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Nature and Science

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Multidisciplinary Academic Journal Publisher

An Economic Study for the Production and Marketing of Sour Lime in Sharkia Governorate

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Abstract: Sour Lime are considered one of the most important citrus crops due to their economic importance, as the value of lemon production amounted to about 1461 million pounds, representing about 18.3%, 5.21% of the value of production of both citrus and fruits during the period (2014-2019). The research showed a decrease in the fruitful area of the lemon crop in the Sharkia Governorate from 11.5 thousand feddans during the period (2006-2011), to 4.5 thousand feddans in period (2014- 2019). The results of the productivity function at the sample level indicate that there is a statistically significant positive relationship between production and each of the crop collection man/day, number of trees, amount of organic fertilizer/m3, and its productivity elasticity coefficient reached 0.506, 0.505, 0.309, meaning that an increase of 10% from These variables increase the quantity of lemon crop production by about 5.06%, 5.05%, 3.9%, respectively, per feddan. The total elasticity of these variables is 1.3. It was also found that the optimum volume of production and the lowest costs in the first and second categories and the total sample was achieved by 8, 5, 8 of the total lemon farmers in the research sample, and this represents about 27%, 17%, 12% of the number of lemon farmers in the sample, which reflects the economic inefficiency for the use of production factors, the first and second categories, and the total sample, did not achieve the maximum volume of production for profit. Regarding the marketing paths of the crop in the research sample, the quantity of lemon crop sorting amounted to 59.7 tons, representing 5%, while the surplus directed to the market amounted to about 1134.2 tons, representing 95%, and the quantity of lemons sold to the agency dealer in the Abu Kabir market area was about 907.4 tons, representing 76%, and from them to The wholesaler market and the rest 226.8 tons were sold to lemon exporters in the region, representing 19%, while the quantity of the lemon crop sold to the retailer was about 998 tons, representing 83.6% of the total quantity produced from the lemon crop, which amounted to 1193.9 tons per sample. The most important problems in the production and marketing of the lemon crop were represented in the low selling prices, representing 17.7%, the spread of viral diseases and flower worm (hamra) representing 16.1%, the cheating of pesticides and the lack of a safe source for purchase representing 14.5%, the high prices of production requirements representing 12.9%, followed by the rest of the problems, The research recommends the following: 1-Providing seedlings with good origins that are resistant to diseases,2-The work of an association for lemon producers in the region concerned with the production and marketing of the crop, 3- Supporting production requirements for farmers.

[Kamel Salah El-Din; Yomna Shehata Mostafa, and Mohamed Ibrahim Mohamed Raafat **An Economic Study for the Production and Marketing of Sour Lime in Sharkia Governorate** *Nat Sci* 2022,20(01):9-29]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature 2. doi:10.7537/marsnsj200122.02.

Keywords: Crop area, Production and costs function, Marketing channels, Problems of crop production and marketing

Introduction

Citrus is one of the most important types of fruits in Egypt due to its economic advantages over other types of fruits. The value of citrus production is about 8 billion pounds, representing about 1.93%, 3.57%, 28.5%, respectively, of the value of all agricultural, vegetable and fruit production, which amounts to about 1.93%. About 414.1, 223.7, 28.07 billion pounds, respectively, during the period (2014-2019), and Citrus are one of the most important citrus crops for its economic importance, as the value of lemon production amounted to about 1.46 billion pounds, representing about 18.3%, 5.21% of the value of production of each citrus The Egyptian salty lemon is one of the most successful lemon cultivations in the country, This is due to its strong tolerance for both negative conditions that it can face, such as thirst and drought. Lemon is a crop with multiple nutritional value, which includes prevention or treatment of some diseases, as it contains both sugars, water, fiber, phosphorous, copper, zinc, sodium, and a group of vitamins, the most famous of which are Vitamin (C), and lemon fruits are characterized by a high economic value that exceeds the economic value of many types of fruits, where the fruits of the lemon tree are used in the manufacture of juices, sauces and various types of essential oils, where oils are manufactured from lemon peels and leaves, and lemon is used in the preparation of various types of sweets, jams and industry Perfume and cosmetics.

Research problem:

The research problem represents It has been observed in recent years that the annual rate of increase in the area of fruitful lemon is very small at the level of the Republic in general, and the Sharkia Governorate in particular, where the fruitful area reached about 11.5 thousand feddan during the period (2006-2011) and decreased to about 34, 4.5 thousand feddan during the period (2014-2019) at the level of the Republic and Sharkia Governorate, respectively, which led to a decrease in the total production in the province, which had an impact on the amount of exports, which represented about 7.7% of the total production during the research period, in addition to the recent exposure of the crop to major price shocks And the high production costs per feddan, which led to the farmers' reluctance to expand its cultivation and grow other crops.

Research objective:

The research aims to study the economics of producing and marketing lemon in Egypt in general and Sharkia Governorate in particular, by studying the following points:

1-A study of the development of some productive and economic variables (total and fruitful area, productivity and production) at the level of the Republic in general, and the Sharkia Governorate in particular.

2- Estimation of production functions to know the most important factors affecting the lemon yield through the study sample.

3- Estimation of the productive cost functions of the lemon crop through the study sample.

4- Studying the economic efficiency in the sample of the study and studying the marketing paths for the lemon crop, and putting some recommendations that help decision-makers in solving the productivity problems of this crop and increasing its production and exports.

Research method and data sources:

The research relied on descriptive and quantitative analysis methods using statistical methods and methods that achieve research objectives such as averages, percentages and simple regression in addition to estimating production functions, costs and marketing paths with the research sample. Agriculture, Directorate of Agriculture, Sharkia Governorate, Central Agency for Public Mobilization and Statistics.

The research also relied mainly on field data collected for a random sample from the Abu Kabir Center with 60 farmers representing about 20% of the total number of farmers in Bandar Abu Kabir Association, which is 300 farmers, whose average lemon area is 2 feddan, and accordingly the sample was divided into Two categories, the first is less than 2 feddan, and the second is more than 2 feddan, with 30 farmers in each category (the first category farmers are 180 farmers, and the second is 120 farmers) and were collected by personal interviews during the year 2020/2021.

The following standard models were used in the analysis:

A- General direction equation:

The research used the General direction equation to show the effect of time on the economic variables under study, and the following standard picture was used in the relationship of economic variables with the time factor.

$Yi= A + BTi$

Yi= expresses the variable in question in the view i.

Ti = a variable representing the time in observation i.

i = 3,2,1........... n.

B - production function:

The research used the following logarithmic paired form in estimating the production function using stepwise regression.

= Estimated value of production quantity of lemon. = Quantity of a variable factor of production. (A ,B) = constant coefficients.

C- Cost function:

The research used the following quartile image in estimating the average cost function.

A.T.C = A + B1 qi + B2 qi2

A.T.c. The estimated value of the total costs of producing a ton of lemon in view i.

Amount of production of a ton of lemon per watch i.

.A ,B = coefficients of the function in observation i., i = 1, 2, 3, ..., n.

The most important results:

First: The development of economic and productive variables for the lemon crop in Egypt and Sharkia Governorate:

A- Evolution of economic and productive variables for the lemon crop in Egypt (2000-2019)

1- **Total area**: The data in Table (1) indicate that the average total area in the Republic amounted to about 39.6 thousand feddan during the period (2000-2019), with a minimum of about 36.4 thousand feddan in 2000, and a maximum of about 46.8 thousand feddan in 2008, and It was found that the total area of the lemon crop has taken an annual increasing trend that is not statistically significant, which means that the total area is relatively stable around its arithmetic average of about 39.6 thousand feddan, as shown in Table (2).

2- **The fruitful area**: Table (1) shows that the fruitful area of the lemon ranged between a maximum of about 38.8 thousand feddan in 2008, and a minimum of about 32.4 thousand feddan in 2014, with an annual average of about 34.8 thousand feddan during the aforementioned period The fruitful area also took a statistically significant annual decreasing general trend, which means that the fruitful area is relatively stable around its arithmetic average of about 34.8 thousand feddan.

3- **Feddan productivity**: extrapolating data from Table (1), it was found that the average productivity of lemon reached about 9.2 tons / feddan and ranged between a minimum of about 8.3 tons / feddan in 2000, and a maximum of about 10.2 tons / feddan in 2017, as shown The feddan productivity of the lemon crop has taken a general and annual increasing trend, statistically significant, estimated at about 0.086 tons / feddan, representing about 0.74% of the average feddan productivity of the lemon crop during the study period, as shown in Table (2).

4- **Total production**: Table (1) shows that the total production of lemon ranged between a minimum of about 274.5 thousand tons in 2000, and a maximum of about 362.7 thousand tons in 2017, with an annual average of about 321.4 thousand tons, during the period The aforementioned, as the total production took an annual increasing trend, which is not statistically significant, which means that the total production is relatively stable around its arithmetic average of about 321.4 thousand tons.

