Agricultural Administration in Siwa Oasis in the Directorate of Agriculture in Matrouh in Egypt, in addition to the use of some research, studies, scientific journals and references related to the topic of research, and the data has been analyzed on the computer Using SPSS **v.16**.

2.7. Selection of the research sample

A random sample has been captured from the producers of the olive crop in Matrouh Governorate in Egypt, which falls within the desert governorates and which the state works to develop due to its economic resources and natural wealth that can contribute to achieve agricultural development 2021/2022, that it was chosen Siwa center, which is located deeply in the desert of the governorate that it occupies the first rank in the area planted with the olive crop compared to the other centers of the governorate, which are all located in the coastal range and start from the eastern side adjacent to the governorate of Alexandria in the center of El Hamam, followed in succession to the west by the centers of Al Alameen, El Dabaa, Matrouh, El Negaila, Sidi Barrani, El Salloum center in the far north west of the governorate (Nasser *et al.*, 2018), and the area of the olive gardens in Siwa center was about 18566 feddan, representing about 39% of the total areas of the Olive gardens in the centers of the Matrouh governorate which are about 47600.88 feddan 2021/2022 (M.A.L.R, 2022) - Table (1)

Table 1. The relative importance of the areas of the olive crop in the centers of Matrouh Governorate 2021/2022.

Center	Areas of the olive gardens	
	(Feddan)	(%)
Siwa	18566.00	39.00
Sidi Barrani	10250.00	21.53
Matrouh	7759.00	16.30
El Dabaa	4902.88	10.31
Al Alameen	2409.00	5.06
El Negaila	2400.00	5.04
El Hamam	1314.00	2.76
El Salloum	-	-
Total	47600.88	100.00

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation (2022), Agriculture Directorate of Matrouh, Statistics Department, unpublished data, Egypt.

A random sample has been selected which based on a 100 producers of the olive crop in the villages of Abu Shroff and Siwa as they are the most important villages of Siwa center according to the relative importance of the area planted with the crop, where the area planted with the Olive crop in each of them is about 5345, 5050 feddan, respectively, representing about 28.79%, 27.20% of the total area cultivated with the crop in Siwa center in Matrouh Governorate 2021/2022 (M.A.L.R, 2022)- Table (2), and a random sample of traders was selected with 25 wholesale shops, 25 traders from retailers who deal with wholesalers.

Table 2. The relative importance of the areas cultivated with the olive crop in the villages of Siwa center in Matrouh Governorate 2021/2022.

Village	Areas of the olive gardens	
	(Feddan)	(%)
Abu Shroff	5345.00	28.79
Siwa	5050.00	27.20
El Maraki	3445.00	18.56
Bahey El Din	2246.00	12.09
Agurmi	1970.00	10.61
Umm Al Saghir	510.00	2.75
Total	18566.00	100.00

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation (2022), Agriculture Directorate of Matrouh, Statistics department, unpublished data, Egypt.

3. Results and Discussion:

3.1. The fruitful area, yield, and production of the Olive crop in Egypt and Matrouh Governorate during (2005-2020).

It is clear from the data in Tables (3, 4) that

3.1.1. The fruitful area

The fruitful area of the olive crop in the new lands in Egypt during (2005-2020) ranged between a minimum about 46.76 thousand feddan in 2005, and a maximum of about 271.70 thousand feddan in 2017, and the fruitful area increased at a statistically significant annual growth rate at 0.01, it was estimated at 11% of the period average, which amounted to about 132.95 thousand feddan. The F. area of the olive crop in the new lands in Matrouh Governorate during the research period ranged between a min. about 18.62 thousand feddan in 2005, and a max. of about 37.31 thousand feddan in 2020, and the F. area increased at a statistically significant annual growth rate at 0.01, it was estimated at 5% of the average of the period, which amounted to 25.34 thousand feddan.

Table 3: Fruitful area, yield, and production of the olive crop in Egypt and Matrouh Governorate during (2005-2020).

Years	Fruitful area (Thousand feddan)			Yield (Ton/Feddan)			Production (Thousand ton)		
	Matrouh	Egypt	%	Matrouh	Egypt	%	Matrouh	Egypt	%
2005	18.62	46.76	39.82	1.18	3.29	35.87	21.99	153.79	14.29
2006	19.13	52.41	36.50	3.00	4.53	66.23	57.40	237.20	24.19
2007	19.31	54.83	35.22	2.72	4.18	65.07	52.53	229.14	22.92
2008	19.81	58.25	34.01	2.86	4.71	60.72	56.65	274.22	20.66
2009	20.15	96.54	20.87	2.76	4.07	67.81	55.67	393.02	14.16
2010	20.82	105.22	19.79	2.16	3.19	67.71	44.96	336.02	13.38
2011	21.16	111.48	18.98	2.17	3.60	60.28	46.00	401.72	11.45
2012	21.87	123.39	17.72	2.57	3.95	65.06	56.29	487.05	11.56
2013	23.31	134.05	17.39	2.60	3.63	71.63	60.61	486.79	12.45
2014	24.12	132.35	18.22	2.75	3.85	71.43	66.32	509.69	13.01
2015	28.94	153.33	18.87	2.68	4.22	63.51	77.42	647.36	11.95
2016	29.18	175.16	16.66	3.40	4.62	73.59	99.21	808.44	12.27
2017	30.93	271.70	11.38	3.45	4.42	78.05	106.71	1201.46	8.88
2018	35.42	200.09	17.70	4.93	5.17	95.36	174.78	1033.79	16.91
2019	35.43	200.27	17.69	4.37	4.66	93.78	154.64	933.13	16.57
2020	37.31	211.36	17.65	3.01	4.35	69.19	112.20	920.33	12.19
Average	25.34	132.95	-	2.91	4.15	-	77.71	565.82	-
Min.	18.62	46.76	-	1.18	3.19	-	21.99	153.79	-
Max.	37.31	271.70	-	4.93	5.17	-	174.78	1201.46	-

Source: Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics Bulletin, Egypt, Various issues during the period (2005-2020).

