

# An economic study of lentil production and imports in Egypt using the policy analysis matrix

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## Summary

The lentil crop occupies second place in the legume group after fava beans in terms of nutritional importance, However, the cultivated area decreased from about 3,258 acres in 2010 to about 516 acres in 2021, Which resulted in a deterioration in the total production of lentils from about 2,178 tons in 2010 to about 527 tons in 2021, Consequently, the self-sufficiency rate declined to about 1% in 2021, Therefore, it is necessary to know the impact of the reasons that led farmers to refrain from growing lentils in Egypt, Which represents a burden on the trade balance and increases the burden on the state in providing the foreign exchange necessary for the import process, as the percentage of dependence on imports of lentils increased to reach about 99% during the same year.

The lentil crop ranks first among winter field crops in terms of production cost per acre, Despite its high cost, it ranks fourth after wheat, chickpeas, and perennial clover in terms of net return per acre, It also ranks second in terms of profitability of the producing unit after chickpeas, Therefore, it is clear that encouraging farmers to expand the cultivation of lentils will lead to an increase in farm income and an increase in the quantities produced, which will lead to an increase in the rate of self-sufficiency in the lentil crop.

The study showed that 99% of local consumption of lentils depends on imports, as about 113.95 thousand tons were imported, with a value of about 1.04 billion pounds during the period (2010-2021). It was also shown that the most important factor affecting the quantity of Egyptian imports of lentils is the quantity consumed, as whenever the quantity consumed of the lentil crop increases by one thousand tons, the quantity of imports increases by a statistically significant amount of about 0.992 thousand tons.

The results of the policy analysis matrix showed that the value of the total financially assessed production costs exceeds the total economically assessed production costs, While the overall average net per-acre return for the financially assessed lentil crop is less than its economically assessed counterpart for the same crop during the period (2010-2021), The nominal protection factor for traded production inputs, the nominal protection factor for return per acre, and the effective protection factor for the lentil crop were estimated at approximately 0.94, 0.74, and 0.71 pounds, respectively, during the same period, As for the effective protection rate for the lentil crop in Egypt, it reached about (29%), which is a negative value, and this result is consistent with all previous results in the research. The local resources cost factor was estimated at about 0.34 pounds, which is significantly less than the correct one, This means achieving a comparative advantage in lentil production. It is clear that the production policies used for the lentil crop during the study period were unfavorable to lentil farmers because implicit taxes were imposed on them, which led to a decrease in the incentive of lentil farmers in Egypt, which led to instability of the cultivated areas of lentil farmers in Egypt. The study recommends the necessity of increasing the cultivated area of lentils, especially in new lands, and encouraging farmers to grow lentils by giving incentives to farmers such as reducing the price of seeds or fertilizers, providing the necessary seeds, providing effective weed pesticides, and encouraging contract farming.

**Key words:** Lentil production, relative importance of lentils, lentil imports, lentil production policy.

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## I. Introduction:

Legumes are distinguished by their importance among the basic agricultural crops in Egypt, as they contain a high percentage of plant protein which is considered a cheap alternative to animal protein, Therefore, it is an important source of food for most members of society. The lentil crop occupies second place in the group of legumes after beans in terms of nutritional importance, as its consumption is widespread among most of the population of Egypt due to the diversity and versatility of its uses in food meals in a way that suits the tastes of consumers, Its seeds are used in human food, While hay is used in animal feed and contributes to raising the

nutritional value of feed, especially for dairy animals (Mustafa, 2020) Lentils have a high nutritional value, as their seeds are high in protein, reaching about 30% (Faraj, 2022), In addition to the percentage of carbohydrates present and the percentage of minerals such as manganese, iron, vitamins, and others, They are all beneficial elements for humans, and raise the body's immunity, especially during the Corona pandemic (Bahloul and Younis, 2022), In addition, it is considered one of the crops most suitable for current environmental conditions Due to its low water and fertilizer needs compared to other crops.

**Research problem:**

Due to the economic changes that have faced the Egyptian agricultural sector recently, and giving complete freedom to the farmer in choosing the types of crops that he grows, and as a result of the obstacles that lentil growers faced, such as the lack of seeds, the lack of weed killer, and the high prices of manual labor necessary to get rid of weeds and follow the flood irrigation method. Harmful to plants, Which led to a decrease in the cultivated area of the lentil crop in Egypt, despite its economic and nutritional importance, as it amounted to about 3,285 acres in 2010 to about 516 acres in 2021, which resulted in a deterioration in the total production of lentils from about 2,178 tons in 2010 to about 527 tons in the year. 2021, and consequently the self-sufficiency rate declined to about 1% in 2021, The matter becomes more serious as a result of the increase in population and the decrease in per capita share, which leads to resorting to imports with the aim of bridging the gap between production and consumption, which has recently led to a continuous rise in prices, as the price of a kilogram of lentils reached about 8.8 pounds in 2010 and increased until it reached about 45.26 pounds. pounds in 2023 (Central Agency for Public Mobilization and Statistics, 2023). Therefore, it is necessary to know the impact of the reasons Which led to farmers reluctance to grow lentils in Egypt, Which represents a burden on the trade balance and increases the burden on the state in providing the foreign exchange necessary for the import process, The percentage of dependence on imports of lentils increased to about 99% during the same year.