5- **The farm price**: The data of Table (1) showed that the farm price of lemon ranged between a minimum of about 782 pounds / ton in 2001, and a maximum of about 5648 pounds / ton in 2018, with an annual average of about pounds / ton, and it was found that the price The lemon crop has taken a statistically significant annual increasing trend, estimated at about 245.97 pounds / ton, representing about 9.9% of the average agricultural price of the lemon crop during the research period.

B-The development of economic and productive variables for the lemon crop in Sharkia Governorate (2000-2019)

1- **Total area**: The data in Table (1) indicate that the average total area reached about 10.4 thousand feddan during the period (2000-2019), with a maximum of about 15.8 thousand feddan in 2008, and a minimum of about 4.08 thousand feddan in 2019 with a decrease representing About 74%, as it was found that the total area of the lemon crop took a general statistically significant decreasing trend estimated at about 0.547 thousand feddan, representing about 5.3% of the average total area of the lemon crop during the study period, as shown in Table (2).

2- **The fruitful area**: it was found that the fruitful area of the lemon ranged between a maximum of about 13.01 thousand feddan in 2000, and a minimum of about 2.16 thousand feddan in 2019, with an annual average of about 9.65 thousand feddan during the aforementioned period, and the fruitful area was taken A general.

Table (1): The development of economic and production variables for the sour lemon crop in Egypt and Sharkia Governorate During the period (2000-2019)

	Egypt					Sharkia Governorate				
The years	The total area (thousand feddan)	The fruitful area (thousand feddan	Productivity (Ton/ feddan)	Production (thousand tons)	Farm price (pounds /ton)	The total area (thousand feddan)	The fruitful area (thousand feddan)	Productivity (Ton/ feddan)	Production (thousand tons)	% of the Republictotal
2000	36.38	33.25	8.26	274.48	875	13.03	13.01	11.6	150.49	54.83
2001	37.69	34.51	8.59	296.27	782	13.09	12.98	11.8	153.22	51.72
2002	37.65	34.75	9.34	324.61	965	13.04	12.89	12.5	161.49	49.75
2003	37.72	34.93	9.43	329.34	816	13.03	12.86	12.7	163.55	49.66
2004	38.66	35.59	9.44	335.82	878	12.97	12.88	12	154.55	46.02
2005	39.91	36.04	9.28	334.43	1229	12.89	12.76	11.2	142.35	42.56
2006	40.44	36.33	8.7	316.01	1263	12.76	12.72	9.1	116.09	36.74
2007	40.57	37.44	8.6	324.59	2334	12.5	12.48	9	112.29	34.59
2008	46.8	38.08	8.6	329.74	1741	15.84	12.32	9.5	116.5	35.33
2009	43.69	36.85	8.7	321.28	1828	14.23	11.93	9.5	112.7	35.08
2010	40.18	36.98	8.6	318.11	2646	11.18	11.16	8.9	100.46	31.58
2011	37.2	33.38	8.9	296.77	2687	8.33	8.25	9.2	75.79	25.54
2012	39.79	32.78	9.2	300.53	2712	7.24	6.75	9.7	65.33	21.74
2013	39.55	32.69	9.2	300.32	2739	7.39	5.56	10.6	58.67	19.54
2014	38.06	32.46	9.3	301.48	2771	6.65	5.82	11.1	64.41	21.36
2015	39.27	35.52	9.9	350.59	2811	8.18	5.78	11.7	67.94	19.38
2016	38.87	34.43	10.1	345.93	3322	5.67	4.72	11.4	54.79	15.84
2017	38.45	35.56	10.2	362.71	5617	5.43	4.46	11.6	51.63	14.23
2018	42.71	34.78	10.1	352.56	5648	4.32	3.93	11.6	45.39	12.87
2019	38.64	31.24	9.9	312.11	5667	4.08	2.16	11.6	24.94	7.99
Average	39.61	34.88	9.22	321.38	2467	10.41	9.65	10.77	103.56	32.22

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Economics Bulletin.

Table (2) Equations of the General direction equation of some economic and production variables for the lemon crop in Egypt and Sharkia Governorate during the period (2000-2019)

Statement	The equation	T	R^2	average	% change rate
Egypt					
Total area (thousand feddan)	$\hat{Y}=38.79+0.077 X_i$	0.81	0.035	39.6	-
Fruitful area (thousand feddan)	$\hat{Y}=35.85-0.09X_i$	-1.34	0.09	34.88	-
Productivity (tons/feddan)	$\hat{Y}=8.49+0.068X_i$	3.97**	0.47	9.22	0.74
Total production (thousand tons)	Y^=305.65+1.49Xi	1.81	0.16	321.4	-
Farm price (pounds/feddan)	$\hat{Y}=-116.18+245.97X_i$	9.5**	0.83	2466.5	9.9
Sharkia Governorate					
Total area (thousand feddan)	$\hat{Y}=15.83-0.547X_i$	-7.6**	0.76	10.4	5.3
Fruitful area (thousand feddan)	$\hat{Y}=15.78-0.62X_i$	-11.7**	0.88	9.65	6.4
Productivity (tons/feddan)	$\hat{Y}=11.02-0.019X_i$	-0.38	0.008	10.77	-
Total production (thousand tons)	$\hat{Y}=176.25-7.3X_i$	-17.06**	0.94	103.5	7.3

Table (1) Source:
**Significant at 0.01, *Significant at 0.05 (-) Not significant
Y: refers to the area, productivity and production of lemon in Egypt and Sharkia Governorate in thousand tons.
xi: x: time variable, I: number of years (1,2,3,4,................,20).
Source: Calculated and compiled from Table (1).

Statistically significant annual decreasing trend estimated at about 0.62 thousand feddan, representing about 6.4% of the average fruitful area of the lemon crop during the study period, as shown in Table (2).

3- **Feddan productivity**:

Extrapolating data from Table (1), it was found that the average productivity of salty lemon was about 10.8 tons / feddan, and ranged between a maximum of about 12.7 tons / feddan in 2003, and a minimum of about 8.9 tons / feddan in 2010, as shown the feddan productivity of the lemon crop has taken a general annual decreasing trend that is not statistically significant, which means that the feddan productivity is relatively stable around its arithmetic average of about 10.8 tons / feddan during the study period as shown in Table (2).

4- **Total production**:

Table No. (1) shows that the total production of lemon ranged between a maximum of about 163.5 thousand tons in 2003, representing about 49.7% of the total production in the Republic, and a minimum of about 24.9 thousand tons in 2003. 2019, representing About 8% of the total production. The total production at the level of the republic, with an annual average of about 103.6 thousand tons, represented about 32% of the republic's total production of lemon during the mentioned period, and the total production took a general direction decreasing statistically annually. The importance is estimated at 7.29 thousand feddan, which represents about 7.04% of the average kidney production of the lemon crop during the research period.

Second: Geographical distribution of the most important lemon producing governorates in Egypt:

It is clear from Table (3) that the annual average of the total area of sour lemon in the Republic amounted to about 39 thousand feddan, and the Nubaria region, Sharkia governorate, Beheira, Fayoum and Assiut occupies the first to fifth place, as the total area of them reached about 13.5, 6.12, 4.0, 3.9, 2.5 thousand feddan respectively, representing about 34.3%, 16%, 10.2%, 10.1%, and 5.9%, respectively, and the annual average of the fruitful area was about 11.5, 5.29 thousand tons in Nubaria and Sharkia governorates, representing about 49.5% of the total of the Republic, while the annual average estimated The five governorates have about 26.3 thousand feddan, representing about 77.4% of the total republic, while the annual average of the fruitful area for the rest of the other governorates is about 5.25thousand feddan, representing about 15.4% of the total republic, it was found that the feddan productivity of the five governorates was about 11.3, 11.1, 10.2, 9.6, and 6.2 tons/feddan, respectively, and the total production of the five governorates amounted to about 138.5, 58.3, 32.4, 26.4, 19.7 thousand tons, respectively, representing about 41.9%, 17.6%, 9.8%, 7.9%, 5.9%, respectively, of the total production in the Republic.