3.1.2. The yield

The yield of the olive crop in the new lands in Egypt during (2005-2020) ranged between a minimum about 3.19 ton/feddan in 2010, and a maximum of about 5.17 ton/feddan in 2018, with an annual average of about 4.15 ton/feddan, while the statistical significance of the rate of change has not been established, which indicates the fluctuation of yield about the average during the research period.

The yield of the olive crop in the new lands in Matrouh Governorate during the research period ranged between a min. about 1.18 ton/feddan in 2005, and a max. of about 4.93 ton/feddan in 2018, and the yield increased at a statistically significant annual growth rate at 0.01, it was estimated at 4.5% of the average of the period, which amounted to about 2.91 ton/feddan.

Table 4. Equations of the general trend of the fruitful area, yield, and production of the olive crop in Egypt and Matrouh Governorate during (2005-2020).

N	Items		Equation	R^2	F	Change Rate (%)
1	Fruitful area	Matrouh	Ln Y= 2.781+0.050 T (13.96)**	0.933	194.76**	5.0
2		Egypt	Ln Y= 3.825+0.110 T (12.13)**	0.913	147.03**	11.0
3	Yield	Matrouh	Ln Y= 0.645+0.045 T (3.40)**	0.452	11.57**	4.5
4		Egypt	Ln Y= 1.306+0.013 T	0.206	3.63$^{n.s.}$	1.3
5	Production	Matrouh	Ln Y= 3.427+0.094 T (6.63)**	0.758	43.92**	9.4
6		Egypt	Ln Y= 5.131+0.123 T (13.76)**	0.931	189.36**	12.3

(**) Indicates statistical significant. at the 0.01 level.
(n. s.) Indicates non-sign. Y:Estimated value of the dependent variable in the year (t).
T: The time variable (1,2,……..,16). - The values between brackets are the value of calculated (t).
Source: The results of analyzing the data contained in Table (3) on the computer using the $SPSS_{V.16}$ program.

3.1.3. The production

The production of the olive crop in the new lands in Egypt during the period (2005-2020) ranged between a min. about 153.79 thousand ton in 2005, and a max. of about 1.20 million ton in 2017, and the production increased at a statistically significant annual growth rate at 0.01, it was estimated at 12.3% of the period average, which amounted to about 565.82 thousand ton.

The production of the olive crop in the new lands in Matrouh Governorate during the research period ranged between a minimum about 21.99 thousand ton in 2005, and a maximum of about 174.78 thousand ton in 2018, and the production increased at a statistically significant annual growth rate at0.01, it was estimated at 9.4% of the average of the period, which amounted to 77.71 thousand ton.

3.2. The production costs, marketing costs, the relative importance of their items, and revenue of the olive crop in the research sample

3.2.1. The production costs and the relative importance of its items to the olive crop in the research sample

The feddan production costs items of the olive harvest in the research sample include three main items: (1) Wages, which include both human labor wages, and machine wages, (2) The value of production requirements, including: the value of seedlings, the value of municipal fertilizer, the value of nitrogen fertilizer, the value of phosphate fertilizer, the value of potash fertilizer, and the value of pesticides, (3) The rent of the cultivated land (opportunity cost) as fixed costs, while the total revenue is the value of the output of the crop.

The relative importance of these production costs items, which are included in Table (5), can be reviewed as follows:

The average of wages spent on an feddan of olive crop in the research sample in Matrouh Governorate amounted to 6498.2 pounds, representing about 20.16% of the average of total production costs per feddan of olive crop, which amounted to about 32228.4 pounds, the wages include both human labor wages, and machinery wages with an average of about 2857.4, 3640.8 pounds, representing about 8.87%, 11.29% of the average of total production costs per feddan, respectively, and the average value of production requirements used per feddan was about 5230.2 pounds, representing about 16.23% from the average of total production costs per feddan, and the production requirements used include: seedlings cost, municipal fertilizer price, nitrogen fertilizer price, phosphate fertilizer price, potash fertilizer price, pesticide value with an average of about 983.9, 1981.7, 812.1, 338.7, 754.2, 359.6 pounds, representing about 3.05%, 6.15%, 2.52%, 1.05%, 2.34%, 1.12% of the average of total production costs per feddan respectively, the average of total variable costs spent on production an feddan of olive amounted to 11728.4 pounds, representing about 36.39% of the average total production costs per feddan, while the average of rent per feddan (opportunity cost) amounted to 20500 pounds, representing about 63.61% of the average of total production costs per feddan.

Table 5. Production costs items and their relative importance for the olive crop in the research sample of producers in Matrouh Governorate during 2021/2022.

