An Econometric Study of Egyptian Maize Imports

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ABSTRACT

The maize crop is one of the most important strategic grain crops in Egypt due to its economic and nutritional significance, with multiple uses in the country for both non-human and human consumption. Despite the increased area cultivated with maize in Egypt and the rising local production, domestic output does not meet consumption needs. According to statistics from the average period of 2017-2021, local production is approximately 7.32 million tons, while domestic consumption is estimated at around 17.079 million tons, distributed among several uses, including 11.888 million tons for non-human consumption and 2.329 million tons for human consumption. This research aims to measure the extent to which Egyptian demand for maize imports and local consumption are influenced by positively impactful variables, which will assist agricultural policymakers in making decisions that contribute to meeting the required import quantities.

During the period from 2017 to 2021, the quantity of maize consumed in Egypt reached its lowest in 2007 at approximately 11.392 million tons and its highest in 2019 at around 18.322 million tons, with an average of about 14.393 million tons during this period. The quantity of Egyptian maize imports reached its lowest in 2008 at approximately 3.022 million tons, while it peaked in 2013 at about 13.034 million tons, with an average of around 7.396 million tons. The value of Egyptian maize imports was at its lowest in 2009 at approximately 836.599 million dollars and peaked in 2022 at around 2500.913 million dollars, with an average of about 1758.948 million dollars during the period. From 2018 to 2022, maize imports were primarily concentrated from Brazil, Argentina, and Ukraine, with the average quantity of Egyptian maize imports from these countries during the study period being approximately 7.397 million tons, accounting for 86.22% of the average quantity of Egyptian maize imports during this period.

To identify the factors influencing the quantity of Egyptian maize imports, it was found that the most impactful variables include the Egyptian import price of maize in dollars per ton, the import price of maize from Brazil in dollars per ton, and the average per capita share of gross domestic product at current U.S. dollar prices. Additionally, the gap in maize supply and the quantity of maize for animal feed were significant factors. Meanwhile, the variables affecting Egyptian consumption of maize included the gap in maize supply in million tons, the quantity of maize consumed in the previous year in million tons, and the average per capita share of gross domestic product at current U.S. dollar prices. The economic and statistical significance of these variables was confirmed, as was the statistical significance of the mathematical model used.

Keywords: Maize crop, Demand, Imports, Egypt.

INTRODUCTION

The maize crop, both white and yellow varieties, is one of the most important strategic grain crops in Egypt (Field Crops Research Institute, 2006), due to its economic and nutritional significance, with multiple uses for both non-human and human consumption. It accounts for up to 70% of the production of dry feed, serves as a main ingredient in poultry feed, and is used in bread production as flour, comprising 20%. Additionally, it yields various food products due to its high starch and protein content, such as glucose and fructose syrup, and corn oil. Maize is also utilized in the manufacturing of numerous industrial products, including pharmaceuticals, dyes, paints, fibers, plastics, paper, and consumer goods. Furthermore, maize is converted into ethyl alcohol for biofuel production, which has impacted the global trade of maize.

Given the importance of both white and yellow maize, the area cultivated with these varieties in Egypt increased from approximately 1.78 million acres in 2007 to about 2.25 million acres by 2021 (Ministry of Agriculture and Land Reclamation, Agricultural Economics Bulletins, Annual Publications), with an annual increase of around 30,000 acres during this period. Production estimates for these years were approximately 6.14 million tons and 7.45 million tons, respectively, reflecting an annual increase of about 90,000 tons. There has also been growing interest in supporting scientific research to enhance the yield per acre of maize, aiming to achieve maximum food security from this crop, especially with the shift towards mixing maize flour with wheat for bread production to reduce wheat imports and mitigate the agricultural and national trade deficit.

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Research Problem:

Despite the increase in the cultivated area of both white and yellow maize in Egypt and the growth in local production, domestic output does not meet consumption needs (Rashad, 2015). According to statistics for the average period from 2017 to 2021, local production is approximately 7.3 million tons, while local consumption is estimated at around 17.1 million tons, distributed among several uses, including 11.9 million tons for non-human consumption and 2.3 million tons for human consumption (Ministry of Agriculture and Land Reclamation, Agricultural Economics Bulletins, Annual Publications). This situation results in a reliance on imports to cover the maize supply gap, which amounts to approximately 9.7 million tons. The average quantity of maize imports during this period is estimated at 8.8 million tons, valued at 1,98 Billion dollars. This creates a burden on the agricultural trade balance and the Egyptian balance of payments. Additionally, recent years have seen local changes due to the liberalization of the exchange rate in 2016 and 2024, as well as external factors such as the COVID-19 pandemic and the Russian-Ukrainian war, which have affected the availability of maize supplies from the countries from which maize is imported.