Table (3) The geographical distribution of the total and fruitful area, productivity and production of the lemon crop in the governorates Republic during the period (2012-2019)

Governorate	Total area (thousand feddan)		The fruitful area (thousand feddan)		Productivity (tons/feddan)		Total production (thousand tons)	
	average	%	average	%	average	%	average	%
Beheira	4.00	10.20	3.18	9.34	10.2	103.9	32.4	9.78
Sharkia	6.12	16.30	5.29	15.55	11.1	113.5	58.3	17.64
Fayoum	3.98	10.10	4.24	12.46	6.2	63.5	26.4	7.97
Asyut	2.50	5.90	2.07	6.07	9.6	97.7	19.6	5.98
Sohag	0.54	1.40	0.54	1.58	8	81.7	4.3	1.31
qana	1.02	2.64	1.04	3.05	7.5	76.3	7.8	2.36
the new Valley	1.91	4.58	0.88	2.59	4.4	44.5	3.9	1.19
Nubaria	13.50	34.28	11.55	33.94	11.3	115	138.5	41.90
Other governorates	5.68	14.65	5.25	15.41	0.00	0.00	39.2	11.87
Total Republic	39.24	100.00	34.03	100	9.79	100	33.6	100

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Economics Bulletin.

Third: The area of the single lemon crop in the administrative centers of Sharkia Governorate:

Table (4) indicates the relative importance of the area of the loaded and single lemon crop in the administrative centers in Sharkia Governorate 2020/2021. The Husseinieh Center ranked first in the area of the lemon crop (loaded) with an area of 1390 acres (loaded), representing 34.87%, In second place was the New Salhiya Center and City, with an area of 955 acres (loaded), representing 23.96%, Followed by Abu Kabir Center with an area of 622 feddan and 17 carats (single) representing 15.61%, Abu Hammad Center with an area of 375 feddan and one carat (loaded) representing 9.41%, Faqous Center with an area of 203 feddan (loaded) representing 5.09%, Kafr Saqr Center with an area of 200 feddan and 11 carats (loaded) representing 5.02%, Belbeis Center with an area of 175 feddan and 18 carats (loaded) representing 4.39%, then the rest of the governorate centers (Awlad Saqr, Mashtoul El-Souk, Derb Negm, Hahya, Minya El-Qamh, Zagazig), With an area of 64 feddan and 17 carats, representing 1.6 percent of the total area of the lemon crop in the governorate, which amounts to 3986 feddan and 16 carats.

The table also shows the presence of two types of cultivations for the lemon crop, a lemon crop loaded on other crops such as (mango, orange, etc.) and another single, in order to avoid the risk when growing one crop from weather, environmental and market conditions, making maximum use of the unit area and obtaining the highest return, and the other is a lemon crop Solo, which by its nature needs a great deal of experience from farmers, and therefore the research was based on the single lemon crop in Abu Kabir Center, as it is one of the oldest and most famous centers for cultivation of this crop and to avoid the shortcoming in estimating the economic variables with the crops loaded on it.

The relative importance of the lemon crop area in the villages of Abu Kabir Center, Sharkia Governorate

Table (4) shows the relative importance of the area of the lemon crop in the villages of Abu Kabeer Center in Sharkia Governorate 2020/2021, where Bandar Abu Kabir occupied the first place with an area of 451 feddan, representing 68.11%, then Nazlat Al-Areen ranked second with an area of 43 feddan and 12 carats, representing 6.49%, and Al-Mashaaleh ranked third. With an area of 37 feddan and 2 carats, representing 5.59%, Al-Haswa with an area of 33 acres and 10 carats, representing 4.98%, Abu Yassin with an area of 31 feddan and 16 carats, representing 4.68%, the rest of the villages of the Abu Kabir Center (Kafr Abu Kabir, Abu Salim, Al-Ghaba, Maimon, Centris, Bani Ayyad, Farasha, Al-Rahmaniya, Al-Mansterly) with an area of 52 feddan and 3 carats, representing 7.8%, of the total area of the lemon crop in Abu Kabir Center, which amounts to 662 feddan and 17 carats.

Accordingly, Bandar Abu Kabir was chosen to represent the sample of the field study, and based on the data of record 2 services from the Agricultural Association, with an estimate of the average sample, which amounted to 2 feddan, due to the small cultivated areas, the sample was divided into two categories, the first (less than 2 feddan), the second (more than 2 feddan).

2-Ministry of Agriculture and Land Reclamation, Directorate of Agriculture in Sharqia, Agricultural Administration of Babu Kabir, unpublished data, 2020/2021.
Description of the sample search:

Table No. (5) shows the description of the field research sample for the lemon crop, where the total area of the first category was 40 feddan with an average of 1.3 feddan, while the total area of the second category was 75 feddan, with an average of 2.5 acres and an increase of 35 feddan, representing 46.7%, and the results indicate that the total lemon trees In the first category there were 7,193 trees, an increase of 1,330 trees over the second category with a 22.7% increase The average number of trees in the first category was 236 trees/feddan, 65 trees more than the second category by 38%. The difference in the number of trees is due to the high age of lemon trees in the second category, which reaches 40 years.

Table (4) the relative importance of the area of the lemon crop in the administrative centers and villages of Abu Kabir Center Sharkia Governorate 2020/2021

Center (1)	area		%	current situation	the village **(2)**	area		Relative importance**%**
	feddan	carat				feddan	carat	
Zagazig	2	18	0.05	single	Bandar Abu Kabir	451	0	68.11
Minya El-Qamh	2	9	0.07	single	Kafr Abu Kabir	14	15	2.11
Hahya	4	12	0.10	single	Almashaeila	37	2	5.59
Abu Kabir	622	17	15.61	single	Abu Sleem	8	0	1.21
Husseiniya	1390	0	34.87	loader	Nazlat Al Areen	43	12	6.49
Salhia	955	0	23.96	loader	Alhuswa	33	10	4.98
Faqous	203	0	5.09	single	Alghaba	3	5	0.45
Abu Hammad	375	1	9.41	loader	Maymun	4	8	0.60
Derb Negm	2	7	0.07	single	Centris	4	5	0.60
Belbeis	175	18	4.39	loader	Bani Ayyad	15	6	2.27
Mashtoul El-Souk	4	9	0.12	Single	Farasha	7	4	1.06
Kafr Saqr	200	11	5.02	Loader	Rahmaniyah	8	0	1.21
Awlad Saqr	48	10	1.21	Single	mansterly	1	6	0.15
-	-	-	-	-	Abu Yaseen	31	16	4.68
Total	3982	112	100.00		Total	659	89	100
	3986	16				662	17	

Source:1- Ministry of Agriculture and Land Reclamation, Directorate of Agriculture in Sharqia, unpublished data, 2020/2021.

In addition to replacing small seedlings with old trees on the farm, and for the average productivity of lemon trees, it reached the highest in the second category 55 kg / tree, an increase of 9 kg / tree representing 16.4%, due to the large planting distances between trees, which allows trees to obtain the appropriate light needs that effect On the quality of fruits, the average per feddan productivity was higher in the first category, 10,856 tons, an increase of 1.451 tons, representing 15.4% over the second category due to the increase in the number of trees per feddan.

The table shows that the total lemon crop of the second category amounted to 705,375 tons, an increase of 216,855 tons over the first category, at a rate of 30.7%, due to the expansion of the crop areas in the second category compared to the first category. The average number of labor units for the highest acre in the second category was 91 men / day, with an increase of 21 workers / feddan compared to the first category by 23.1%. The table shows an increase in the amount of pesticide used in the resistance to reach the highest level in the second category, 3.5 liters / feddan, with an increase of 0.25 liters / feddan by 7% compared to the first category.

This is due to the spread of bacterial and viral diseases in the area, especially the tunnel-maker, the worm (red) and snails. As for municipal fertilizers, it has been found that farmers are keen to use municipal fertilizer for the crop, especially before the fasting process, to raise soil fertility, provide the plant with its nutritional needs, and maintain soil moisture around the plant, which leads to helping it get out of the fasting process and push it towards flowers. The first category is 24.5 m^3 / feddan, an increase of 4.5 m^3 / feddan over the first category by 18.4%.

Fourth: Economic indicators of the lemon crop in the research sample:

The economic indicators deal with the average productivity, the average production costs per ton, selling prices, the average revenue, the net return per kilogram, the return on the invested pound, according to the sample tenure categories in Table (6).

1- Average productivity ton / feddan: the productivity of the lemon crop reached a minimum of about 9.41 tons / feddan for the farms of the first category, while its maximum reached about 10.85 kg / feddan in the second category, as a result of the increase in the number of lemon trees in the first category despite the high average productivity of the tree in the second category, the general average of productivity was about 10.13 tons / feddan in the research sample.

Table (5): Study sample variables for lemon crop in Sharkia Governorate 2020/2021

variable	First class	Second class	The difference	%
Total area of lemon in views/feddan	40	75	35	46.7
Total sample lemon trees/tree	7193	5863	-1330.39	-22.7
Average number of trees per feddan/tree	236	171	-65	-38.0
Average tree yield/kg	46	55	9	16.4
Average productivity per acre in ton / feddan	10.6	9.41	-1451	-15.4
Total quantity of lemon in sample / ton	488.52	705.375	216.855	30.7
Average number of human labor units per feddan man/day	70	91	21	23.1
Average amount of pesticides used liter/feddan	3.25	3.5	0.25	7.1
Average amount of organic fertilizer m3/fed	20	24.5	4.5	18.4

Source: collected and calculated from field sample data.