Economic variables			Value or Qty.	(%)
Sample size	No.	Producers	100	-
Average area	No.	Feddan	4.1	-
Human labor	No.	Labor/ working day	19	-
	Value	Pound	2857.4	8.87
Machinery work	No.	Working hour/ machine	20.2	-
	Value	Pound	3640.8	11.29
Total wages	Value	Pound	6498.2	20.16
Seedlings	No.	Seedling	143	-
	Value	Pound	983.9	3.05
Municipal fertilizer	Qty.	m^3	6.8	-
	Value	Pound	1981.7	6.15
Nitrogen fertilizer	Qty.	Kg effective unit	23.5	-
	Value	Pound	812.1	2.52
Phosphate fertilizer	Qty.	Kg effective unit	15.7	-
	Value	Pound	338.7	1.05
Potash fertilizer	Qty.	Kg effective unit	17.4	-
	Value	Pound	754.2	2.34
Pesticide	Qty.	Liter	4.8	-
	Value	Pound	359.6	1.12
Production requirements	Value	Pound	5230.2	16.23
Total of variable costs	Value	Pound	11728.4	36.39
Rent (opportunity cost)	Value	Pound	20500.0	63.61
Total of production costs	Value	Pound	32228.4	100

Source: Compiled and calculated from the questionnaire data for the research sample of the producers.

3.2.2. Marketing costs and the relative importance of its items for the olive harvest in the research sample

The items of feddan marketing costs for the olive harvest in the research sample include four items: (1) The cost of sorting, (2) The cost of staging, (3) The cost of packing, (4) The cost of transportation, (5) Other costs, and the relative importance of the items of those marketing costs,

which are included in Table (6), can be reviewed as follows:

The average of marketing costs spent on an feddan of olive crop in the research sample in Matrouh Governorate amounted to about 4940.0 pounds, and the items of those costs include: The cost of sorting with an average of about 1120.9 pounds, representing about 22.69% of the average of marketing costs and the grading cost with an average of about 879.3 pounds, representing about 17.8% of the average of marketing costs per feddan, and the packing cost with an average of about 542.1 pounds, representing about 10.98% of the average of marketing costs per feddan, and the cost of transportation at an average of about 1567.7 pounds, representing about 31.73% of the average of feddan marketing costs, and other costs with an average of about 830.0 pounds, representing about 16.80% of the average of marketing costs per feddan.

Table 6. Marketing cost items and the relative importance of each of them to the olive harvest in the research sample of producers in Matrouh Governorate during 2021/2022.

Items	Marketing costs	
	Pound	(%)
Sorting	1120.9	22.69
Staging	879.3	17.80
Packing	542.1	10.98
Transportation	1567.7	31.73
Other*	830.0	16.80
Total marketing costs	4940.0	100.0

**Includes: the cost of the sign (Communication), the carrying.*

Source: Compiled and calculated from the questionnaire data for the research sample of the producers.

3.2.3. The yield and total revenue of the olive crop in the research sample

It is possible to review the yield and total revenue, which are included in Table (7) as follows:

The average of yield of the olive crop in the research sample in Matrouh Governorate was about 7.3 ton/feddan, with an average of farm price of about 8194.0 pound per ton, and with an average of total revenue of about 59816.2 pound/feddan.

Table 7. Average of yield and total revenue of the olive crop in the research sample of producers in Matrouh Governorate during 2021/2022.

Variables	Unit		Value or Qty.
Yield	Qty.	Ton/feddan	7.3
Farm price	Value	Pound/ton	8194.0
Total revenue	Value	Pound/feddan	59816.2

Source: Compiled and calculated from the questionnaire data for the research sample of the producers.

3.3. The productive and economic indicators of the olive crop in the research sample

3.3.1. The Productive indicators of the olive crop in the research sample

By measuring some productivity indicators of the olive crop in the research sample, which measures its partial efficiency, which is represented in the production averages of the economic resources used in the production of the olive crop, it is clear from the data in Table (8) that: The average of unit production of variable cost items, which represents the partial efficiency of human labor, machinery work, seedlings, municipal fertilizer, nitrogenous fertilizer, phosphate fertilizer, potassium fertilizer, and

pesticides, was about 0.38 ton/ labor /working day, 0.36 ton/working hour/ machine, 0.05 ton/sapling, 1.07 ton/m^3, 0.31 ton/kg effective unit, 0.46 ton/kg effective unit, 0.42 ton/kg effective unit, and 1.52 ton/liter of each, respectively.

3.3.2. The economic indicators of the olive crop in the research sample

By measuring some economic indicators of the olive harvest in the research sample, which measures the total efficiency of it, which are: net return, marginal income, value added, profit margin ratio, relative profitability, return on the invested pound, and benefit-cost ratio, it is clear from the data received in Table (9) the following: The total efficiency criteria for an feddan of olive harvest, which are: net return, marginal income, value added, profit margin ratio, relative profitability, return on the invested pound, and the benefit-cost ratio is about 27.59 thousand pounds, 48.09 thousand pounds, 54.59 thousand pounds, 46.12%, 235.22%, 0.86 pounds, and 1.86.

Table 8. The productive indicators of the olive crop in the research sample of producers in Matrouh Governorate during 2021/2022.

Productive indicators	Unit	Olive crop
Production of human labor	ton/ labor /working day	0.38
Production of machinery work	ton/working hour/ machine	0.36
Production of seedlings	ton/sapling	0.05
Production of municipal fertilizer	ton/m^3	1.07
Production of nitrogenous fertilizer	ton/kg effective unit	0.31
Production of phosphate fertilizer	ton/kg effective unit	0.46
Production of potassium fertilizer	ton/kg effective unit	0.42
Production of pesticides	ton/liter	1.52

Source: Compiled and calculated from the questionnaire data for the research sample of the producers.

Table 9. The economic indicators of the olive crop in the research sample of producers in Matrouh Governorate during 2021/2022.

