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The Optimal Orientation for Egyptian Imports of Maize

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ABSTRACT

The research mainly aimed at a proposed estimate of the optimal geographical distribution of Egyptian imports of maize, which would reduce its import bill, The research found a set of results, the most important of which are the following: (1) American maize is the highest price in the Egyptian market, reaching about 201 dollars/ton, while the maize imported from Paraguay has the highest price competitive advantage in the Egyptian market as it is the lowest price with a value of about 123.8 dollars/ton, followed by Ukrainian and Brazilian maize. And the Argentine, at a price of about 155.8, 166.6, 168.8 dollars/ton. Egyptian maize imports are concentrated in eight countries, which represent about 98.53% of total Egyptian imports of maize, with a value of about 98.38% of the value of maize imports. Ukraine, Argentina, Brazil, the United States of America and Romania come in the first three places.(2) It became clear from the results of the programming model analysis that the average amount of Egyptian imports of maize during the study period, which amounted to about 9.1 million tons, can be achieved at a cost estimated at about 1.44 billion dollars, which achieves savings of about 61.5 million dollars, representing about 4.1% of the average value of Egyptian imports from Maize during the study period, which is about 1.5 billion dollars.(3) The saving in the value of imports was achieved by stopping imports of maize from Romania, the United States of America, Bulgaria and Serbia, which are the highest-priced countries, and relying on meeting the quota of imports of maize on four countries: Ukraine, Brazil, Argentina and Paraguay, with an amount of imports amounting to about 3643 thousand tons Maize from Ukraine and Brazil, and 877,945 thousand tons, maize from Argentina and Paraguay, respectively.(4)The study recommends the necessity of periodic review of the importation of maize in light of price changes and stimulating the trend towards lower-priced markets, as one of the possible solutions to reduce its import bill.

Introduction

Maize is one of the most important cereal crops in the world after wheat and rice, as it has multiple uses as it is used in the manufacture of starch, glucose and yeast and extracting oils from the seed embryo, which is a major component in the manufacture of livestock and poultry feed[(1)], as well as the tendency of the main producing countries to use it in the production of biofuels. The United States of America tops the list of the most important producing countries, with a production quantity of 392.5 million tons, representing 34.2% of the global production of 1.15 billion tons, followed by China, Brazil, the European Union, Argentina and Ukraine, according to the 2018 data of the Food and Agriculture Organization [(11)].

The maize crop is the basis for the production of both red and white meat and eggs which constitute about 70% of the concentrated feed components for livestock and poultry production[(6)], which are affected by fluctuations in their quantities and prices, especially since the provision of the largest volume of local needs depends on imports from the external market, which amounted to about 8.6 million tons in 2018 with a value of About 1.85 billion dollars[(7)].

The local maize crop faces difficulties in local marketing due to the high production costs, and consequently the price farm are higher than international prices[(5)], so feed factories resort to importing from the lower-priced global market, in addition to the high moisture content of grains not to use dryers and therefore they do not bear storage for a long period without Infection with fungi, and there is a tendency for many maize farmers to produce silage that is more profitable than grain production [(4)], which makes dependence on imports to meet the needs of the Egyptian market an indispensable necessity, at least in the short run.

The research problem is represented in the inability of local production of maize to meet the increasing demand for it, which led to an increase in dependence on imports and thus a high import bill, which constitutes a burden on the country's trade balance, and there are many international markets to which Egyptian imports of maize go. The situation varies

between prices and costs of import, as well as the timing of exports for each of them, which requires determining the optimal orientation structure for those markets in order to work to reduce the value of imports of maize.

The research aims mainly to estimate a proposal for the optimal geographical distribution of Egyptian imports of maize that would reduce its import bill by studying the following axes:

1. General indicators of maize production and consumption in Egypt.
2. The comparative price advantage of imports of maize in the Egyptian market.
3. The current geographical distribution of Egyptian imports of maize.
4. for the optimal orientation of Egyptian imports of maize.