2- Average production costs (a thousand pounds / feddan): the production costs per feddan in the first category amounted to a minimum of about 28.43 thousand pounds / feddan, while a maximum of about 32.6 thousand pounds / feddan in the second category, with an average year of 30.51 thousand pounds / feddan in the research sample.

3-The average cost of a kilo of lemon per pounds / kg: the average cost of a kilogram of lemon reached a minimum of about 2.6 pounds per kilogram for farmers of the first category, while the maximum was about 3.5 pounds per kilogram for farmers from the second category as a result of the fruit quality specifications for the fruit and its large size. The general average selling price was about 3.04 pounds / kg in the research sample.

4- Average total revenue (pound / feddan): the average total revenue reached its maximum limit in the first holding category of about 52.10 thousand pounds / feddan, while the minimum reached about 45.14 thousand pounds / feddan for farmers of the second holding category. An average of 48.63 thousand pounds per feddan in the research sample.

5 net yield per feddan (pound / feddan): The minimum net feddan in the second holding category amounted to about 12.5 thousand pounds / feddan, while the maximum amounted to about 23.68 thousand pounds / feddan for farmers of the first tenure category with an average. At about 18.11 thousand pounds / feddan. .

6- Net yield per kilogram for lemon (pound): the average minimum net return per kilogram in the second holding category was about 1.3 pounds / kg, while the maximum was about 2.2 pounds / kg for farmers of the first holding category, where it averaged about 1.8 pounds / kg in The research sample.

7- Return on the invested pound: the return on the invested pound reached a minimum of about 0.38 piasters in the second holding category, while its maximum reached about 0.83 piasters for farmers of the first holding category, with an average of about 59 piasters at the level of the research sample.

Table (6): Indicators of the economic productive efficiency of lemon crop with a field research sample in Sharkia Governorate

Economic Indicators	F1 (less than 2 feddan)	F2 (more than 2 feddan)	Sample average
Average productivity (tons)/feddan	10.85	9.41	10.13
Production costs (thousand pounds) / feddan	28.43	32.59	30.51
The average cost of a kilo of lemon pounds/kg (1)	2.6	3.5	3.0
Total Revenue (Thousand Pounds/feddan) (2)	38.69	35.82	37.26
Weighted average selling price per kilo	4.8	4.8	4.8
Total Net Return (Thousand Pounds/feddan) (3)	23.67	12.55	18.11
Net Yield Kilograms of lemon (pounds) (4)	2.2	1.3	1.8
Return on invested pound (5)	0.83	0.38	0.59

1- Average cost of a kilogram of lemon (pounds) = total production costs (pounds) ÷ average productivity (kg).
2- Total revenue (pounds) = selling price of a ton of lemon (pounds) x average productivity (tons).
3- Net revenue (pounds) = total revenue (pounds) - production costs (pounds).
4- Net yield of lemon (pounds) = selling price kg/pound - cost of kg kg/pound
5- Return on the invested pound = total net return (pounds) ÷ production costs (pounds).
Source: collected and calculated from field sample data.

Fifth: Lemon production functions in the research sample:

Table No. (7) shows the results of the statistical analysis of the production functions of lemon trees in its double logarithmic form and the gradual regression analysis of the tenure categories in the research sample in Sharkia Governorate during the productive season 2020/2021. (X_1) Number of trees, (X_2) Amount of organic fertilizer / m^3, (X_3) Chemical fertilizer Active substance / feddan, (X_4) hoeing, man / day, (X_5) irrigation hour/day (X_6) Pesticides, liters / feddan, (X_7) hourly labor/feddan, (X_8) pruning man/day, (X_9) cropping man/day.

First: The first category of possession (less than 2 feddan);

The results of Table No, (7) indicated that there was a positive, statistically significant relationship between production and functional variables (X_1) the number of lemon trees per feddan, (X_9) the crop productivity per capita/day. About 0.869, 0.565, respectively, indicating that each 10% increase in these two variables increases the amount of lemon production by about 8.69%, 5.65%, and the overall modulus of elasticity is about 1.9, indicating an increase in the return on capacity. And that the farms of the first category from the sample of lemon farms work in the economic stage, which is the first stage of the law of diminishing returns and efficiently towards the use of resources, and the value of R^2 indicates that these variables are responsible for 76% of the production of lemon farms in the first holding category, and the remaining percentage is 24 % to other factors not studied during labor.

Perform an interim estimation using stepwise regression

-**Estimation of the first stage**: It was found that there is a positive, statistically significant relationship between the production (X_9) of the crop, man/day, and the productivity elasticity modulus of 0.765, with an increase of 10% of this variable, in addition to an increase in the amount of lemon crop production by about 7.65% per feddan. The value of R^2 indicates that this variable is responsible for 45% of the amount of lemon production.

-**Estimation of the second stage**: It was found that there is a positive, statistically significant relationship between production and each of (X_9) the total yield per man/day, and (X_2) the amount of organic fertilizer / m^3.

The productivity elasticity factor is about 0.708 and 0.394, with an increase representing about 10% of these two variables. The amount of lemon crop production increases by about 7.08% and 3.94% per feddan, respectively, and the total elasticity for them is 1.1, the value of R^2 indicates that it is responsible for 59% of the amount lemon production.

-**Estimation of the third stage**: It was found that there is a positive and statistically significant relationship between production and each of (X_9) the amount of crop per man/day, and (X_2) the amount of organic fertilizer/m3, (X_1). The production elasticity coefficient was about 0.529, 0.364, 0.834, with an increase of about 10% for these two variables, and it increases the quantity of lemon crop production by about 5.29%, 3.64%, 8.34%, respectively, per feddan. The total elasticity of these variables reached 1.7, and the value of R^2 indicates that These variables account for 69% of the lemon production

Second: The second possession category (more than 2 feddan)

1- **Estimation of the first stage**: There is a positive, statistically significant relationship between the production of (X_9) of the crop, man / day, and the production elasticity coefficient was about 0.765, an increase of %10 of this variable, which led to an increase in the quantity of lemon crop production by about %7.65 per feddan. The value of R^2 indicates that this variable is responsible for %45 of the amount of lemon production.
2- Estimation of the second stage: There is a positive, statistically significant relationship between production and each of (X_9) the total crop per capita / day, and between (X_2) the amount of organic fertilizer / m3, and the productivity elasticity factor is about 0.708 , 0.394 with an increase of %10 of these two variables increases the amount of lemon crop production by about %7.08, %3.94 per feddan, respectively, and the total elasticity of them reached about 1.1, and the results indicated that R^2 is responsible for %59 of the amount of lemon production.
3- Estimation of the third stage: There is a positive, statistically significant relationship between production and each of (X_9) the total yield per man / day, and between (X_2) the amount of organic fertilizer / m^3, (X_1) and the productivity elasticity coefficient reached about 0.529, 0.364, 0.834, with an increase of %10 for these two variables increases the amount of lemon crop production by about %5.29, %3.64, %8.34, respectively, per feddan.

Second: **The second possession category (more than 2 feddan)**

The results of Table No. (7) indicated that there is a positive, statistically significant relationship between production and the function variables (x_1) the number of lemon trees per feddan, (x_9) the harvest of the crop, man/day. About 0.399 and 0.506, respectively, which indicates that each increase of 10% of these two variables leads to an increase in the quantity of lemon production by about 3.99%, 5.06%, and the total modulus of elasticity for them is about 1.09, which indicates an increase in the return on capacity, and that the second holding class farms from a sample of lemon plantations are working. In the economic stage, which is the second stage of the law of diminishing returns and efficiency towards the use of resources, and the value of R2 indicates that these variables are responsible for 77% of the production of lemon farms in the category of second holding, and 23% are due to other factors that are not studied by function.

Perform a step estimation using stepwise regression

1- Estimation of the first stage: It was found that there is a positive, statistically significant relationship between the production of (X_9) of the crop, man / day, and the productivity elasticity coefficient was 0.610, an increase of 10% from this. The variable increases the amount of lemon crop production by about 6.10% per feddan, and indicates that the value of R^2 indicates that this variable is responsible for 69% of the amount of lemon production.
2- Estimation of the second stage: It was found that there is a positive, statistically significant relationship between production and each of (X_9) total man / day, and (X_2) the amount of organic fertilizer / m^3, and the productive elasticity factor that was reached. 0.508, 0.399 that an increase of %10 of these two variables increases the amount of production of lemon crop by about %5.08, %3.99 respectively per feddan, and the total elasticity of both of them is 0.9, and the value of

R^2 indicates that it is responsible for %74 of the amount of lemon production.