Economic indicators	Unit	Olive crop
Net return	Pound/feddan	27587.8
Marginal income	Pound/feddan	48087.8
Value added	Pound/feddan	54586
Profit margin ratio	%	46.12
Relative profitability	%	235.22
Return on the invested pound	Pound	0.86
Benefit-cost ratio	-	1.86

Source: Compiled and calculated from the questionnaire data for the research sample of the producers.

3.4. Statistical estimation of the production function of the olive crop in the research sample

The production function of the olive crop can be estimated based on the primary data of the research sample in Matrouh Governorate using the stepwise multiple regression method for the different mathematical formulas. The outputs of this function are the dependent variable (Y), which represents the amount of production (ton), while its inputs are represented in the following independent variables: Human labor (X_1)- (labor/working day), number of machine-working hours (X_2)- (working hour/ machine), number of seedlings (X_3)- (seedling), quantity of municipal fertilizer (X_4)- (m^3), amount of nitrogenous fertilizer (X_5)- (kg effective unit), quantity of phosphate fertilizer (X_6) –(kg effective unit), quantity of potassium fertilizer (X_7) –(kg effective unit), and quantity of pesticides (X^8)–(liters). The best statistical model for the production function was selected based on the parameter significance test using (t-test), the significance test for the whole model using (F-

test), and the adjusted coefficient of determination (Adjusted R^2) (Shephard, 2016), and it was found that the best estimated function after exclusion the variables that disagree with the economic or statistical logic is the double logarithmic function, as the results in Table (10) show them as follows:

It shows the significance coefficients of the variables of the amount of nitrogenous fertilizer, and the amount of phosphate fertilizer at 0.05, as well as the significance coefficients of the variables of the number of human labor, the amount of municipal fertilizer, and the amount of potassium fertilizer at 0.01 based on the calculated values of the (t-test), as shown by the significance of the effect of the all independent variables on the amount of production of the olive crop at 0.01 based on the value of the (F-test), and the value of the adjusted coefficient of determination was about 0.864, which indicates that the changes in the productive resources (the independent variables) included in the production function explains about 86.4% of the changes that occurred in the amount of olive production, while the other changes, estimated at 13.6%, are attributed to variables not included in the production function.

Table 10. The statistical estimation of the production function of the olive crop in the research sample of producers in Matrouh Governorate during 2021/2022.

Statement		Value
Equation constant	Value	1.359
	t-value	(6.414)**
Number of human labor (x_1)	Elasticity	0.512
	t-value	(2.98)**
Amount of municipal fertilizer (X_4)	Elasticity	0.048
	t-value	(3.17)**
Amount of nitrogenous fertilizer (X_5)	Elasticity	0.201
	t-value	(2.21)*
Amount of phosphate fertilizer (X_6)	Elasticity	0.097
	t-value	(2.13)*
Amount of potassium fertilizer (X_7)	Elasticity	0.105
	t-value	(3.22)**
Adjusted R^2	0.864	
F	41.9**	

** Significant at 0.05* *** Significant at 0.01*

Source: The results of statistical analyzing the questionnaire data for the research sample of the producers.

It was found that there is a direct relationship between the amount of olive crop production (Y) and the number of human labor (X_1), the amount of municipal fertilizer (X_4), the amount of nitrogen fertilizer (X_5), the amount of phosphate fertilizer (X_6), and the amount of potassium fertilizer (X_7), where the elasticity of production of these resources amounted to 0.512, 0.048, 0.201, 0.097, and 0.105, respectively, and since they are positive and less than one, they indicate a decreasing marginal product, which means that by increasing the quantities used of these resources about 10% over the current level of use, this leads to an increase in the total product of olive by 5.12%, 0.48%, 2.01%, 0.97%, and 1.05%, respectively, which indicates that they are used in the second production stage, which is the stage of economic production.

By examining the efficiency of the use of productive resources in the production of the olive crop in the research sample, the review of the results shown in Table (11) shows the following:

The total production elasticity in the previous estimated production function was about 0.963, and since it is less than one, this indicates that olive production is subject to a decreasing return to scale, and this indicates that by increasing all of the quantities used from the aforementioned production resources by 10% over the current level of use, it leads to an increase in the amount of production of the olive crop at a lower rate, which is about 9.63%.

Table 11. The economic efficiency of the resources used to produce the olive crop in the research sample in Matrouh Governorate during 2021/2022.

Variables	Unit	Average of the variable amount	Production elasticity	Marginal product (Ton)	Average product (Ton)	Value of marginal product (Pound)	Resource unit price (Pound)	Economic efficiency coefficient
Human labor	labor/working day	19.0	0.512	0.197	0.385	1614.22	150.0	10.76
Municipal fertilizer	m^3	6.8	0.048	0.052	1.083	426.09	292.8	1.46
Nitrogen fertilizer	kg effective unit	23.5	0.201	0.062	0.308	508.03	34.56	14.69
Phosphate fertilizer	kg effective unit	15.7	0.097	0.045	0.464	368.73	21.57	17.09
Potassium fertilizer	kg effective unit	17.4	0.105	0.044	0.419	360.54	43.34	8.32
Sum of elasticities			0.963	-				

Source: Collected and calculated from the results of the statistical analysis of the data of the questionnaire form for the research sample.

The marginal product of the variables of the number of human labor, the amount of municipal fertilizer, the amount of nitrogen fertilizer, the amount of phosphate fertilizer, and the amount of potash fertilizer are about 0.197, 0.052, 0.062, 0.045, 0.044 ton, respectively, which means that when the quantities used of these resources are increased by 1 labor/ working day, 1 m^3, 1 kg effective unit, 1 kg effective unit, 1 kg effective unit, respectively, this will lead to an increase in the quantity of olive production about 0.40 tons and with a monetary value of about 3277.60 pound, and the average output for those variables reached about 0.385, 1,083, 0.308, 0.464, and 0.419 ton, respectively.