Research Objectives:

This research aims to measure the extent to which Egyptian demand for maize imports and local consumption are influenced by positively impactful variables. This will assist agricultural policymakers in making decisions that contribute to providing the necessary import quantities, as delays in supply can negatively affect the various uses of maize, both for non-human and human consumption. To achieve the study's objectives, the following points will be examined:

1. The development of production and consumption indicators for both non-human and human consumption of maize.
2. The evolution of Egyptian maize imports.
3. The geographical distribution and relative importance of the main countries supplying maize to the Egyptian market.
4. Identifying the variables that positively influence the quantity of Egyptian maize imports and local consumption (2007-2021).

Methods and Data Sources:

This research relies on the use of descriptive and analytical statistical methods to achieve its objectives, including averages, growth rates, percentages, and time series trends. It employs both cross-sectional time series data and panel data, utilizing multiple regression analysis to quantitatively assess the relationship between the quantity of Egyptian maize imports and the influencing variables, whether internal or external (Hammam and Al Damrawi, 2021).

The research is based on secondary data published by the Economic Affairs Sector of the Ministry of Agriculture, the Central Agency for Public Mobilization and Statistics, and some data available on the internet (www.trademap.org; www.faostat@fao.org), in addition to relevant references and scientific studies related to the research topic.

Productive and Consumption Indicators of Maize in Egypt

A. Productive Indicators of Maize in Egypt

Maize is a summer crop, planted in the second half of April after harvesting early winter crops, and in May when planted after clover, wheat, and barley. Early planting is preferred as it allows for better growth of maize plants, while planting after May can lead to reduced yields. In southern regions such as Toshka, East Oweinat, New Valley, and Wadi El-Said in Edfu, planting occurs in the first half of March (Ministry of Agriculture and Land Reclamation, Agricultural Economics Bulletins, Annual Publications). Analyzing productive and consumption indicators helps determine the size of the supply gap and formulate policies to either reduce the gap or take measures to cover it through foreign trade.

Development of Cultivated Area of Maize in Egypt: Table (1), shows the development of the area planted with white and yellow maize in Egypt from 2007 to 2021. The area reached its lowest in 2011 at approximately 1.76 million acres and its highest in 2018 at around 3.42 million acres, with an average of about 2.10 million acres (Ministry of Agriculture and Land Reclamation, Agricultural Economics Bulletins, Annual Publications). during this period. The trend analysis of the cultivated area of white and yellow maize shows an annual increase of approximately 0.03 million acres during the study period, with statistical significance confirmed. The coefficient of determination (R^2) is about 0.62, indicating that time accounts for 62% of the changes in summer maize planted, and the statistical significance of the mathematical model used has been established.

Development of yield per Acre of maize in Egypt: Table (1), illustrates the development of yield per acre for summer maize (both white and yellow) in Egypt from 2007 to 2021. It is noted that maize yield was at its lowest in 2015 at approximately 3.12 tons per acre, and at its highest in 2007 at around 3.45 tons per acre, with an average yield of about 3.29 tons per acre during this period (Ministry of Agriculture and Land

Reclamation, Agricultural Economics Bulletins, Annual Publications).

The trend analysis indicates that the yield per acre of maize in Egypt is decreasing by approximately 0.01 tons per acre annually during the study period, with no statistical significance established for this decrease. This suggests that there has been no change in yield per acre during the study period, and the statistical significance of any mathematical models used has not been confirmed.

Development of total production of maize in Egypt: Table (1), shows the development of total production of summer maize (both white and yellow) in million tons from 2007 to 2021. The total production was at its lowest in 2011 at approximately 5.89 million tons and reached its highest in 2017 at about 7.66 million tons, with an average of around 6.91 million tons during this period (Ministry of Agriculture and Land Reclamation, Agricultural Economics Bulletins, Annual Publications). Trend analysis indicates that the total production of summer maize in Egypt is increasing by approximately 0.09 million tons annually during the study period, with statistical significance confirmed. The coefficient of determination (R^2) is 0.57, indicating that time accounts for 57% of the changes in total production of summer maize, and the statistical significance of the mathematical model used has been established (Table 2). From the above, it can be concluded that the increase in total maize production is due to the expansion of cultivated area rather than an increase in yield.