Third: At the level of the sample farms

The results of Table No. (7) indicated that there was a positive, statistically significant relationship between production and functional variables (**x_1**) the number of lemon trees per feddan, (x_2) the amount of organic fertilizer/m3, (x_9). The total crop man/day and it was found that the productivity elasticity coefficient for each of the number of trees and the amount of municipal fertilizer and the collection of lemon crop at the level of the study sample amounted to about 0.523, 0.277, 0.509, respectively, which indicates that each increase by 10% of these variables increases the amount of Lemon production is about 5.23%, 2.77%, 5.09%, and the total elasticity has reached about 1.4, which indicates an increase in capacity productivity and so, The lemon sample farms operate in the economic stage which is the first stage of the law of diminishing returns and efficiency towards resource use, and the value of R^2 indicates that these variables are responsible for 74% in the production of lemon farms in the sample and the remaining 26% are due to other unstudied **function factors. Performing a phased estimation using stepwise regression:**

-The first stage estimate: It was found that there was a statistically significant positive relationship between the production (X_9) of the crop, man/day, and the productivity elasticity coefficient reached 0.659, meaning that an increase of 10% of this variable increases the quantity of lemon crop production by about 6.59% per feddan, and it indicates The value of R^2 indicates that this variable is responsible for 59% of the quantity of lemon production in the sample.

-The second stage estimate: it was found that there is a statistically significant positive relationship between production and each of (X_9) the sum of the crop man/day, (X_1) the number of trees, and the productivity elasticity coefficient reached 0.530, 0.372, meaning that an increase of 10% of these two variables increases the The amount of lemon production was about 5.30% and 3.72%, respectively, per feddan, and the total elasticity of both was 0.9, and the value of R^2 indicates that they are responsible for 64% of the amount of lemon production.

-The third stage estimate: It was found that there is a positive, statistically significant relationship between production and each of (X_9) the total return per capita / day, (X_1) the number of trees, (X_2) the amount of organic fertilizer / m^3, and the production elasticity coefficient was 0.506, 0.505, 0.309, that is, increasing these variables by%10 increases the amount of lemon crop production by about %5.06, %5.05, and %3.9, respectively, per feddan. The overall resilience of these variables was 1.3, and the R^2value indicates that these variables are responsible for %0.72of lemon production.

1- **Sixth:** The costs of producing the lemon crop in the research sample:

The results of Table No. (8) indicate the relative importance of the cost items, including the fixed costs and the variable costs of the lemon crop in the categories of holding in Sharkia Governorate for the year 2020/2021.

Relative Importance of Cost Items:

First: Fixed costs, including annual rent, consumption of water pumps and other expenses.

1-Annual rent: the lowest annual rent in the first tenure category amounted to about 10 thousand pounds / feddan, 0.92 pounds / kg, at a rate of 35.175%, while the highest annual rent in the second tenure category amounted to 10,500 thousand pounds / feddan, and about 1.12. pounds / kg, representing about 23.21%, due to the large area of the farm at the sample level, which amounted to 10,250 thousand pounds / feddan, 1.02 pounds per kilogram, representing 33.59% of the total costs of 30,514 thousand pounds / feddan. at the sample level.

2-Depreciation of water pumps: the cost of raising water was the lowest in the first holding category, about 4 thousand pounds / feddan, 0.37 pounds / kg, representing about 14.07%, while the highest in the second holding category amounted to about 4,500 thousand pounds / feddan, 0.48 pounds / kg, representing About 13.81%, in order to increase the operational capacity of these pumps. As for the sample level, it amounted to about 4,250 thousand pounds / feddan, 0.42 pounds per kilogram, representing about 13.93%, of the total costs amounting to 30,514 thousand pounds / feddan for the lemon crop at the level of the research sample.

3- Other expenses represented in (annual mud tax): which is fixed in both categories of holdings, amounting to 100 pounds / feddan, 0.1 pounds / kg, representing 0.33% of the total costs of the crop.

4- Total fixed costs: the average fixed costs in the first holding category amounted to 14,100 thousand pounds / feddan without 1.30 pounds / kg, at a rate of 49.59%, while the highest in the second holding category amounted to 15,100 thousand pounds / feddan, 1.61 pounds The kilogram represents 46.33%, the highest level for the research sample, which amounted to 14,600 thousand pounds / feddan, 1.45 pounds / kg, representing 47.85% of the total costs of the crop, which amounted to 30,514 thousand pounds / feddan.

Second: Variable costs:

1- **Organic fertilization**: The cost of organic fertilization was the lowest in the first tenure category 1200 pounds / feddan, 0.11 pounds / kg, while the highest in the second holding category was 1470 pounds / feddan, 0.16 pounds / kg, while at the level of the study sample it amounted to 1335 pounds / feddan, 0.13 pounds / kg, representing 4.37% of the total costs of the crop.

Table (7): Statistical measurement of lemon crop production functions in the research sample 2020/2021

Category		Standard Model	Total flexibility	$R^{/2}$	F
Category 1	public image	$Logq_i$ =- 0.37 +0.869 $Logx_1$ +0.199 $Logx_2$ + 0.346 $Logx_3$ (-0.20) (-2.9)** (1.34) (1.41) -0.012 $Logx_4$ + 0.296 $Logx_5$ -0.166 $Logx_6$ -0.050 $Logx_7$ (-0.174) (1.39) (-1.38) (0.49) - 0.100 $Logx_8$ + 0.565 $Logx_9$ (-0.7) (3.16)**	1.9	0.76	7.21**
	the first	Logqi = 5.976 + 0.765 Logx9 (8.47)** (4.78)**	0.8	0.45	22.8**
	The second	Logqi = 5.002 + 0.708 Logx9 + 0.394 Logx2 (7.25)** (5.03)** (3.12)**	1.1	0.59	19.90**
	the third	Logqi = 1.316 + 0.529 Logx9 +0.364 Logx2+ 0.834 Logx1 (0.95) (3.84)** (3.27)** (2.98)**	1.7	0.69	20.13**
Category 2	public image	Logqi = 4.03 +0.399 Logx1 +0.238Logx2 + 0.119 Logx3 (-0.20) (-2.9)** (1.34) (1.41) -0.045 Logx4 + 0.048 Logx5-0.073 Logx6 -0.0029 Logx7 (-0.174) (1.39) (-1.38) (-0.49) + 0.029 Logx8 + 0.506 Logx9 (0.7) (3.16)**	1.09	0.77	7.56**
	the first	Logqi = 6.643 + 0.610 Logx9 (20.48)** (7.97)**	0.6	0.69	63.6**
	The second	Logqi = 4.975 + 0.508 Logx9 + 0.399 Logx1 (6.45)** (6.11)** (2.35)**	0.9	0.74	39.7**
total sample	public image	Logqi = 2.51 +0.523 Logx1 +0.277Logx2 + 0.261 Logx3 (2.53)* (2.94)** (2.87)** (1.51) -0.026 Logx4 + 0.050 Logx5 -0.095 Logx6 -0.058 Logx7 (-0.59) (0.37) (-1.22) (-0.86) - 0.068 Logx8 + 0.509 Logx9 (-0.73) (6.50)**	1.4	0.74	16.29**
		Logqi = 6.43 + 0.659 Logx9 (20.83)** (9.22)**	0.7	0.59	85.16**
	the first	Logqi = 4.99 + 0.530 Logx9 + 0.372 Logx1 (7.25)** (5.03)** (3.12)**	0.9	0.64	51.13**
	The second	Logqi = 3.39 + 0.506 Logx9 +0.505 Logx1+ 0.309 Logx3 (5.10)** (6.87)** (4.03)** (4.02)**	1.3	0.72	48.55**

whereas:

qi = the quantity of lemon production in tons per observation i. X1 = the number of trees in the view i.
X2 = the amount of organic fertilizer / m^3 in viewing i. X3 = chemical fertilizer active substance / feddan in observation i.
X4 = man's porridge/day per watch i. X5 = Irrigation hour/day per observation i.
X6 = pesticides liter/acre in observation i. X7 = work per hour/feddan per view i.
X8 = trim man/day per watch i. X9 = total crop man/day in observation i.
i = 3,2,1............. , 30 for the first category.
i = 3,2,1.............,30 for the second category.
* *Significant at 0.01, *Significant at 0.05
Source: The results of the statistical analysis of the sample data.

2-Chemical fertilization (effective unit): The cost of chemical fertilization (effective unit) was the lowest in the second holding category 412.5 pounds / feddan, 0.04 pounds / kg, while the highest in the first holding category amounted to 425 pounds / feddan, 0.04 pounds / kg, either at the sample level. The research amounted to 418.8 pounds / feddan, 0.04 pounds / kg, representing 1.37%, of the total total costs of the crop.