**Research objective:**

The study aims to identify the current situation of the lentil crop in Egypt during the period (2010-2021) by studying each of:

- 1- Productivity indicators of the lentil crop in Egypt.
- 2- The importance of lentils among the most important winter field crops.
- 3- Consumer indicators for lentils in Egypt.
- 4- Development of the quantity, value and import price of the lentil crop.
- 5- Factors affecting Egyptian imports of lentils.
- 6- Analysis of the production policy of lentils in Egypt.

**Research method and data sources:**

The research relied on descriptive and quantitative analysis methods and the use of some statistical methods such as arithmetic averages, percentages, instability coefficient, and simple and multiple regression analysis, The policy analysis matrix was used To learn about the levels of protection enjoyed by lentil producers and the extent to which the state bears the burden of supporting them, whether this support is for the final product or production requirements, by estimating the nominal protection coefficients, The Effective Protection Coefficient, and the Domestic Resource Cost Coefficient, The research also relied on secondary data published by the Ministry of Agriculture and Land Reclamation, the Central Administration for Agricultural Economics, the Central Agency for Public Mobilization and Statistics, and some websites, databases, and statistics available on the International Information Network (the Internet), in addition to some research, studies, and scientific journals related to the subject of the research.

## **II. Results:**

**First: Productive indicators of the lentil crop in Egypt:**

1- Cultivated area: Studying the development of the cultivated area of lentils in Egypt during the period (2010-2021), It was found that it ranged between a minimum of about 354 acres in 2019, The maximum reached about 5020 acres in 2017, An average of about 1628 acres during the study period.

By estimating the time trend equation for the area cultivated with lentils in Egypt, the significance of the function was not proven - Table (1) in the Appendix.

2- Acre productivity: The acre productivity of the lentil crop ranged between a minimum of about 0.66 tons/acre in 2010, and a maximum of about 1.02 tons/acre in 2021.

By estimating the growth equation for the acre productivity of the lentil crop, it was found that it increased by an annual change amounting to about 0.03 tons/acre, and with a statistically significant annual growth rate at a

significance level of 0.01, amounting to about 3.5% of the period average of about 0.89 tons/acre during the study period.

3-Lentil production: By studying the development of the quantity produced from the lentil crop in Egypt during the period (2010-2021), it was found that it ranged between a minimum of about 352 tons in 2019, and a maximum of about 4762 tons in 2017, with an average of about 1406 tons during the study period.

By estimating the time trend equation for the quantity produced from the lentil crop in Egypt, the significance of the function was not proven.

4-Farm price: The agricultural price of the lentil crop ranged between a minimum of about 1,033 pounds/ardeb in 2010, and a maximum of about 3,336 pounds/ardeb in 2021.

By estimating the growth equation for the agricultural price of the lentil crop, it was found that it increased by an annual change amounting to about 215 pounds/ardeb, and with a statistically significant annual growth rate at a significance level of 0.01, amounting to about 11.5% of the period average of about 1873 pounds/ardeb during the study period.

5- Production costs per acre: The per-acre production costs of the lentil crop ranged between a minimum of about 3.25 thousand pounds in 2010 and a maximum of about 13.12 thousand pounds in 2021.

By estimating the growth equation for the per-acre production costs of the lentil crop, it was found that they increased by an annual change amounting to about 1.00 thousand pounds, and with a statistically significant annual growth rate at a significance level of 0.01, amounting to about 14.4% of the period average of about 6.96 thousand pounds during the study period.

6- Total revenue per acre: The total per-acre revenue of the lentil crop ranged between a minimum of about 4.59 thousand pounds in 2010, and a maximum of about 22.94 thousand pounds in 2021.

By estimating the growth equation for the total per-acre revenue from the lentil crop, it was found that it increased by an annual change amounting to about 1.72 thousand pounds, and with a statistically significant annual growth rate at a significance level of 0.01, amounting to about 14.9% of the period average of about 11.55 thousand pounds during the study period.

7- Net return per acre: The net per-acre return of the lentil crop ranged between a minimum of about 1.10 thousand pounds in 2016 and a maximum of about 9.83 thousand pounds in 2020.

By estimating the growth equation for the net per-acre return from the lentil crop, it was found that it increased by an annual change amounting to about 0.72 thousand pounds, and with a statistically significant annual growth rate at a significance level of 0.01, amounting to about 15.7% of the period average of about 4.59 thousand pounds during the study period.

8- Total revenue to total costs : By studying the evolution of the total revenue to the total costs of the lentil crop in Egypt during the period (2010-2021), it was found that it ranged between a minimum of about 0.18 pounds in 2016, and a maximum of about 2.06 pounds in 2012, with an average of about 0.65 pounds during the study period.

By estimating the time trend equation for the total revenue to the total costs from the lentil crop in Egypt, the significance of the function was not proven - Table (1) in the appendix.

9-Profitability of the producing unit: The profitability of the unit produced from the lentil crop ranged between a minimum of about 1.27 thousand pounds in 2016, and a maximum of about 9.77 thousand pounds in 2020.

By estimating the growth equation for the profitability of the ton produced from the lentil crop, it was found that it increased by an annual change amounting to about 0.59 thousand pounds, and with a statistically significant annual growth rate at a significance level of 0.05, amounting to about 12.2% of the period average of about 4.87 thousand pounds during the study period.

10-Return on invested pounds: By studying the development of the return of the pound invested from the lentil crop in Egypt during the period (2010-2021), it was found that it ranged between a minimum of about 0.18 pounds in 2016, and a maximum of about 1.06 pounds in 2012, with an average of about 0.65 pounds during the study period.