Materials and Methodology

In achieving its objectives, the research relied on the use of descriptive and quantitative economic analysis methods of the variables in question, such as arithmetic averages, percentages, coefficient of variation, and the simple regression method for estimating temporal trend equations, and calculating the non-stability coefficient for some variables, which depends on the percentages method for averages of deviations, which are estimated according to For the following equation [(2)]:

$$Non-Stability\ Coefficient = \frac{|y-\hat{y}|}{y} * 100$$

If the value of the parameter is equal to zero, this indicates the stability of the variable during the study period, while increasing its value indicates an increase in fluctuations and instability of the variable under study.In addition to the linear programming method to reduce the value of Egyptian imports of maize for the period (2016-2018) and the objective function takes the following mathematical form[(3)]:

$$Min: Z = \sum_{i=1}^{n} P_i\, Q_i$$

Where: Z: the value of Egyptian imports of maize.
P_i: average prices of maize imports from different countries.
Q_i: The average quantity of imports of maize from different countries.
n: the number of countries exporting maize to Egypt.
i: Directory of exporting countries (i= 1, 2, 3,……, n).

Under the following Determinants:
The first determinant: the quantity of Egyptian maize imports is not less than the average of its total imports (K_i) during the study period.

$$\sum_{i=1}^{n} Q_i \leq K_i$$

The second determinant: The amount of Egyptian maize imports should not exceed the export capacity (M_i) of the exporting countries.

$$\sum_{i=1}^{n} Q_i \leq M_i$$

The third determinant: that the amount of Egyptian maize imports from any country should not exceed 40% of its total imports in order to avoid geographic concentration.

$$Q_i \leq 0.4 \sum_{i=1}^{n} Q_i$$

Data sources

The research was based on secondary data published and issued by the Egyptian Ministry of Agriculture and Land Reclamation through the Economic Affairs Sector, such as the Agricultural Statistics Bulletin, the Foreign Trade Statistics Bulletin for Agricultural Exports and Imports, the Central Agency for Public Mobilization and Statistics, in addition to the United Nations database Comtrade and the Food and Agriculture Organization.

Results and Discussion

General indicators of maize production and consumption in Egypt

By studying the development of both area, productivity and production of the maize crop, both white and yellow, during the period (2005-2019), it becomes clear from the data contained in tables numbers (1, 2, 3) that:

The average annual area of maize was about 2.11 million acres, with an annual growth rate of about 2.5%, due to the increase in the area of yellow maize from about 150 thousand feddan at the beginning of the period to about one million feddan at the end, with an annual average of about 440 thousand feddan, with a growth rate An annual rate of about 14.1%, which led to an increase in the relative importance of the average area of maize from the total area of maize during the study period from 10% in the period (2005-2009) to 32.6% in the period (2015-2019), at a time when it was characterized by The area of white maize with relative stability at an annual average of about 1.65 million feddan, and the coefficient of variation was about 9.2%, and the statistical significance of the annual growth rate was not proven.

Productivity was characterized by relative stability during the study period, with an annual average of about 3.36, 3.18, and 3.32 tons / feddan for both white and yellow maize and total maize, with a difference coefficient of about 5.1%, 3.8% and 4.5% for each, respectively. This indicates the absence of a positive impact of the vertical expansion programs on the productivity of the maize crop in Egypt, including the cultivation of new varieties, agricultural methods and modern technological means.

The average annual production of maize was about 6.87 million tons, with an annual growth rate of about 1.2%, and this growth is due to the increase in the production of yellow maize from about 0.5 million tons at the beginning of the period to about 3 million tons at the end, with an annual average of about 2.82 million tons. With an annual growth rate of about 14.2%, which led to an increase in the relative importance of yellow maize production out of the total production of maize during the study period from 10% in the period (2005-2009) to 32.6% in the period (2015-2019), while the annual average reached White maize production is about 5.52 million tons, at a statistically significant annual decline rate of about (1.7%).