3-Crop hoeing: The cost of the lowest hoeing operation in the first holding category amounted to 2000 pounds / feddan, 0.18 pounds / kg, while the highest cost in the second holding category amounted to 2300 pounds / feddan, 0.24 pounds / kg, while in the study sample it amounted to 2150 pounds / feddan 0.21 pounds/kg represents 7.05% of the total crop costs.

4-Crop irrigation: The cost of crop irrigation was the lowest in the first holding category, 1850 pounds per feddan, 0.17 pounds per kilogram, while the highest cost in the second holding category amounted to 2,100 pounds / feddan 0.22 pounds / kg. As for the level of the research sample, it amounted to 1975 pounds per feddan, 0.2 pounds per kilogram, representing 6.47% of the total costs of the crop**.**

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5 Pesticides: The cost of using the lowest pesticides in the first holding category amounted to about 487.5 pounds per feddan, 0.04 pounds per kilogram, while the highest in the second holding category amounted to about 525 pounds per feddan, 0.06 pounds per kilogram, while in the research sample it amounted to about 506.3 pounds / feddan, 0.05 pounds / kg, representing 1.66% of the Total crop costs.

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6Use of machines (spraying motor with a capacity of 600 liters): The cost of using the mechanical work below in the first holding category amounted to 450 pounds / feddan, 0.04 pounds / kg, while the highest in the second holding category amounted to 600 pounds / feddan, 0.06 pounds / kg, while at the level of The sample amounted to 525 pounds / feddan, 0.05 pounds / kg, representing 1.72%, of the total costs of the crop

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7Pruning process: The cost of the lowest pruning process in the second possession category was 900 pounds / feddan, 0.10 pounds / kilo, while the highest cost in the first tenure category was 600 pounds / feddan 0.09 pounds / kilo. While in the research sample, 950 pounds per feddan amounted to 0.9 pounds / kg, representing 3.11% of the total crop costs.

8 -**Harvesting the crops:** The cost of the process of collecting the crops below in the first holding category amounted to 6.921 thousand pounds / feddan, and 0.64 pounds / kg, while the highest cost in the second holding category amounted to 9.188 pounds / feddan, 0.98 pounds / kg. While in the research sample, it amounted to about 8,054 thousand pounds / feddan and 0.81 pounds / kg, representing about 26.4% of the total costs of the crop.

9-**Total variable costs:** The total variable costs below in the first holding category amounted to 14,333 thousand pounds / feddan 1.32 pounds / kg, while the highest costs in the second holding category amounted to 17,495 thousand pounds / feddan 0.98 pounds / kg. As for the research sample, it amounted to 15,914 thousand pounds / feddan and 0.81 pounds / kg, representing 52.15% of the total costs of the crop.

10-**Total costs**: The total costs of the crop below in the first holding category amounted to about 28,433 thousand pounds / feddan, and about 2.62 pounds / kg, while the highest in the second holding category amounted to about 32,595 thousand pounds / feddan, and about 3.47 thousand pounds / kg, while in The research sample is about 30,514 thousand pounds / feddan 3.04 pounds / kg.

Seventh: Statistical measurement of the cost functions of lemon tree production in Sample A:
The cost function indicates a relationship between two variables, one of which is the dependent variable, which is the costs of producing the lemon crop, and the independent variable, which is the quantity of lemon production. Economic theory in this field suggests that the total cost function is usually of the second degree or the third degree. This part of the research will measure the statistical estimation of the cost functions of lemon crop production by categories of sample holders.

1-The First holding category
Equation No (1) in Table (9) shows in its quadratic form the functional relationship between the average total costs and the quantity of lemon production in the first holding category. It was found that there is a statistically significant relationship between both the average total cost and the production of lemon, and the coefficient of determination was about 0.85, indicating that about 85% of the changes in the total costs are due to the changes in production. The optimum production volume was estimated at the lowest costs by formulating the average costs with marginal costs, which amounted to about 11181 tons / feddan, and

this volume was achieved in 8 farmers from the sample by 4.4% of the sample. - The total number of farmers in the category 180 farmers, and to multiply the profits, that is, to obtain the maximum size of the profit, through the equation of the marginal cost function with the marginal revenue (sale price) which was estimated at about 3.6 pounds / kg, that is, the volume of production of the maximum profit amounted to 12412 tons / feddan It did not come true. The size of the sample growers.

2-The second holding category

Equation No. (2) in Table (9) shows in its quadratic form the functional relationship between the average total costs and the quantity of lemon production in the first holding category. There is a statistically significant relationship between each of the average total cost and lemon production, and the coefficient of determination reached About 0.86, indicating that about 86% of changes in total costs are due to changes in production. The optimum volume of production, which is the least costly, was estimated by formulating the average costs with marginal costs, which amounted to about 9.869 tons / feddan, and this volume was achieved in 5 farmers from the sample by 4.2%. The total number of farmers in the second holding category, which is 120 farmers, and to maximize profits, that is, to obtain the maximum size of the profit, by equating the marginal cost function with the marginal revenue (sale price), which was estimated at about 3.8 pounds / kg, that is, the maximum volume of production for profits amounted to 11.230 tons / feddan. This size is achieved for the farmers' sample.

Table (8): Items of the cost structure of lemon production in the research sample in Sharkia Governorate, season 2020/2021 Egyptian pounds /feddan

Statement		First category			second Category			All sample farms		
		Average cost / feddan pound	Average cost / kg pound	(%)	Average cost / feddan pound	average cost / kg pound	(%)	Average cost / feddan pound	Average cost / kg pound	(%)
fixed costs	annual rent	10000	0.92	35.17	10500	1.12	32.21	10250	1.02	33.59
	Destruction of the lifting pump	4000	0.37	14.07	4500	0.48	13.81	4250	0.42	13.93
	expenses	100	0.01	0.35	100	0.01	0.31	100	0.01	0.33
total fixed costs		14100	1.3	49.59	15100	1.61	46.33	14600	1.45	47.85
Variable costs	organic fertilization m3	1200	0.11	4.22	1470	0.16	4.51	13350	0.13	4.37
	Chemical fertilization is an active substance	425	0.04	1.49	412.5	0.04	1.27	418.8	0.04	1.37
	hoeing	2000	0.18	7.03	2300	0.24	7.06	2150	0.21	7.05
	irrigation	1850	0.17	6.51	2100	0.22	6.44	19750	0.2	6.47
	exterminator	487.5	0.04	1.71	525	0.06	1.61	506.3	0.05	1.66
	mechanization	450	0.04	1.58	600	0.06	1.84	525	0.05	1.72
	pruning	1000	0.09	3.52	900	0.1	2.76	950	0.09	3.11
	crop harvest	6921	0.64	24.34	9188	0.98	28.19	8054	0.81	26.4
total variable costs		14333	1.32	50.41	17495	1.86	53.67	15914	1.59	52.15
Total costs		28433	2.62	100	32595	3.47	100	30514	3.04	100

Source: It was collected and calculated from the sample data.

3- Total sample.

Equation No. (3) in Table (9) shows in its quadratic form the functional relationship between the average total costs and the quantity of lemon production in the first holding category. It was found that there is a statistically significant relationship between both the average total cost and the production of lemon, and the coefficient of determination was about 0.81, indicating that about 81% of the changes in the total costs are due to changes. In production, the optimum volume of production was estimated at the lowest costs, by formulating the average costs with marginal costs of 11,037 tons/feddan. That is, obtaining the maximum volume of profit through the equation of the marginal cost function with the marginal revenue (selling price), which was estimated at about 3.7 pounds per kilogram, that is, the volume of production of the maximum profit amounted to 11,850 tons / feddan. This size was not achieved for the farmers' sample.

Eighth: Marketing paths and margins for the lemon crop with the research sample:

First: Marketing paths for the lemon crop with the research sample:

Figure No (1) shows the methods of marketing the lemon crop by sample, as the sorting of the lemon crop reached 59.7 tons at 5%, while the surplus quantity destined for the market was about 1134.2 tons at a rate of 95%, and the quantity of lemons sold to the wholesaler in the region (Abu Kabeer market) is about 907.4 Tons representing 76% of it to the wholesaler in the market and the remaining 226.8 tons were sold to the lemon exporters in the region at 19%. (of which 136.1 tons by 11.4% were exported to the foreign market, and the remaining 90.7 tons by 7.6% were sorted, which was returned again for sale in the local market), while the amount of the crop was citrus sold to the retailer. The volume of the retailer was about 998 tons, representing 83.6% Of the total quantity produced from the lemon crop, which amounted to 1193.9 tons in the research sample.

Table (9): The results of the statistical measurement of the cost functions of the lemon crop in Sharkia Governorate, season 2020.