By estimating the time trend equation for the return on the invested pound from the lentil crop in Egypt, the significance of the function was not proven.

11-Cost of unit produced: The cost of the unit producing the lentil crop ranged between a minimum of about 3.95 thousand pounds/ton in 2012, and a maximum of about 12.85 thousand pounds/ton in 2021.

By estimating the time trend equation for the cost of the unit produced from the lentil crop, the significance of the function was not proven - Table (1) in the Appendix.

#### **The most important items of production costs for the lentil crop:**

By studying the most important items of lentil production costs in Egypt during the period (2010-2021). It was found that the average acre rent amounted to about 2661 pounds per acre, representing about

38.26% of the total costs of lentil production, followed by workers' wages, which averaged about 1,583 pounds per acre, representing about 22.75% of the total costs per acre, followed by machinery wages, which averaged about 803 pounds per acre, representing about 11.54% of the total costs per acre for the lentil crop, followed by the price of lentil seeds, which averaged about 762 pounds per acre, representing about 10.95% of the total costs per acre for the lentil crop, then the price of chemical fertilizer, which averaged about 703 pounds per acre, representing About 10-11% of the total costs per acre for the lentil crop, then general expenses, which averaged about 327 pounds per acre, representing about 4.7% of the total costs per acre for the lentil crop, followed by the price of lentil pesticides, which averaged 117 pounds per acre, representing about 1.68% of the total costs. Acres for lentil crops in Egypt during the period (2000-2021 )-Table (1).

**Table (1): Development of items in per-acre production costs for the lentil crop in Egypt during the period (2010 – 2021)**

Years	Workers	Machines	Seeds	Chemical fertilizer	Pesticides	General expenses	Total costs	Rent	Total costs+ Rent
2010	567	391	506	308	81	204	2057	1197	3254
2011	766	426	620	352	82	239	2485	1154	3639
2012	636	491	548	330	82	167	2254	1261	3515
2013	951	494	565	392	85	199	2686	1217	3903
2014	825	693	600	382	79	206	2785	1385	4170
2015	1127	488	617	384	84	216	2916	1500	4416
2016	1098	565	617	384	81	220	2965	3282	6247
2017	1482	827	715	547	108	294	3973	4223	8196
2018	2355	1071	965	791	121	436	5891	4123	10014
2019	2700	1165	1038	944	150	503	6797	4103	10900
2020	3040	1337	1109	1613	170	581	7850	4243	12093
2021	3445	1687	1243	1043	280	657	8875	4247	13122
Average	1583	803	762	703	117	327	4295	2661	6956
growth rate %	**17.0	**12.9	**8.0	**13.7	**9.5	**11.7	**13.7	**15.4	**14.4

**Source:** Collected and calculated from data from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, **Agricultural Statistics Bulletin**, various issues.

**Second: The importance of the lentil crop among the most important winter field crops during the period (2019-2021):**

The area cultivated with lentils decreased to occupy tenth place compared to other winter field crops - wheat, perennial clover, sugar beets, clover, fava beans, barley, flax, dried fenugreek, and chickpeas- With an average area of about 0.47 thousand acres, representing about 0.01% of the total winter crop area of about 5.73 million acres during the period (2019-2021), the production costs of the lentil crop increased to occupy first place among winter field crops, with an average of about 12.04 thousand pounds, representing about 10.88 % of the total acreage cost of winter crops amounting to about 110.6 thousand pounds, Consequently, the cost of the unit produced - the ton - rose to occupy first place as well, with an average of about 11.96 thousand pounds, representing about 18.75% of the total cost of the unit produced for winter field crops, which amounted to about 63.77 thousand pounds during the study period - Table (2) in the appendix.

Despite the high production costs of the lentil crop, it achieves a relatively high return compared to other winter field crops. It occupies fourth place after wheat, chickpeas, and perennial alfalfa in terms of both total acreage revenue and net acreage yield, with an average of about 21.01 and 8.97 thousand pounds, respectively, representing about 10.44% and 9.9% of the total acreage revenue and net acreage yield for winter field crops, which amount to about 201.2 , 90.57 thousand pounds in the same order during the same period. It also occupies fourth place in terms of both the ratio of total revenue to total costs, and the return on the invested pound, after chickpeas, sustainable clover, and mowed clover, with an average of about 1.75 and 0.75 pounds, respectively, representing about 8.42% and 7.67% of the total revenue to total costs. And the return of the invested pound is about 20.78 and 9.78 pounds in the same order. It also ranked second in terms of profitability of the producing unit after chickpeas, with an average of about 8.91 thousand pounds/ton, representing about 17.7% of the total profitability of the producing unit, which amounted to about 50.37 thousand pounds/ton during the study period.

Therefore, it is clear that encouraging farmers to expand the cultivation of lentils will lead to an increase in farm income and an increase in the quantities produced by increasing the areas cultivated with lentils, which leads to increased production and an increase in the rate of self-sufficiency in the lentil crop.

**Third: Consumer indicators for the lentil crop in Egypt:**

1- Quantity of lentils consumed: Studying the development of the quantity consumed from the lentil crop in Egypt during the period (2010-2021) It was found that it ranged between a minimum of about 64 thousand tons

in 2014, and a maximum of about 272 thousand tons in 2018, with an average of about 108.33 thousand tons during the study period, and by estimating the time trend equation for the quantity consumed of the lentil crop in Egypt, the significance of the function was not proven - Table (2).