By estimating the economic efficiency coefficients of the previously mentioned olive crop production resources by dividing the marginal product value of the productive resource used by the unit price of the resource, it turns out that it amounted to about 10.76, 1.46, 14.69, 17.09, and 8.32,respectively, and since it is greater than 1, this indicates that the producers of the olive crop in the research sample can increase the profits from the production of the olive crop by increasing the number of human labor, the quantities used of municipal fertilizer, nitrogenous fertilizer, phosphate fertilizer, and potassium fertilizer.

3.5. The marketing path of the olive crop in the research sample farms

The methods and paths of marketing the olive crop in the research sample farms in Matrouh Governorate from the producer to the final consumer was to, as shown in Figure (1), in five ways: (1) The selling before or after the fruits of the crop ripping: the producer sells the crop before or after the crop ripping, which the agreement with the traders after estimating the crop and agreeing on the price so that the producer gets the value of the crop at once, in which the trader performs all the services and marketing operations, (2) Balance sale: where the producer sells the crop inside the farm by weight after agreeing on the price with the wholesaler or retailer, in which the producer performs all services and marketing operations, (3) Selling in wholesale markets: where the producer sells the

crop in wholesale markets, and in which the producer performs all services and marketing operations on the crop, (4) Selling in retail markets: where the producer sells the crop in retail markets, in which he performs all services and marketing operations, (5) Selling to olive oil presses: where pressing the oil for the account of the producer or for the account of the wholesaler, where the producer performs all the services and marketing operations, and then the olive oil is marketed from the press for the wholesaler or retailer and then the final consumer.

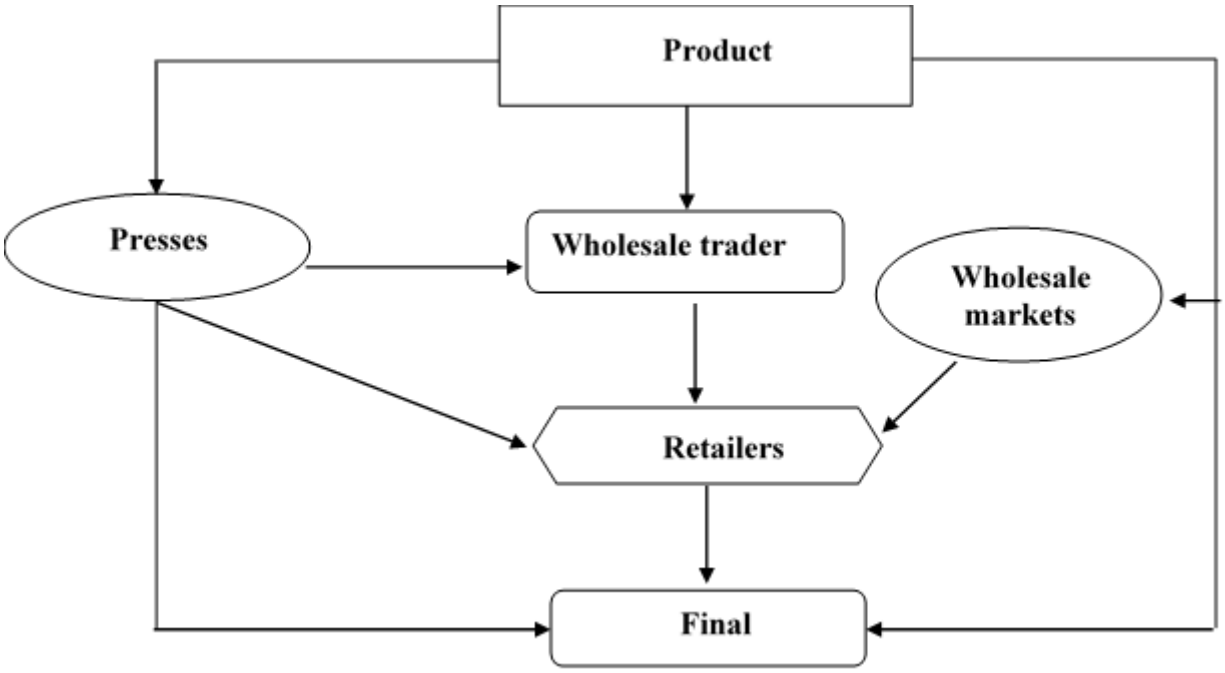

Figure 1. Marketing behavior of the olive crop in Matrouh Governorate 2022.
Source: Prepared by researchers.

3.6. Marketing margins and the share of the producer, wholesaler and retailer from the consumer pound distribution and the marketing efficiency coefficient of the olive crop

It is possible to estimate the marketing margins and the share of each of the producer, the wholesaler and the retailer from the consumer pound distribution, in addition to the marketing efficiency coefficient of the olive crop in the research sample, as shown by the data in Table (12) as follows:

The marketing margin represents the difference between the price that the producer gets and the price paid by the consumer, and it may appear in the form of an absolute or relative value, since the absolute price margin is calculated in the form of absolute monetary units, while the percentage price margin is calculated in the form of a percentage from the selling price of the product (El-Dnasury,2021), the average of absolute marketing margin between the wholesale price and the farm price of the olive crop was about 1755 pound/ ton, and between the retail price and the wholesale price was about 3185 pound/ ton, while it was between the retail price and the farm price about 4940 EGP/ ton, and the relative marketing margin between the wholesale price and the farm price was about 17.64%, and between the retail price and the wholesale price was about 24.25%, while it was between the retail price and the farm price about 37.61%.