General indicators of maize consumption in Egypt

By studying the development of production, imports, consumption, and the self-sufficiency rate of maize in Egypt during the period (2005-2019), it is clear from the data contained in tables No. (4, 5) that:
Production of maize ranged between a minimum of about 5.9 million tons in 2011, and a maximum of about 8.3 million tons in 2018, with a statistically significant annual growth rate of

about 1.2% of the average for the period of about 6.8 million tons, and an annual change of about 81.6 One thousand tons, and the production of maize was characterized by relative stability during the study period, with an average non-stability coefficient of about 5.1%.

Imports of maize ranged between a minimum of about 3.2 million tons in 2012, and a maximum of about 10.1 million tons in 2019, with a statistically significant annual growth rate of about 6% of the average period of about 6.3 million tons, and an annual change of about 378 thousand tons, and the average non-stability coefficient of imports of maize during the study period was about 9.7%. The consumption of maize ranged between a minimum of about 9.3 million tons in 2009, and a maximum of about 17 million tons in 2018, with a statistically significant annual growth rate of about 2.3% of the average for the period of about 13.2 million tons, and an annual change of about 304 thousand Tons, and the average non-stability coefficient of consumption of maize during the study period was about 3.9%. The self-sufficiency rate of maize in Egypt ranged between a minimum of about 40.7% in 2017, and a maximum of about 71.3% in 2009, and the statistical significance of the growth rate of the self-sufficiency ratio was not proven in addition to a decrease in the average non-stability coefficient of about 5.5%, which indicates Due to its relative stability and the wrapping of the values around the period average of about 53.2%.

Table -1 Development of productive indicators of maize crop in Egypt during the period (2005-2019)

year	White Maize			Yellow Maize			Total Maize		
	Area	Productivity	Production	Area	Productivity	Production	Area	Productivity	Production
2005	1.79	3.55	6.37	0.15	3.35	0.5	1.94	3.54	6.87
2006	1.57	3.64	5.71	0.14	3.12	0.44	1.71	3.6	6.15
2007	1.6	3.47	5.57	0.18	3.21	0.57	1.78	3.45	6.14
2008	1.86	3.39	6.31	0.22	3.15	0.68	2.08	3.36	6.99
2009	1.72	3.38	5.8	0.26	3.21	0.84	1.98	3.36	6.64
2010	1.69	3.17	5.36	0.31	2.96	0.91	2.00	3.14	6.28
2011	1.48	3.39	5.03	0.28	3.11	0.86	1.76	3.35	5.89
2012	1.84	3.38	6.22	0.32	3.11	0.99	2.16	3.34	7.21
2013	1.72	3.36	5.79	0.42	3.17	1.31	2.14	3.32	7.1
2014	1.72	3.32	5.71	0.47	3.29	1.53	2.19	3.32	7.25
2015	1.74	3.16	5.51	0.52	2.98	1.55	2.26	3.12	7.06
2016	1.54	3.26	5.03	0.67	3.19	2.15	2.21	3.24	7.18
2017	1.46	3.65	4.84	0.84	3.35	2.82	1.93	3.24	6.77
2018	1.62	3.01	5.11	1.00	3.09	3.14	2.62	3.05	8.25
2019	1.35	3.32	4.48	0.85	3.34	2.84	2.95	3.33	7.32
Average	1.65	3.36	5.52	0.44	3.18	1.41	2.11	3.32	6.87
S.D	0.144	0.172	0.553	0.78	0.121	0.913	0.326	0.148	0.597
C.V	9.2	5.1	10	177.3	3.8	64.8	15.5	4.5	8.7

Area with Million Feddan; Productivity with Ton / Feddan; Production with Million Ton.
Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Agricultural Statistics Bulletin, Cairo.