2-Average per capita: By studying the development of the average per capita share of the lentil crop in Egypt during the period (2010-2021), it was found that it ranged between a minimum of about 0.6 kg/person in 2015, and a maximum of about 9 kg/person in 2016, with an average of about 1.72 kg. / individual during the study period, and by estimating the time trend equation for the average per capita share of lentil crop in Egypt, the significance of the function was not proven.

3-Self-sufficiency rate: The self-sufficiency rate of the lentil crop ranged between a minimum of about 0.41% in 2019, and a maximum of about 3.13% in 2014. By estimating the time trend equation for the self-sufficiency rate of the lentil crop, it was found that it decreased by an annual change amounting to about 0.27%, and at an annual rate of decrease. Statistically significant at a significance level of 0.01, amounting to about 14.3% of the period average of about 1.88% during the study period - Table (2).

**Table (2): Development of the most important consumption indicators of the lentil crop during the period (2010-2021)**

Years	Production (thousand tons)	Consumption (thousand tons)	Per capita (kg/year)	Self-sufficiency%
2010	2.18	116	1.3	1.72
2011	1.8	94	1.1	2.13
2012	0.72	68	0.8	2.94
2013	0.74	66	0.7	3.03
2014	0.84	64	0.7	3.13
2015	1.25	65	0.6	3.08
2016	1.59	99	09	2.02
2017	4.76	108	1.0	1.85
2018	1.59	272	2.4	0.74
2019	0.35	85	0.7	0.41
2020	0.53	146	1.3	0.68
2021	0.53	117	1.0	0.85
Average	<b>1.41</b>	<b>108</b>	<b>1.72</b>	<b>1.88</b>
growth rate %	<b>7.8-</b>	<b>5.1</b>	<b>2.7</b>	<b>**14.3-</b>

**Source:** Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Food Balance Bulletin**, Cairo, various issues.

**Fourth: Development of the quantity, value and import price of the lentil crop:**

**1-Quantities of imports of lentils:** Studying the development of import quantities of lentils in Egypt during the period (2010-2021), It was found that it ranged between a minimum of about 66.68 thousand tons in 2013, representing about 58.52% of the average for the study period, and a maximum of about 276.84 thousand tons in 2018, representing about 242.95% of the average for the same period, which was about 113.95 thousand tons. By estimating the time trend equation for the quantity of lentil imports in Egypt, the significance of the function was not proven. By studying the instability factor for the quantities of imports of lentils, it was found that its geometric mean was about 16.78%, which indicates that the quantities of Egyptian imports of lentils are characterized by instability during the study period - Table (3).

**2- Import prices of lentils:** Import prices of lentils in Egypt ranged between a minimum of about 5,047 pounds/ton in 2010, representing about 52.81% of the average for the period (2010-2021), and a maximum of about 16.54 thousand pounds/ton in 2021, representing about 173.03% of the same average Period, By estimating the time trend equation for import prices of lentils in Egypt, it was found that they increased by an annual change amounting to about 630.73 pounds, and with a statistically significant annual growth rate at a significance level of 0.05, amounting to about 6.6% of the period average of about 9.56 thousand pounds. By studying the instability factor for the import prices of lentils, it was found that its geometric mean was about 17.28%, which indicates that the import prices of Egyptian imports of lentils were characterized by instability during the study period.

**3- Import values of lentils:** By studying the development of import values of lentils in Egypt during the period (2010-2021), it was found that they ranged between a minimum of about 479.08 million pounds in 2012, representing about 45.93% of the average period of the study, and a maximum of about 2,149.18 million pounds

in 2021, representing about 206.05% of the average for the same period, By estimating the time trend equation for the import values of lentils in Egypt, it was found that they increased by an annual change amounting to about 120.99 thousand pounds, and with a statistically significant annual growth rate at a significance level of 0.01, amounting to about 11.6% of the average period of about 1043 million pounds. By studying the instability coefficient for the values of imports of lentils, it was found that its geometric mean amounted to about 18.79%, which indicates that the values of Egyptian imports of lentils are characterized by instability during the study period - Table (3).

**Table (3): Development of the quantity, value and import price of the lentil crop in Egypt during the period (2010-2021)**

years	Quantity of imports		Import price		Import value	
	thousand tons	%	pounds/ton	%	million pound	%
2010	126.24	110.79	5047	52.81	637.13	61.06
2011	93.31	81.89	6394	66.91	596.62	57.20
2012	76.36	67.01	6274	65.65	479.08	45.93
2013	66.68	58.52	8243	86.26	549.64	52.70
2014	74.38	65.28	8801	92.09	654.62	62.76
2015	73.29	64.32	13424	140.47	983.84	94.33
2016	105.39	92.49	10293	107.71	1084.78	104.00
2017	106.49	93.46	15024	157.21	1599.91	153.39
2018	276.84	242.95	5497	57.52	1521.79	145.90
2019	90.29	79.24	9964	104.26	899.65	86.25
2020	148.13	130.00	9181	96.07	1359.98	130.39
2021	129.97	114.06	16536	173.03	2149.18	206.05
Average	113.95	100.00	9557	100.00	1043.02	100.00
%growth rate	5.00	-	*6.6	-	**11.6	-
Instability % coefficient	16.78	-	17.28	-	18.79	-

**Source:** Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Foreign Trade Statistics for Exports and Imports**, Cairo, various issues.

**Fifth: Factors affecting Egyptian imports of lentils:**

Identifying the determinants and factors affecting the imported quantities of lentils within foreign markets is of great importance so that the import policy for lentils can be established on sound foundations that include reducing the trade deficit and reducing the import bill.