The category	Standard Model of Cost Function	Actual size (tons)	Optimum volume of production (tons)	Maximum Profits (tons)	R^2	F
Category(1)	**A.T.C**= $4.89 - 0.266\, q_i + 0.0119\, q_i^2$ (- 2.53)** (1.8) **	10.856	11.181	12.412	0.85	82.55**
Category(2)	**A.T.C**= $7.161 - 0.543\, q_I + 0.0275\, q_i^2$ (-3.67)** (2.29)**	9.405	9.869	11.230	0.86	84.87**
Total sample	**A.T.C**= $6.318 - 0.378\, q_i + 0.0171\, q_i^2$ (-6.33)** (3.8) **	10.131	11.037	11.850	0.81	128.13**

ATCi = Average costs per acre in pounds per view i**.** qi = acre production of lemon in tons in observation i**.**

qi2 = acre production of lemons in tons in observation i**.**

i = 3,2,1............., 30 farms for the first category**.**

i = 3,2,1............., 30 farms for the first category**.**

* * Significant at 0.01, *Significant at 0.05

Source: The results of the statistical analysis of the sample data**.**

Second: Margins and marketing paths for the lemon crop in the field research sample

Table No. (11) shows that there are two paths for marketing the lemon crop. The first path is the sale from the farmer to the agency agent in the region, and the second path is the sale from the farmer to the exporters in the region.

The first course: selling from the farmer to the agency dealer in the region. In this way, the farmer bears the costs of marketing operations (collecting, sorting and transporting the crop) which amount to105 piasters/kg representing 22% and the commission of the sales process (10% on the sold quantity). About 48 piasters / kg at10%, with total marketing costs of 153 piasters / kg at 32%, and the net return of the farmer

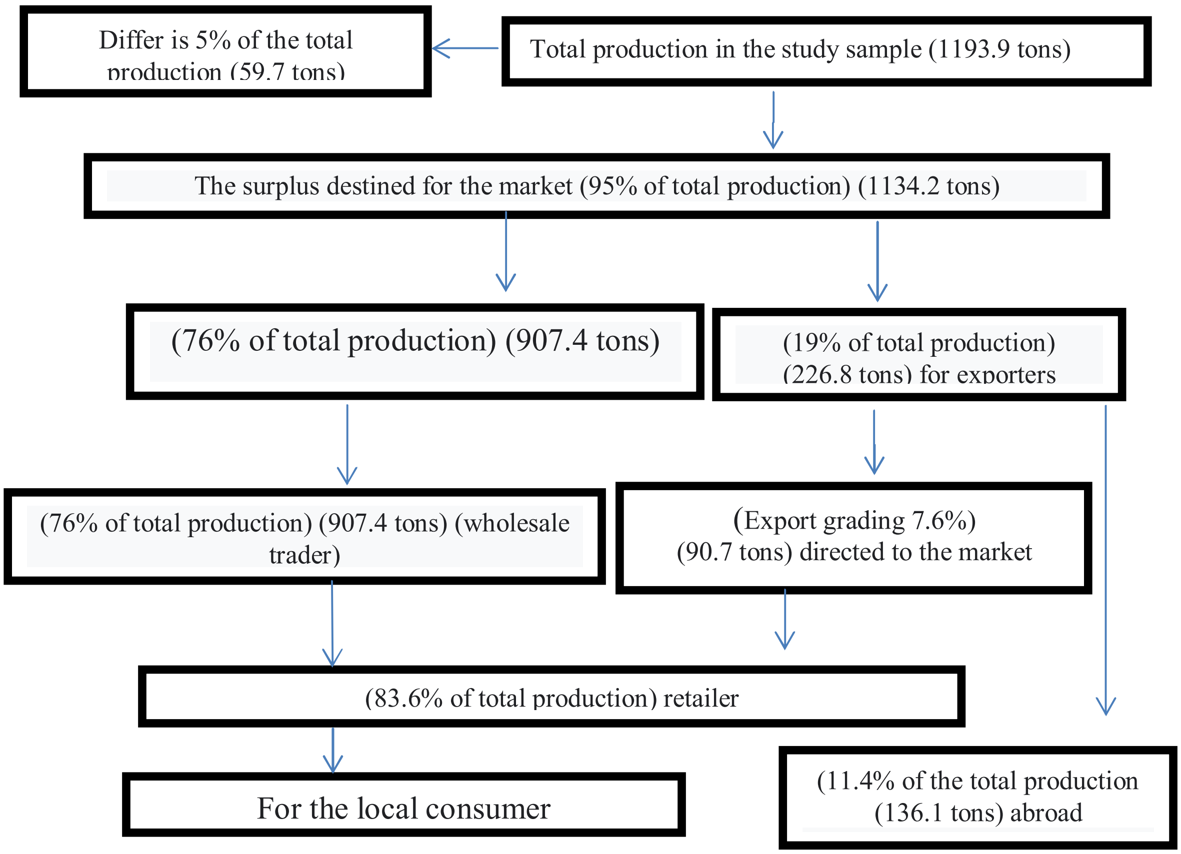

Figure (1): Marketing paths for the lemon crop in the research sample in Sharkia Governorate 2020/2021 is about 107 piasters / kg at 22% of the selling price of the agency dealer. in the region, which amounts to 480 piasters/kg.

The second course: selling from farms to exporters in the region. In this way, the farmer bears the costs of marketing operations (collecting and sorting the crop and transportation), which amount to 105 piasters/kg, representing 22%, and the farmer's net return amounted to about 155 piasters/kg, representing 32%, of the selling price. For the agency's dealer in the region, which amounts to 480 piasters/kg. This indicates that farmers in the second marketing course achieved an increase in the net return of 48 piasters/kg, representing 45%.

Third: Distribution of the consumer's pound on the marketing costs and margins of the lemon crop in the research sample:

The results of Table (11) indicate that the share of farmers' production costs from the consumer's pound was highest in the second marketing course, while it was below 22% in the first marketing course, and the share of marketing costs from the consumer's pound was above 15.3% in the first marketing course, while the lowest was 15.3% In the second marketing course, 14%, as for the share of the farmer's return from the consumer's pound, it was higher in the second marketing course, 21%, compared to 10.7% in the second marketing course, and finally, the share of the selling price of the Consumer's pound was above 64%, compared to 48% in the marketing course the second

Table (10): Marketing paths and margins for lemon crop farmers with a research sample

Statement	The first course is selling to the dealership in the region (piaster /kg)	**%**	The second course is selling to exporters in the region (piaster /kg)	**%**
Production costs per kilo	**220**	**46**	**220**	**46**
Crop collection and sorting	**80**	**17**	**80**	**17**
crop transfer	**25**	**5**	**25**	**5**
Agency dealer commission 10%	**48**	**10**	**0**	**0**
total marketing costs	**153**	**32**	**105**	**22**
Total production and marketing costs	**373**	**78**	**325**	**68**
net income of the farmer	**107**	**22**	**155**	**32**
Selling price to the dealer in the region	**480**	**100**	**480**	**100**

Source: research sample.

As for the wholesaler, the share of marketing costs of the consumer pound was 8% and the net profit was 8.4%. Finally, the retailer's share of the above purchase price in the first cycle was 64.4% compared to 35% in the second cycle.

As for marketing costs, the highest percentage in the second cycle was 13% compared to 12% in the first cycle. The share of the highest net profit in the second cycle was 33% compared to 23.6% in the first marketing cycle. From the above it is clear that the highest net profit was for retail stores 2.5 pounds / kg, and 2.36 pounds / kg in the second and first marketing cycle, respectively, then farms 1.55 pounds / kg, and 1.07 pounds / kg in the second, and the first marketing cycle, respectively, and finally Wholesaler 0.84 pounds/kg.

From the above it is clear that the share of the farmer is 4.8 pounds, representing 48% of the consumer price, and the rest 5.2 pounds, representing 52% of the marketing rings for the crop, of which 1.64 pounds, representing 16.4% for the wholesaler, and 3.56 pounds, representing 35.6% for the retailer, from the consumer price in the first marketing course of which amounted 10 pounds/kg.

As for the second marketing path, the farmer’s share amounted to 4.8 pounds/kg, representing 64%, and the retailer, 3.5 pounds, representing 36%, of the consumer price, which amounted to 7.5 pounds/kg.

Fourth: Marketing Efficiency and Return of the Pound Invested for Dealers in the Marketing Routes of the Lemon Crop in the Research Sample:

The results of Table (12) indicate that the marketing efficiency of the wholesaler came in the first place 88%, followed by the marketing efficiency of the retailer in the first marketing course84% the second 80% then the marketing efficiency of the farmers in the second marketing course 68%, 59% in the first marketing course.