Table -2 Estimating the equations for the trend for the development of area, productivity and production of maize in Egypt during the period (2015-2019)

Crop	Items	equation	F	R^2	% Annual growth rate
White maize	Area	Ln Y = 0.57 – 0.01 T (- 2.00)$^{n.s.}$	4.04$^{n.s.}$	0.24	-1.0
	Productivity	Ln Y = 1.26 – 0.006 T (- 2.08)$^{n.s.}$	4.33$^{n.s.}$	0.25	-0.6
	Production	Ln Y = 1.84 – 0.017 T (- 3.82)**	14.6**	0.53	-1.7
Yellow maize	Area	Ln Y = -2.13+ 0.141 T (21.99)**	483**	0.97	14.1
	Productivity	Ln Y = 1.15+ 0.001 T (0.29)$^{n.s.}$	0.08$^{n.s.}$	0.01	0.1
	Production	Ln Y = -0.99 + 0.142 T (20.19)**	400.7**	0.97	14.2
Total maize	Area	Ln Y = 0.54+ 0.025 T (4.22)**	17.83**	0.58	2.5
	Productivity	Ln Y = 1.26- 0.007 T (-3.71)**	13.73**	0.51	-0.7
	Production	Ln Y = 1.83+ 0.012 T (2.9)**	8.98**	0.41	1.2

*** Significant at 1% probability level n.s. not significant .*
Source: calculated from the data in Table No. (1).

Table- 3 The relative importance of the average area and production of yellow Maize compared to the average area and production of maize in Egypt during the period (2015-2019)

Period	total area of maize		Yellow Maize			
	Area	Production	Area		Production	
	1000 Feddans	1000 Tons	1000 Feddans	%	1000 Tons	%
2002-2009	1.9	1.9	0.19	10	0.61	32.1
2010-2014	2.05	6.75	0.36	17.6	1.12	16.6
2015-2019	2.39	7.32	0.78	32.6	2.5	34.2

Source: calculated from the data in Table No. (1).

Table-4 Evolution of consumption indicators of maize in Egypt during the period (2005-2019)

Year	Production	Imports	Consumption	Self-sufficiency ratio
		1000 Tons		%
2005	6870	5098	12818	53.60
2006	6150	3769	10656	57.71
2007	6140	4474	11399	53.86
2008	6990	5075	12519	55.84
2009	6640	1883	9317	71.27
2010	6280	4845	12509	50.20
2011	5890	6892	14073	41.85
2012	7210	3248	10155	71.00
2013	7100	6167	14257	49.80
2014	7250	8231	12313	58.88
2015	7060	8305	14877	47.46
2016	7180	8708	13909	51.62
2017	6770	9193	16627	40.72
2018	8250	9224	16988	48.56
2019	7320	10107	15919	45.98
Average	**6873.3**	**6347.9**	**13222.4**	**53.2**

Source: - Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economy, Bulletin of Agricultural Statistics, Cairo.
- Central Agency for Public Mobilization and Statistics, Bulletin of Production and Foreign Trade Movement, Cairo.

Table- 5. Estimation of time trend equations for indicators of consumption of maize in Egypt during the period (2015-2019)

Items	Equation	F	R^2	% Annual growth rate
Imports	Ln Y = 8.06+ 0.06 T (3.8)**	14.22**	0.52	6.0
Consumption	Ln Y = 9.25+ 0.029 T (3.7)**	13.8**	0.51	2.9
Self-sufficiency ratio	Ln Y = 4.09 – 0.016 T (- 1.8)n.s.	3.2n.s.	0.20	-1.6