To study the factors determining the quantity of lentil imports to Egypt in thousand tons, a stepwise multiple regression model was used in both the linear form and the double logarithmic form, which included several variables, namely the quantity of lentil imports from the world in thousand tons (Y) as a dependent variable on the one hand, and the quantity of production of the lentil crop in thousand tons (X1), the amount of consumption of lentils in thousand tons (X2), the population of Egypt in one million people (X3), the import price in thousand dollars/ton (X4), the exchange rate of the dollar in pounds (X5) as independent variables on the other hand within the model - Table (4), to determine the extent of the impact of each of these independent factors on the quantity of Egyptian imports of lentils, as follows:

When studying the impact of the aforementioned factors on the quantity of Egyptian imports of lentils, based on the values of “F” and “R<sup>2</sup>”, as well as the significance of the regression coefficients and the logic of the results obtained, it was found that the linear model has the best model expressing the semantic relationship, and by examining the regression coefficients of the model Completely linear showed that some of them were significant and others were not, so the step-wise linear model was used to reach the best model that agrees with economic logic and at the same time is statistically significant.

Through the results, it was shown from the stepwise linear model, as shown in Table (6), that the most influential factor on the quantity of Egyptian imports of lentils is the quantity of lentils consumed (X2), and it was also shown from the statistical estimate that the more the quantity consumed of the lentil crop increased by one thousand tons The quantity of imports increases by a statistically significant amount of about 0.992 thousand tons, or an annual rate of about 0.92% of the average quantity consumed of the lentil crop, which amounts to about 108 thousand tons during the period (2010-2021).

The estimation results indicate that the model shown in the equation is statistically significant at a significance level of 0.01, and the value of the adjusted coefficient of determination shows that 99% of the changes occurring in the quantity of lentil imports from the world are mainly due to the quantity of lentil consumption. It was also shown that the sign of the regression coefficient for the independent variable X2 was in agreement with Economic logic.

Table (4): The most important factors affecting the imported quantity of lentils during the period (2010-2021).

years	Quantity of imports	production quantity	The amount of consumption	population	Import price	Dollar exchange rate
	thousand tons	thousand tons	thousand tons	million population	pounds/ton	pounds
2010	126.24	2.18	116	78.73	5047	5.63
2011	93.31	1.8	94	80.41	6394	5.93
2012	76.36	0.72	68	82.55	6274	6.08
2013	66.68	0.74	66	84.63	8243	6.89
2014	74.38	0.84	64	86.81	8801	7.09
2015	73.29	1.25	65	88.96	13424	8.78
2016	105.39	1.59	99	91.02	10293	10.20
2017	106.49	4.76	108	95.20	15024	17.85
2018	276.84	1.59	272	97.14	5497	17.88
2019	90.29	0.35	85	98.90	9964	16.80
2020	148.13	0.53	146	100.60	9181	15.88
2021	129.97	0.53	117	102.06	16536	15.74
Average	<b>113.95</b>	<b>1.41</b>	<b>108.33</b>	<b>90.58</b>	<b>9557</b>	<b>11.23</b>
%growth rate	<b>5.00</b>	<b>7.80-</b>	<b>5.10</b>	<b>**2.5</b>	<b>*6.6</b>	<b>**12.20</b>

**Source:** Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy **Food Balance Bulletin**, Cairo, various issues.  
 - Compiled and calculated from: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Foreign Trade Statistics for Exports and Imports**, Cairo, various issues.

Table (5): Estimating the parameters of the regression relationship between total lentil imports and the most important factors affecting it for the period (2010-2021)

Sample		The equation	R <sup>2</sup>	R <sup>2</sup>	F
Linear	entire	$\hat{Y}_i = 16.57 - 2.45 X_1 + 1.05 X_2 - 0.19 X_3 + 0.001 X_4 - 0.45 X_5$ (- 0.74) ** (21.81) (- 0.14) (0.93) (- 0.24)	0.996	0.993	**295.25
	stepwise	$\hat{Y}_i = 6.49 + 0.992 X_2$ ** (38.75)	0.993	0.993	**1501
Logarithmic	entire	$\ln \hat{Y}_i = 1.28 - 0.06 \ln X_1 + 1.03 \ln X_2 - 0.7 \ln X_3 + 0.14 \ln X_4 - 0.003 \ln X_5$ (1.02-) ** (8.91) (-0.61) (1.05) (0.02)	0.976	0.964	**82.24
	stepwise	$\ln \hat{Y}_i = 0.45 + 0.915 \ln X_2$ ** (21.41)	0.97	0.968	**458.16

Where:

$\hat{Y}_i$  = Quantity of Egyptian imports of lentils in thousand tons.

$X_1$  = Production quantity in thousand tons.

$X_2$  = Quantity of consumption in thousand tons.

$X_3$  = Population in million people.

$X_4$  = Import price in pounds/ton.

$X_5$  = Exchange rate in pounds.

$i = 1, 2, 3, \dots, 12$ .

\*\* Significant at the 0.01 level . , \* Significant at the 0.05 level .

**Source:** Calculated from data in Table (4).

**Sixth: Analysis of production policies for the lentil crop in Egypt:**

An analysis of production policies was carried out during the period (2010-2021), by using the policy analysis matrix, It consists of two basic elements: the production costs per acre, evaluated financially and economically, and the productive returns evaluated financially and economically at the local price (market price) and the global price (border price), in addition to deducing the net return, evaluated financially and economically, for the lentil crop (Hasab El-naby , Abd Allatef, 2019).