The table also shows that the return on the pound spent was higher than 2.5 pounds for the retailer in the second marketing cycle, and 2 pounds in the first marketing cycle, followed by the return on the pound spent from the farmer in the second marketing cycle 1.48 pounds, the return on the pound spent from the wholesaler 1.05 pounds in the first marketing cycle, and finally, the return on the pound spent by the farmer in the first settlement course is 0.7 pounds. This indicates higher profitability of retailer and wholesaler and lower profitability of farmers.

Table (11): Distribution of the consumer pound on the marketing costs and margins of the lemon crop in the research sample

Statement	The first course is selling to the dealership in the region piaster/kg	%	The second course is selling to exporters in the region piaster /kg	%
Production costs per kilo	**220**	**22**	**220**	**29**
Crops harvesting and sorting	**80**	**8**	**80**	**11**
Crop transfer	**25**	**2.5**	**25**	**3**
Agency dealer commission	**48**	**4.8**	**0**	**0**
Total marketing costs	**153**	**15.3**	**105**	**14**
Total production and marketing costs	**373**	**37.3**	**325**	**43**
Net return of the farmer	**107**	**10.7**	**155**	**21**
Wholesaler selling price	**480**	**48**	**480**	**64**
cost transport	**50**	**5**	-	-
Market Entry Fee	**20**	**2**	-	-
Aging	**10**	**1**	-	-
Wholesale wholesaler costs	**80**	**8**	-	-
Costs and Margins for Wholesaler	**560**	**56**	-	-
Net Profit	**84**	**8.4**	-	-
Retailer selling price	**644**	**64.4**	**400**	**53**
Crop transfer	**25**	**2.5**	**25**	**3**
Selling bags	**25**	**2.5**	**25**	**3**
Exit fee	**20**	**2**	**0**	**0**
Weight difference	**50**	**5**	**50**	**7**
Total marketing costs	**120**	**12**	**100**	**13**
Total marketing costs and margins	**764**	**76.4**	**500**	**67**
Retailer net profit	**236**	**23.6**	**220**	**33**
Consumer selling price	**1000**	**100**	**80**	**100**

Source: sample study.

Ninth: Production and marketing problems of lemon farmers in the research sample:

Table (13) indicates the problems of production and marketing of the lemon crop in the research sample in Sharkia Governorate in 2020, and it is clear from it that the problem of low selling prices represents 17.7%, while the spread of viral diseases. The flower worm (red) represents about 16.1%, pesticide fraud and lack of a safe source of purchase represents about 14.5%, and it was found that the increase in production input prices accounted for about 12.9%. And the lack of other marketing outlets in the region.

It represents about 11.3%, as it was found that the prevalence of tunnel makers and low tree productivity account for about 9.7%, and the high cost and unavailability of labor is about 8.1% of the total repeat production. And the problems of marketing the lemon crop in the sample.

Table (12): Marketing Efficiency and Return of the Pound Invested in the Marketing Routes of the Lemon Crop in the Research Sample

Statement	The first course of sale to the dealer in the region piaster/kg	Second route selling to exporters in the region piaster /kg
The marketing efficiency of the farmer	59	68
Marketing efficiency of the wholesaler	88	-
Marketing Efficiency of the Retailer	84	80
Yield to the farmer (pounds)	0.70	1.48
Wholesaler Pound Yield (pounds)	1.05	-
Retail Trader Pound Yield (pounds)	2	2.5

Marketing efficiency = 1- (marketing costs / marketing costs + marketing variances) * 100
Return on the pound invested = net return per marketing ring / marketing costs
Source: Table (11)

Table (13): Problems of production and marketing of the lemon crop in the research sample in Sharkia Governorate 2020

problem	Frequency	%
Low selling price	**55**	**17.7**
Spread of bacterial and viral diseases flower worm (red)	**50**	**16.1**
Pesticide cheating and lack of a safe source	**45**	**14.5**
Spread of tunnel makers	**30**	**9.7**
High labor cost	**25**	**8.1**
Decreased tree productivity	**30**	**9.7**
Unavailability of other marketing outlets in the region	**35**	**11.3**
The increase in the prices of production inputs	**40**	**12.9**
Total	**310**	**100.0**

Source: field research sample

Summary and recommendations:

The research showed that citrus is one of the most important types of fruit in Egypt due to its economic advantages over other types of fruit, as the value of citrus production is about 8 billion pounds, representing about 1.93%, 3.57%, 28.5%, respectively, of the value of all agricultural, vegetable and fruit production Which amounted to about 414.09, 223.7, 28.07 billion pounds, respectively, during the period (2014-2019). The salty lemon is one of the most important citrus crops due to its economic importance, as the value of lemon production amounted to about 1461 million pounds, representing about 18.3%, 5.21% of the value of production of each of Citrus fruits.

The research aimed to study the economics of production and marketing of the municipal lemon crop in Sharkia Governorate by studying the development of economic and productive variables for the lemon crop in Egypt and Sharkia Governorate during the period (2000-2019) and production and productivity indicators Economic efficiency, statistical measurement of production functions, and pound distribution on costs and margins. Marketing, production and marketing problems of lemon crop farmers with the study sample.

The research showed a decrease in the fruitful area of the lemon crop in Sharkia Governorate from 11.5 thousand feddan during the period (2006-2011), to 4.5 thousand feddan during the period (2014-2019), and this led to the farmers' reluctance to expand the cultivation of the crop due to the increased costs production factors, especially in recent years.

The research revealed that the average area of the lemon crop in the Republic amounted to about 39.6 thousand feddan during the period (2000-2019), with a minimum of about 36.4 thousand feddan in 2000, and a maximum of about 46.8 thousand feddan in 2008, and that the area took an increasing yearly trend that is not Statistically significant, which means that the total area is relatively stable around its arithmetic average of about 39.6 thousand acres, while the area of the lemon crop in Sharkia Governorate ranged between a maximum of about 13.01 thousand feddan in 2000, and a minimum of about 2.16 thousand acres in 2019, with an annual average It reached about 9.65 thousand feddan, and the fruitful area took a general statistically significant annual decreasing trend, estimated at about 0.62 thousand feddan, representing about 6.4% of the average fruitful area of the lemon crop in the governorate during the research period, And it was found that there are two types of cultivations for the lemon crop, a lemon crop loaded with other crops such as (mango, orange, etc.) and another single, in order to avoid the risk when cultivating a single crop from weather, environmental and market conditions, and to maximize the utilization of the unit area by obtaining the highest return.

The results of the productivity function at the sample level indicate that there is a positive, statistically significant relationship between production and each of (X_9) the collection of the crop, man/day, (X_1) the number of trees, (X_2) the amount of organic fertilizer/m3, and its productivity elasticity coefficient reached 0.506, 0.505. , 0.309, meaning that an increase of 10% of these variables increases the quantity of lemon crop production by about 5.06%, 5.05%, 3.9%, respectively, per feddan. And the production of lemon, and the optimum production volume was estimated at 11.037 tons / feddan, and this volume was achieved by 8 of the sample farmers, and the maximum profit amounted to 11,850 tons / feddan, and this volume was not achieved for the sample farmers, and it turned out that the optimal volume of production and the lowest costs in the first and second categories and the total sample were achieved with 8, 5, 8 of the total lemon farmers in the research sample, and this represents about 27%, 17%, 12% of the number of lemon farmers in the sample, which reflects the economic inefficiency. For the use of production factors, the first and second categories and the total sample volume of production, the maximum profit, were not achieved.

As for the marketing paths of the crop in the research sample, the quantity of lemon crop sorting amounted to 59.7 tons, representing 5%, while the surplus directed to the market amounted to about 1134.2 tons, representing 95%, and the quantity of lemon sold to the agency's dealer in the region, Abu Kabir market) about 907.4 tons, representing 76%, of which To the wholesaler market and the rest 226.8 tons were sold to lemon exporters in the region, representing 19% (of which 136.1 tons, representing 11.4% were exported to the foreign market, and the rest 90.7 tons, representing 7.6% sorted, which were returned again for sale in the local market), while the amount of the lemon crop sold to the retailer About 998 tons, representing 83.6% of the total quantity produced from the lemon crop, amounting to 1193.9 tons per sample.

The problems of producing and marketing the lemon crop in the research sample were represented in the low selling prices, representing 17.7%, the spread of viral diseases and flower worm (Red) representing 16.1%, the cheating of pesticides and the unavailability of a safe source for purchase representing 14.5%, the high prices of production requirements representing 12.9%, the lack of outlets Other marketing in the region represents 11.3%, the spread of tunnel makers and the low productivity of the tree represents 9.7%, the high cost of labor and its unavailability represent 8.1%.

From the above, the research recommends the following:

1-Providing seedlings with good origins that are resistant to diseases

2-Providing pesticides from safe sources at reasonable prices

3- Supporting production requirements for farmers

4-The work of an association of lemon producers in the region concerned with the production and marketing of the crop

5- Providing training and counseling courses for farmers.

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12/29/2021