*** Significant at 1% probability level n.s. not significant.*
Source: Calculated from the data of Table No. (4).

The comparative price advantage of imports of maize in the Egyptian market

The relative price is one of the most important factors affecting the competitive position of the commodity, and the lower the export price compared to its counterpart in competing countries, this means that there is a price advantage for the exported commodity and a better competitiveness, and it is evident from the data in Table No. (6) that the export price of American maize is the highest During the study period, when it reached about $ 201 / ton, the prices of maize export to the rest of the countries were attributed to the Egyptian market. The maize imported from Paraguay has the highest price competitive advantage in the Egyptian market, as it is the lowest price, with a value of about $ 123.8 / ton representing about 61.6. % Of the American import price of maize, followed by the maize imported from Ukraine at an export price of about $ 155.8 / ton representing about 77.5% of the import price of American maize, followed by Brazil and Argentina at an export price of about 166.6, $ 168.8 / ton representing About 83.9%, 84% of the US maize price, and the export price of maize to Bulgaria and Serbia is equal to a value of about $ 185.4 / ton, and Bulgarian maize is the lowest in the comparative price advantage, as it represents the highest price It is sought after American maize, at an average price of about $ 194.7 / ton, which represents about 97.8% of the US import price of maize.

Table - 6 Average prices for importing maize for the most important exporting countries to the Egyptian market during the period (2015-2019)

Country	Export price Dollar / Ton	Relative price %
United States of America	201	100.0
Bulgaria	185.4	92.2
Serbia	185.4	92.2
Romania	176	87.6
Argentina	168.8	84.0
Brazil	166.6	82.9
Ukraine	155.8	77.5
Paraguay	123.8	61.6

Source: collected and calculated from: data base http://comtrade.un.org

The current geographical distribution of Egyptian imports of maize

It is clear from the geographical distribution of Egyptian imports of maize as an average for the period (2015-2019) and shown in Table (7) that they are concentrated in eight countries, which represent about 98.53% of the total Egyptian imports of maize, which amount to about 9.1 million tons, with a value that represents about 98.38% Of the value of imports of maize, which amounted to about $ 1.5 billion. Ukraine, Argentina, and Brazil come in the first three places, with an amount of about 2.7, 2.6, and 2.4 million tons each, respectively, representing about 30.2%, 28.4% and 26.3% of the total Egyptian imports of maize for each of them, respectively. Regarding the value of imports, Argentina is ahead of the lower-priced Ukraine, then Brazil, with a value of about 434, 429, and 397 million dollars each, respectively, representing about 28.9%, 28.6%, and 26.5% of the total value of Egyptian maize imports for each of them, respectively, followed by each From the United States of America and Romania, the amount of imports amounted to about 783 and 279 thousand tons for each of them respectively, representing about 8.6% and 3.1% of the total imports of Egyptian maize, and Paraguay came in last place with an amount of about 30.4 thousand tons, representing about 0.33% of the quantity Egyptian maize imports, with a value of about $ 3.7 million, representing about 0.25% of the value of Egyptian maize imports during the study period.

Table -7 Geographical distribution of Egyptian imports of maize as an average for the period (2015-2019)

Country	Quantity of imports		Value of imports	
	Thousand tons	%	Million dollars	%
Ukraine	2752.49	30.22	428.88	28.57
Brazil	2397.81	26.33	397.38	26.47
Argentina	2587.22	28.41	434.35	28.94
Romania	278.93	3.06	49.17	3.28
United States of America	783.23	8.60	136.93	9.12
Bulgaria	30.54	0.34	5.55	0.37
Serbia	113.15	1.24	20.75	1.38
Paraguay	30.35	0.33	3.69	0.25
other countries	133.71	1.47	24.26	1.62
Total	**9107.43**	**100.00**	**1500.96**	**100.00**