The consumer pound distribution is intended to distribute the value of one pound paid by the

consumer between the producer and the various marketers concerned with marketing the commodity (Khalil, et al, 2019). The average of the producer's share from the consumer pound was about 62.39%, while the wholesaler share reached about 13.36%, while the retailer share reached about 24.25%, and thus the middlemen share represents about 37.61%.

Marketing efficiency is meant to maximize the ratio between each of the products of marketing activities, which is the ability to satisfy consumer desires for goods and services, and the extent of the total amount of resources used in marketing operations (Sabbouh & Alattuan,2020).The marketing efficiency of the olive crop in the research sample reached about 47.19%, and since it is less than 50%, this means that a decrease in the marketing efficiency and this is due to a decrease in the share of the producer in the price paid by the consumer.

Table 12. Marketing margins and the share of the producer, wholesaler and retailer from the consumer pound distribution and the marketing efficiency coefficient of the olive cropin the research sample in Matrouh Governorate during 2021/2022.

Statement		Olive crop
Prices (Pound/ ton)	Farm price	8194.0
	Wholesale price	9949.0
	Retail price	13134.0
Absolute marketing margins (Pound/ ton)	Wholesaler – producer	1755.0
	Retailer–wholesaler	3185.0
	Retailer – producer	4940.0
Percentage marketing margins per ton (%)	Wholesaler – producer	17.64
	Retailer–wholesaler	24.25
	Retailer – producer	37.61
Consumer pound distribution (%)	Share of the producer	62.39
	Share of the wholesaler	13.36
	Share of the retailer	24.25
Total share of intermediaries of the consumer pound (%)		37.61
Marketing efficiency coefficient (%)		47.19

Source: Compiled and calculated from the questionnaire data for the research sample of the producers and traders.

3.7. The production and marketing problems that faced the producers of the olive crop with the research sample and the proposed solutions to overcome them

Through the questionnaire and the sample, it was possible to limit the production and marketing problems that faced the producers of the olive crop to the research sample and the most important suggested solutions to overcome these problems, according to their opinions and presented in tables (13, 14) as follows:

3.7.1. Production problems and suggested solutions

The number of production problems that olive crop producers faced in the research sample amounted to five problems, arranged according to their relative importance as contained in the table, on top of which comes the problem of climate changes (weather fluctuations and strong winds), which caused the fall of clusters and consequently the decrease in production and the rise in prices, representing about 98% of the total number of producers in the research sample, followed by the problem of high prices of production requirements and their unavailability in agricultural associations at a rate of about 96% of the total number of producers, followed by the problem of trained labor shortage and high wages, if any, at a rate representing about 84% of the total number of producers, followed by the problem of producers adopting not good

agricultural practices, the most important of which that the deadline for the dates and quantities of water needed for each stage of production, at a rate of about 82% of the total number of producers, and followed by a final problem of the lack of a role for agricultural extension in guiding producers in production and manufacturing processes with a percentage representing about 66% of the total number of producers, and it was statistically confirmed that there are five problems through the estimated (Chi-square) values - Table (13).

Table 13. The relative importance of the production problems faced by the producers of the olive crop in the research sample and the proposed solutions to overcome them in Matrouh Governorate during 2021/2022.

N	Problems and solutions	Frequency	(%)	Chi-square
Production problems:				
1	Climatic changes (weather fluctuations and strong winds) , which caused the fall of clusters.	98	98	92.16**
2	High prices of production requirements and their unavailability in agricultural associations.	96	96	84.64**
3	Trained labor shortage and high wages,if any.	84	84	46.24**
4	Producers adopting not good agricultural practices, the most important of which that the deadline for the dates and quantities of water needed for each stage of production.	82	82	40.96**
5	The lack of a role for agricultural extension in guiding producers in production and manufacturing processes.	66	66	10.24**
Total		100	-	
Proposed solutions:				
1	Pay attention to cultivate windbreaks to face climate changes.	95	95	81.00**
2	Provide agricultural associations with production requirements in sufficient quantities, at appropriate prices and in the required time.	91	91	67.24**
3	Educate human labor through competent organs in agricultural operations for the crop.	82	82	40.96**
4	Sensitize producers to the water requirements for agriculture at the appropriate times	76	76	27.04**
5	Activate the role of agricultural extension in sensitization and orientation for the producers	49	49	0.04n.s
Total		100	-	

*** Significant at 0.01* *n. s. Non sign.*

Source: Compiled and calculated from the questionnaire data for the research sample of the producers and traders.

It was possible to identify the most important proposed solutions according to the producers' opinions of the research sample to overcome the production problems they faced, as it turned out that the most important of those solutions were arranged according to their relative importance summed up in five solutions, on top of which comes the proposal to pay attention to plant windbreaks to face climate changes with a percentage of 95% of the total number of producers, followed by a proposal to provide agricultural associations with production requirements in sufficient quantities, at appropriate prices and in the required time, at a rate of about 91% of the total number of producers, followed by a proposal to educate human labor through competent organs in agricultural operations for the crop, at a rate of about 82% of the total number of producers, followed by a proposal to sensitize producers to the water requirements for agriculture at the appropriate times, representing about 76% of the total number of producers and followed by a final proposal to activate the role of agricultural

extension in sensitization and orientation for the producers, at a rate of about 49% of the total number of producers. It was statistically confirmed that there are four suggested solutions from them through the estimated (Chi-square) values, while was not confirmed the fifth proposal - Table (13).