**1- Production costs are evaluated financially and economically for the lentil crop in Egypt:**

The elements of the per-acre production costs of the lentil crop are considered one of the basic elements of the production policy analysis matrix, It is clear from Table (6) that the items of per-acre production costs for the lentil crop are valued financially and economically in pounds in Egypt during the period (2010 - 2021) and are represented in the wages of workers and machines, the price of seeds, municipal fertilizer and pesticides, and finally public expenses and land rent, The conversion factor was used to obtain the economic evaluation of these items. When comparing the financial evaluation with the economic evaluation of the production costs of the lentil crop in Egypt, it became clear that:

(1)-It turns out that the financial evaluation of workers' wages exceeds the economic evaluation, It amounted to about 1582.67 pounds financially, while it was estimated at about 1060.39 pounds economically, This means that workers' wages are higher locally than internationally for the lentil crop in Egypt during the study period.

(2)-Regarding the machinery wages item, it became clear that the economic evaluation exceeds the financial evaluation, The financial assessment of machinery wages amounted to about 802.91 pounds, while the economic assessment was estimated at about 883.20 pounds.

(3)-Regarding seeds, chemical fertilizers, and pesticides for lentil crops in Egypt, it was found that the financial evaluation of these items is less than the economic evaluation of the same items, Their financial valuation was estimated at 761.92, 703.25, and 116.92 pounds, respectively, While the economic evaluation of these items was about 800.02, 773.58, and 140.30 pounds in the same order, Which indicates that these provisions are supported by the state for lentil farmers.

(4)-Regarding the total costs of the lentil crop in Egypt: It was found that the total financially assessed production costs amounted to approximately 6.96 thousand pounds, exceeding the total economically assessed production costs estimated at approximately 6.65 thousand pounds, This indicates that local prices for the components of lentil costs are higher than their international prices, which means that there are implicit taxes on lentil farmers in Egypt during the study period.

**Table (6): Financial and economic estimation of production costs and total revenue in pounds per acre for the lentil crop during the period (2010-2021)**

items	The value of the cost components and total revenue		
	the financial value	Conversion factor	Economic value
<b>First: Production requirements</b>			
The price of seeds	761.92	1.05	800.02
The price of chemical fertilizer	703.25	1.1	773.58
The price of pesticides	116.92	1.2	140.30
General expenses	326.83	1	326.83
Total production requirements	1908.92	-	2040.73
<b>Second: Local resources</b>			
The value of human work	1582.67	0.67	1060.39
The value of automated work	802.91	1.1	883.20
Total work item	2385.58	-	1943.59
Land rent	2661.25	1	2661.25
<b>Total costs</b>	<b>6955.75</b>	-	<b>6645.57</b>

**Source:** Collected and calculated from data from the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, **Agricultural Statistics Bulletin**, various issues.

**2-The acreage return is evaluated financially and economically during the study period:**

The acreage return of lentils in Egypt is considered one of the most important elements of the policy analysis matrix, Table (7) shows that the general average acreage return for the financially assessed lentil crop amounted to about 11.55 thousand pounds, and that it is less than the economically assessed acreage return for the same crop, which amounted to about 15.59 thousand pounds during the period (2010 - 2021), This means that local prices are lower than international prices during that period, which requires the state to follow policies to encourage lentil farmers to fill the gap and reduce the amount of imports of this crop by increasing local prices to keep pace with international prices for this crop. **3-Financial and economic indicators in the production policy analysis matrix for lentils in Egypt:**

Table (7) shows all the financial and economic indicators in addition to transfers of the lentil crop in Egypt during the period (2010 - 2021). The most important results were as follows:



(1) The net financial return was about 4.59 thousand pounds/acre, while the net economic return was about 8.94 thousand pounds/acre.

(2) The value-added index expresses the extent to which production inputs - pesticides, seeds, and fertilizers - contribute to the per-acre yield. It is clear that the added value estimated at the local price of the lentil crop in Egypt amounted to about 9.64 thousand pounds/acre, which is less than its economically evaluated counterpart, which was estimated at about 13.55 thousand pounds/acre. This demonstrates an increase in the total economically assessed return per acre by a much greater percentage than the increase in the costs of economic production inputs for the lentil crop for the period (2010 – 2021).

(3) The index of transfers to the acreage return of the lentil crop in Egypt reflects the impact of applied policy interventions and market failures, which expresses the difference between the return and the estimated financial and economic costs of the lentil crop. Table (7) shows that the transfers in the matrix to the total acreage return of the lentil crop amounted to about (4.04) thousand pounds, which is a negative value, which means that lentil farmers in Egypt receive a lower local return than their global counterpart.

(4) As for transfers of production inputs, they amounted to about (131.8) pounds, meaning it is also a negative value. This means that lentil farmers pay prices for production inputs that are lower than their global counterparts, meaning they receive subsidies. Also, transfers to the cost of local resources amounted to about 441.99 pounds/acre, which is a positive value. That is, lentil farmers pay higher prices for local production elements than their global counterparts.

(5) As for net return transfers, they are considered one of the most important indicators in the matrix, as they give a general indication of the efficiency of commodity activity performance. Net return transfers amounted to about (4.35) thousand pounds, which is a negative value, and this means that lentil farmers receive a net return lower than its global counterpart.

(6) It was also shown that the value-added transfers in Egypt amounted to about (3.91) thousand pounds, which is a negative value, and thus their results agree with the transfers of the net per-acre return of the wheat crop in Egypt during the period (2010 – 2021).