Source: collected and calculated fromdatabase http://comtrade.un.org

The optimal orientation of Egyptian imports of maize

It is apparent from the results of the analysis of the proposed linear programming model to reduce the average value of Egyptian imports of maize during the period (2015-2019) and included in Table No. (8), that the average quantity of Egyptian imports of maize during the study period of about 9.1 million tons can be achieved at an estimated cost About $ 1.44 billion, which achieves savings of about $ 61.5 million, which represents about 4.1% of the average value of Egyptian imports of maize during the study period, which is about $ 1.5 billion. The saving in the value of imports was achieved by stopping imports of maize from Romania, the United States of America, Bulgaria and Serbia, which are the most expensive countries, and by relying on meeting the quota of imports of maize on four countries: Ukraine, Brazil, Argentina, Paraguay, by increasing the amount of Ukrainian imports of maize And the Brazilian to reach about 3.64 million tons for each of them, representing about 40% for each of them of the total Egyptian maize imports, and at a cost of about 567.6 and 606.9 million dollars of the total value of Egyptian maize imports for each of them, respectively, reducing Argentine maize imports to about 876.6 thousand tons representing About 9.6% of the total amount of maize imports, at a cost of about $ 198 million, representing about 10.3% of the total value of maize imports. Increasing the amount of imports of maize in Paraguay to reach about 945 thousand tons, representing about 10.4% of the total amount of maize imports, at a cost of about $ 117 million, representing about 8.1% of the total value of Egyptian maize imports. By conducting a sensitivity analysis of the changes that may occur to the average prices of Egyptian imports of maize, it is clear from the data provided in Table (9) that the average price of Argentine maize imports can be changed in a range between a minimum of about $ 166.8 / ton, and an upper limit of about 175.8 dollars / ton, and the average prices of maize imports from Romania, the United States of America, can be reduced to a minimum of about 183 and 233 dollars / ton each, respectively, and from Bulgaria and Serbia to a minimum of about 201.6 dollars / ton. Whereas, the average prices of maize imports from Ukraine, Brazil and Paraguay could be increased to a maximum of about $ 168.8 / ton each without affecting the optimal orientation pattern suggested for Egyptian imports of maize.

Table 8 - The Optimal orientationfor Egyptian imports of maize as an average for the period (2015-2019)

Country	quantity of the imports		value of the imports	
	Thousand tons	%	Million dollars	%
Ukraine	3643	40.0	567.57	39.43
Brazil	3643	40.0	606.92	42.16
Argentina	877	9.6	147.97	10.28
Romania	0	0	0	0
United States of America	0	0	0	0
Bulgaria	0	0	0	0
Serbia	0	0	0	0
Paraguay	945	10.4	116.98	8.13
Total	**9107**	**100**	**1439.44**	**100**

Source: *- collected and calculated from http://comtrade.un.org database*
- Computer analysis results using the LINDO Software.

Table 9 - Sensitivity analysis of the change in the prices of Egyptian imports of maize during the period (2015-2019)

Country	Change in import prices Dollars / ton		
	Current	Lower limit	Upper limit
Ukraine	155.8	-	168.8
Brazil	166.6	-	168.8
Argentina	168.8	166.8	175.8
Romania	176	183	-
United States of America	201	233	-
Bulgaria	185.4	201.6	-
Serbia	185.4	201.6	-
Paraguay	123.8	-	168.8

Source: *Computer analysis results using LINDO software.*

Conclusions

The results indicated thatThe average amount of Egyptian imports of maize during the study period, amounting to about 9.1 million tons, can be achieved at a cost estimated at about $ 1.44 billion, which achieves savings of about $ 61.5 million, representing about 4.1% of the average value of Egyptian imports of maize during the study period, which is about $ 1.5 billion.

The saving in the value of imports was achieved by stopping imports of maize from Romania, the United States of America, Bulgaria and Serbia, which are the highest-priced countries, and relying on meeting the quota of imports of maize on four countries: Ukraine, Brazil, Argentina and Paraguay, with an amount of imports amounting to about 3643 thousand tons maize from Ukraine and Brazil, and 877,945 thousand tons of maize from Argentina and Paraguay, respectively .The study recommends the necessity of periodic review of the maize import process in light of price changes and stimulating the trend towards lower-priced markets, as one of the possible solutions to reduce its import bill.

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