3.7.2. Marketing problems and suggested solutions

The number of marketing problems faced by the producers of the olive crop in the research sample was three, arranged according to their relative importance as listed in the table, on top of which comes the problem of monopoly of traders and the main markets are far from the production areas in Siwa Oasis, which increases the transportation costs of the crop about 96% of the total number of producers in the research sample, followed by the problem of increasing the damaged percentage of the crop due to the lack of suitable packages, representing about 83% of the total number of producers, followed by a final problem of unavailability of automatic presses and pickling plants, and the presses are far from the producers with a rate of about 59% of the total number of producers, and it has been statistically confirmed that there were two problems of it through the estimated (Chi-square) values, while the third problem was not statistically confirmed - Table (14).

Table 14. The relative importance of the marketing problems faced by the producers of the oliveharvest in the research sample and the suggested solutions to overcome them in Matrouh Governorate during 2021/2022.

N	Problems and solutions	Frequency	(%)	Chi-square
Marketing problems:				
1	Monopoly of traders and the main markets are far from the production areas in Siwa Oasis, which increases the transportation costs of the crop.	96	96	84.64^{**}
2	Increasing the damaged percentage of the crop due to the lack of suitable packages.	83	83	43.56^{**}
3	Unavailability of automatic presses and pickling plants, and the presses are far from the producers.	59	59	$3.24^{n.s}$
Total		100	-	
Suggested solutions:				
1	Create markets or stations to collect the crop near the production areas.	93	93	73.96^{**}
2	Provide suitable packages for collecting the crop at suitable prices.	78	78	31.36^{**}
3	Establish automatic presses and pickling plants to take advantage of the production.	51	51	$0.04^{n.s}$
Total		100	-	

*** Significant at 0.01* *n. s. Non sign.*

Source: Compiled and calculated from the questionnaire data for the research sample of the producers and traders.

It was possible to identify the most important suggested solutions, according to the opinions of producers, to the research sample to overcome the marketing problems they faced, as it became clear that the most important of those solutions were arranged according to their relative importance, summed up in three solutions, on top of which comes the suggestion to create markets or stations to collect the crop near the production areas with a percentage representing about 93% of the total number of producers, followed by a suggestion to provide suitable packages for collecting the crop at suitable prices, representing about 78% of the total number of producers, followed by a final suggestion to establish automatic presses and pickling plants to take advantage of the

production at a rate representing about 51% of the total number of producers, and it has been statistically confirmed two of the suggested solutions were found through the estimated (Chi-square) values, while the existence of the third suggestion was not confirmed- Table (14).

4. Concluding Remarks

The research had come to some important results can be summarized a;(1) The average of total production costs spent on an feddan of olive crop in the research sample in Matrouh Governorate amounted to about 32228.4 pound, and the average of marketing costs amounted to about 4940.0 pound, and the average of yield of the olive crop was about 7.3 ton/feddan, with an average of farm price was about 8194.0 pound per ton, and with an average of total revenue of about 59816.2 pound/feddan,

(2) The average of unit production of variable cost items, which represents the partial efficiency of human labor, machinery work, seedlings, municipal fertilizer, nitrogenous fertilizer, phosphate fertilizer, potassium fertilizers, and pesticides, was about 0.38 tons/ labor /working day, 0.36 ton/working hour/machine, 0.05 ton/sapling, 1.07 ton/m^3, 0.31 ton/kg effective unit, 0.46 ton/kg effective unit, 0.42 ton/kg effective unit, and 1.52 ton/liter of each, respectively, (3) The total efficiency criteria for an feddan of olive crop, which are: net return, marginal income, value added, profit margin ratio, relative profitability, return on the invested pound, and the benefit-cost ratio is about 27.59 thousand pounds, 48.09 thousand pounds, 54.59 thousand pounds, 46.12%, 235.22%, 0.86 pounds, and 1.86, (4) The economic efficiency coefficients of the olive crop production resources, whose coefficients have been proven to be significant, which are the number of human labor, the quantities used of municipal fertilizer, nitrogenous fertilizer, phosphate fertilizer, and potash fertilizer are about 10.76, 1.46, 14.69, 17.09, and 8.32, respectively, and this indicates that the producers of the olive crop can increase the profits of the crop production by increasing the number of human labor, the quantities used from those resources, (5) The average of absolute marketing margin between the wholesale price and the farm price of the olive crop was about 1755 pound/ ton, and between the retail price and the wholesale price was about 3185 pound/ ton, while it was between the retail price and the farm price about 4940 EGP/ ton, and the relative marketing margin between the wholesale price and the farm price was about 17.64%, and between the retail price and the wholesale price was about 24.25%, while it was between the retail price and the farm price about 37.61%, (6) The average of the producer's share from the consumer pound was about 62.39%, while the wholesaler share reached about 13.36%, while the retailer share reached about 24.25%, and thus the middlemen share represents about 37.61%, (7) The marketing efficiency coefficient of the olive crop in the research sample reached about 47.19%, and since it is less than 50%, this means that a decrease in the marketing efficiency, and this is due to a decrease in the share of the producer in the price paid by the consumer, (8) The number of production problems that olive crop producers faced amounted to five problems, on top of which comes the problem of climatic changes (weather fluctuations and strong winds), which caused the fall of clusters and consequently the decrease in production and the rise in prices, and it was possible to identify the most important proposed solutions according to the producers' opinions to overcome the production problems they faced in five solutions, on top of which comes the proposal to pay attention to plant windbreaks to face climate changes, (9) The number of marketing problems faced by the producers of the olive crop was three, on top of which comes the problem of monopoly of traders and the main markets are far from the production areas in Siwa Oasis, which increases the transportation costs of the crop, and it was possible to identify the most important suggested solutions, according to the opinions of producers

to overcome the marketing problems they faced in three solutions, on top of which comes the suggestion to create markets or stations to collect the crop near the production areas.