**Table (7): Agricultural policy analysis matrix for the lentil crop in Egypt in pounds during the period (2010-2021)**

Evaluation	Total return	Cost of Production inputs	Cost of local resources			Net return	Value Added *
			Total work	the earth	Total		
Financial	11546.5	1908.92	2385.58	2661.25	5046.83	4590.75	9637.58
Economic	15587.78	2040.73	1943.59	2661.25	4604.84	8942.21	13547.05
Transfers	(4041.3)	(131.8)	441.99	zero	441.99	(4351)	(3909)

**Where:**

**( ):The values between parentheses are negative .**

**Value added = total return - cost of production inputs**

**Source:** Collected and calculated from Table (6).

**4-Results of the coefficients of the production policy analysis matrix for the lentil crop in Egypt:**

Protection coefficients are estimated for the policy analysis matrix to judge whether productive policies are sound or not, meaning there is efficiency in the use of resources. Protection coefficients are also one of the most important analytical tools for evaluating performance in a sector over time, The coefficients used are determined in three parameters: nominal protection, effective protection, and comparative advantage.

**A- The nominal protection factor for the lentil crop in Egypt:**

It represents a measure of all types of protection or taxes that lead to inequality between local prices and international prices.

**(1) The nominal protection factor for feddan Production requirements for lentils in Egypt:** Estimated at about 0.94 pounds, meaning that the factor is less than the correct one, and this indicates the presence of implicit taxes on lentil farmers, as indicated by State support for production inputs is estimated at about 0.06 pounds, which is considered somewhat small - Table (8).

**(2) The nominal protection factor for the acreage return of lentils in Egypt:** It was estimated at about 0.74 pounds during the period (2010 - 2021), meaning that the coefficient is less than the correct one, meaning that the state imposes implicit taxes on lentil farmers amounting to about 0.26 pounds, meaning that lentil farmers in Egypt do not receive their real prices for their production.

**This indicator is used effectively B- The nominal protection rate for lentils in Egypt:**

during short time periods, by comparing local prices with international prices, whether for production inputs or the acreage return.

(1) **The nominal protection rate for feddan Production requirements for lentils in Egypt:** It was about (6%), which is a negative percentage and means that the state imposes direct and indirect taxes on production requirements, and that the state does not follow protection policies to support the product.

(2) **The nominal protection rate for per-acre return of lentils in Egypt:** By estimating the nominal protection rate for the per-acre return of the lentil crop, its value was negative and was estimated at about (26%). This means that there are direct and indirect taxes on lentil farmers in Egypt, and at the same time there is support for the consumer, due to this rate falling below zero.

**C- The effective protection factor and rate for the lentil crop in Egypt:**

It amounted to about 0.71 pounds, which is less than the correct one, and this means that there are taxes in the form of negative protection against lentil farmers. As for the effective protection rate for the lentil crop in Egypt during the same period, it reached about (29%), which is a negative value, and this result is consistent with all previous results of the research.

**D- Local resource cost factor (comparative advantage factor) for the lentil crop in Egypt:**

It is used to measure the efficiency of local production in relation to the global market. It was found that the cost factor of local resources was about 0.34 pounds for the lentil crop in Egypt, or significantly less than the correct one. This means achieving a comparative advantage in the production of the lentil crop.

It is clear from the above that the production policies followed for the lentil crop during the period (2010 - 2021) were unfavorable to lentil farmers because implicit taxes were imposed on them, which led to a decrease in the incentive of lentil farmers in Egypt, which led to instability of the cultivated areas of lentil farmers in Egypt during the period Study - Table (8).

**Table (8): Results of the coefficients of the production policies analysis matrix for the lentil crop in Egypt during the period (2010 – 2021)**

Factories	Nominal protection factor <sup>(1)</sup>		Nominal protection rate <sup>(2)</sup>		Effective coefficient of protection <sup>(3)</sup>	Effective protection rate <sup>(4)</sup>	Domestic resource cost factor (comparative advantage factor) <sup>(5)</sup>
	Production supplies	Return per acre	Production supplies	Return per acre			
the value	0.94	0.74	(%6)	(%26)	0.71	(%29)	0.34

**Where:**

( ) : The numbers in parentheses are negative.

(1) : Nominal protection factor = value of production inputs or revenues evaluated financially / value of production inputs or revenues evaluated economically.

(2) : Nominal protection rate = (nominal protection factor for supplies or returns – 1) x 100.

(3) : Effective protection factor = value added is financially evaluated / value added is evaluated economically.

(4) : Effective protection rate = (effective protection factor -1) x 100.

(5) : The cost factor of local resources (coefficient of comparative advantage) = the value of local resources is economically evaluated / the value added is economically evaluated.

**Source:** Calculated from data in tables (6) and (7).

**Recommendations:**

- 1- It is necessary to increase the cultivated area of lentils, especially in new lands.
- 2- Encouraging farmers to grow lentils by giving incentives to farmers, such as reducing the price of seeds or fertilizers.
- 3- Vertical expansion of the lentil crop by following technical recommendations to increase acre productivity in accordance with the state strategy (2020-2030) by increasing legume productivity to reach about 1.4 tons/acre.
- 4- Providing the necessary seeds for growing lentils through the central management of seed production and introducing farmers to varieties with high productivity and quality.
- 5- Providing effective weed killers.
- 6- Encouraging contract farming.