Lastly, in light of the results the research, it recommended the following should be necessary:(1) Paying attention to the cultivation of windbreaks to face the effects of climate change, (2) Paying attention to contract farming to ensure an appropriate price and achieving a economic revenue for olive producers in Matrouh Governorate, (3) Providing production requirements for olive producers in sufficient quantities, at appropriate prices and at the required time, (4) Activate the role of agricultural extension in sensitization and orientation for the olive producers in Matrouh Governorate, (5) Create markets or stations to collect the olive crop near the production areas, (6) Provide suitable packages for collecting the olive crop at suitable prices, (7) Working to raise marketing efficiency by reducing the marketing costs and profits of intermediaries' to encourage olive producers to increase production of olive crop.

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5. References

Abo Elnaga, M.A., Ibrahim, G.A. (2017). 'An economic study for production of olive crop in Matrouh Governorate (Case study Siwa Oasis)', *Egyptian Journal of Agricultural Economics, Egypt,* 27(2), pp. 867-886.

Abo Shama, A.H. (2019). 'Production and Economic determinants of olive yield in Siwa Oasis', *Annals of Agricultural Sciences, Moshtohor, Egypt,* 57(1), pp. 277-296.

Aguinis, H. (2004). *'Regression analysis for categorical moderators',* New York, Guilford Press.

Ahmed, A.A., Hamza, A.M., Nassar, S.Z., Sami, M.M. (2021). 'An economic and financial evaluation of olive manufacturing Siwa Oasis', *Egyptian Journal of Agricultural Economics, Egypt,* 31(4), pp. 1115-1128.

Attia, M.B., Abu Al-Naga, M.A. (2021). 'Economics of olive crop production in Matrouh Governorate', *Egyptian Journal of Agricultural Economics, Egypt,* 31(1), pp. 197-208.

El-Dnasury, M.F. (2021). 'The economic and marketing efficiency of guava crop in Alexandria Governorate', *Alexandria Journal of Agricultural Sciences, Egypt,* 66(2), pp. 31-54.

EL-Sharkawy, E.M. (2012). *'Critical research insights in the field of agricultural economics and economics sciences between theory and practice',* Faculty of Agriculture, Alexandria University, Part 2, pp. 111-112.

Hansen, B.E. (2014). *'Econometrics',* University of Wisconsin, Department of Economics.

Heady, E.O., Dillon, J.L. (1961). 'Agricultural Production Functions', Ames, Iowa State University Press.

Henderson, J.M., Quandt, R.E. (1985). *'Microeconomic Theory; A Mathematical*

Approach', Mc Graw-Hill College, New York, U. S. A., Third Edition.

Hussein, A.M., Shaba, S.F. (2017). 'A study of the determinants of the olive crop production in Nineveh Province (Bashiqa district as a case study for the season 2010)', *Mesopotamia Journal of Agricultural*, 45(1), pp. 25-34.

Mahde, N.M. (2020). 'Investment efficiency of olive crop in South Sinai Governorate', *Egyptian Journal of Agricultural Economics*, 30(1).

Khalil, Y.M., El-eshmawiy, K.H., Elsherif, L.M., Elsayed, A.S. (2019). *'Marketing Efficiency for some Egyptian agricultural crops, Egyptian Association of Agricultural Economics'*, Twenty-Seventh conference of agricultural economists, Agricultural Club, Dokki, Cairo, Egypt, 6-7 November, PP. 159-170.

Ministry of Agriculture and Land Reclamation (2020). *'Economic Affairs Sector, Agricultural Statistics Bulletin'*, Miscellaneous issues during the period (2005-2020), Egypt.

Ministry of Agriculture and Land Reclamation (2022). *'Agriculture Directorate of Matrouh'*, Statistics Department, Unpublished data, Egypt.

Ministry of Agriculture and Land Reclamation (2022). *'Agriculture Directorate of Matrouh'*, Statistics department, unpublished data, Egypt.

Nassar, S.Z., Hamza, A.M., Refaat, A.A., Ahmed, A.A. (2018). 'The economic efficiency for the production of some Agricultural crops in Siwa Oasis', *Egyptian Journal of Agricultural Economics*, 28(1), pp. 161-178.

Rabie, A.M., Gabr, R.H. (2019). 'An economic study for olive crop production in Bir Al-Abd Center North Sinai Governorate', *Annals of Agricultural Sciences, Moshtohor*, 57(4), pp. 1186-1194.

Sabbouh, S.M., Alattuan, S., Abdullah, I.M. (2020). 'An Analytical study of the marketing efficiency of olive oil in the Syrian', *Jordan Journal of Agricultural Sciences*, 16 (1), pp. 15-25.

Shafey, M.A. (2007). *'Economics of Agricultural production'*, Lectures for Postgraduate Students, Economics and Agribusiness Department, Faculty of Agricultural, Alexandria University, Egypt.

Shephard, R.W. (2016). *'Theory of cost and production function'*, Princeton University Press,

William, H.G. (2019). *'Econometric Analysis'*, Eighth Edition, New York University, Upper Saddle River, New Jersey.