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**Appendices :**

**Appendix Table (1): Development of the most important production parameters of the lentil crop in Egypt during the period (2010-2021)**

Year	Area (Acre)	Productivity (tons/acre)	Production (ton)	Farm price (pound/arde b)	Total costs per acre (pound/acre )	Total revenue per acre (pound/acre )	Net return per acre (pound)	Revenue to total costs (Pound)	Unit return (Pound/ton)	Return on invested pounds (Pound)	Unit cost (Pound/ton)
2010	3285	0.66	2178	1033	3254	4594	1340	1.41	2030	0.41	4930
2011	2323	0.71	1795	1203	3639	5687	2048	1.56	2885	0.56	5125
2012	804	0.89	717	1220	3515	7227	3712	2.06	4170.8	1.06	3949
2013	862	0.85	735	1229	3903	6984	3081	1.79	3624.7	0.79	4591
2014	975	0.87	843	1234	4170	7093	2923	1.70	3359.8	0.70	4793
2015	1475	0.86	1250	1254	4416	7162	2746	1.62	3193.0	0.62	5135
2016	1835	0.87	1591	1274	6247	7351	1104	1.18	1269.0	0.18	7180
2017	5020	0.95	4762	1847	8196	11369	3173	1.39	3340.0	0.39	8627
2018	1561	1.02	1585	2759	10014	18059	8045	1.80	7887.3	0.80	9818
2019	354	0.99	352	2824	10900	18166	7266	1.67	7339.4	0.67	11010
2020	528	1.01	531	3265	12093	21925	9832	1.81	9773.4	0.81	12021
2021	516	1.02	527	3336	13122	22941	9819	1.75	9617.0	0.75	12852
Average	1628	0.89	1406	1873	6956	11547	4591	1.65	4874.1	0.65	10946
growth %rate	11-	**3.5	7.8-	**11.5	**14.4	**14.9	**15.7	0.5	*12.2	1.3	6.9

**Source:-** Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Bulletin of Agricultural Statistics**, Cairo, various issues.

-Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Bulletin of Winter Cost and Net Return Statistics**, Cairo, various issues.

**Appendix Table (2): The most important productivity indicators for the lentil crop and the most important competing crops in Egypt during the period (2019-2021).**

The crop	Cultivated area	Relative importance	Production	Relative importance	Total acreage revenue	Relative importance	Total per acre costs	Relative importance	Net return per acre	Relative importance	Ratio of revenue to total costs	Relative importance	Unit profitability	Relative importance	Return on invested pounds	Relative importance	Unit cost	Relative importance
	thousand acres	%	thousand tons	%	Thousand pounds	%	Thousand pounds	%	Thousand pounds	%		%	pounds/ton	%	pound	%	pounds/ton	%
Wheat	3319.0	57.94	9167.6	12.95	16.06	7.98	11.93	10.78	4.12	4.55	1.35	6.50	1493	2.96	0.35	3.58	4322	6.78
barley	62.5	1.09	100.0	0.14	13.98	6.95	11.28	10.20	2.71	2.99	1.24	5.97	1687	3.35	0.24	2.45	7032	11.03
Local fava beans	92.1	1.61	130.7	0.18	18.60	9.24	11.24	10.16	7.36	8.13	1.66	7.99	5193	10.31	0.66	6.75	7927	12.43
Hummus	1.6	0.03	2.08	0.00	33.68	16.74	9.91	8.96	23.77	26.24	3.40	16.36	18156	36.05	2.40	24.54	7573	11.88
Dry fenugreek	3.6	0.06	3.84	0.01	16.79	8.34	10.39	9.39	6.40	7.07	1.62	7.80	5922	11.76	0.62	6.34	9612	15.07
Lupine	0.23	0.00	0.20	0.00	15.27	7.59	9.70	8.77	5.56	6.14	1.57	7.56	6649	13.20	0.57	5.83	11598	18.19
Lentils	0.47	0.01	0.47	0.00	21.01	10.44	12.04	10.88	8.97	9.90	1.75	8.42	8913	17.70	0.75	7.67	11959	18.75
Sugar beet	602.0	10.51	12242.2	17.29	14.33	7.12	10.22	9.24	4.11	4.54	1.40	6.74	202	0.40	0.40	4.09	504	0.79
Clover mowing	146.9	2.56	1667.0	2.35	11.98	5.95	5.51	4.98	6.47	7.14	2.17	10.44	570	1.13	1.17	11.96	486	0.76
Sustainable clover	1481.4	25.86	47411.0	66.96	23.97	11.91	7.49	6.77	16.48	18.20	3.20	15.40	516	1.02	2.20	22.49	234	0.37
Linen	18.3	0.32	78.98	0.11	15.55	7.73	10.93	9.88	4.62	5.10	1.42	6.83	1065	2.11	0.42	4.29	2523	3.96
<b>Total</b>	<b>5728.1</b>	<b>100</b>	<b>70804.1</b>	<b>100</b>	<b>201.2</b>	<b>100</b>	<b>110.6</b>	<b>100</b>	<b>90.57</b>	<b>100</b>	<b>20.78</b>	<b>100</b>	<b>50366</b>	<b>100</b>	<b>9.78</b>	<b>100</b>	<b>63770</b>	<b>100</b>

**Source:**- Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for Agricultural Economy - **Bulletin of Agricultural Statistics**, Cairo, various issues.

-Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration for - Agricultural Economy - **Bulletin of Winter Cost and Net Return Statistics**, Cairo, various issues.

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