Table 1. Development of Some Productive and Consumption Indicators for Maize in Egypt during the Period 2007-2021

Year	Area	Yield	Local Production	Available for consumption *	Gap **	Animal Feed	Remaining for Human Consumption	Net Food
	Million Feddan	Ton / Feddan	Million ton	Million ton	Million ton	Million ton	Million ton	Million ton
2007	1.78	3.45	6.14	11.392	5.252	4.890	5.516	5.284
2008	1.86	3.39	6.31	12.000	5.69	5.455	5.298	5.075
2009	1.98	3.36	6.64	11.967	5.327	5.371	5.320	5.097
2010	2.00	3.14	6.28	12.663	6.383	5.490	5.892	5.645
2011	1.76	3.35	5.89	14.074	8.184	6.989	5.648	5.411
Average	1.88	3.34	6.25	12.419	6.167	5.639	5.535	5.302
2012	2.16	3.34	7.21	13.381	6.171	6.845	5.251	5.030
2013	2.14	3.32	7.10	13.925	6.825	6.788	5.781	5.538
2014	2.19	3.32	7.25	12.313	5.063	5.776	5.268	5.047
2015	2.26	3.12	7.06	14.877	7.817	8.287	4.504	4.315
2016	2.21	3.24	7.18	13.909	6.729	8.413	3.795	3.636
Average	2.19	3.27	7.16	13.681	6.521	7.222	4.920	4.713
2017	2.30	3.33	7.66	16.627	8.967	11.014	3.691	3.536
2018	2.34	3.18	7.43	16.988	9.558	11.375	3.639	3.486
2019	2.15	3.24	6.96	18.322	11.36	12.737	3.620	3.468
2020	2.15	3.30	7.10	16.952	9.852	12.280	2.715	2.601
2021	2.25	3.32	7.45	16.504	9.054	12.036	2.528	2.422
Average	2.24	3.27	7.32	17.079	9.759	11.888	3.239	3.103
General Average	2.10	3.29	6.91	14.393	7.482	8.250	4.564	4.373
Minimum	1.76	3.12	5.89	11.392	5.063	4.890	2.528	2.422
Maximum	2.34	3.45	7.66	18.322	11.36	12.737	5.892	5.645

*Available for consumption = Local production + Imports - Exports

**Gap = Available for consumption - Local production

Source :

1- Collected and calculated from data published in Agricultural Economic Bulletins - Economic Affairs Sector, Ministry of Agriculture and Land Reclamation.

2- Collected and calculated from data by the Ministry of Agriculture and Land Reclamation, Food Balance Sheet, Annual Reports.

Table 2. General Time Trend of Some Production and Consumption Indicators for Maize in Egypt during the Period 2007-2021

y	Dependent Variable	Estimated Equation	R^2	F	Percentage *Change
1	Area of Maize (Million Feddans)	$\hat{Y}$ 1 = 1.84 + 0.03 X (28.840) ** (4. 611) **	0.62	(21.26) **	1.395
2	Maize Yield (Ton/Feddan)	$\hat{Y}$ 2 = 3.35 – 0.008 X (71.875) ** (-1.627)^{ins}	0.16	(2.64)^{ins}	-0.244
3	Total Maize Production (Million Tons)	$\hat{Y}$ = 6.18 + 0.09 X (31.693) ** (4.217) **	0.57	(17.79) **	1.282
4	Available for Use (Million Tons)	$\hat{Y}$ = 10.843 + 0.444 X (20.117) ** (7.484) **	0.81	(56.02) **	3.082
5	Gap (Million Tons)	$\hat{Y}$ = 4.656 + 0.353X (7.298) ** (25.349) **	0.66	(25.35) **	4.718
6	Animal Feed (Million Tons)	$\hat{Y}$ = 3.448 + 0.600X (6.091) ** (9.6403) **	0.87	(92.93) **	7.273
7	Remaining for Human Consumption (Million Tons)	$\hat{Y}$ = 6.393 – 0.289 X (22.839) ** (-30.785)**	0.81	(55.10) **	-6.332
8	Net Food (Million Tons)	$\hat{Y}$ = 6.124 – 0.219 X (22.836) ** (-7.421) **	0.81	(55.08) **	-5.008

where: $\hat{Y}$ = Estimated Value of Dependent Variable

Xi = Time Variable where i (1, 2, 3, ..., 15)

The value in parentheses indicates the calculated T value.

(R^2) Coefficient of Determination (F) Significance of Regression Model

(**) Indicates Significance of Regression Coefficient or Overall Model at Level 0.01.

(ins) Indicates insignificance of Regression Coefficient or Overall Model at Level 0.01.

* Percentage Change = B/X * 100

Source: Collected and calculated from the data in Table (1).

B. Consumer indicators for maize crop in Egypt

1. Development of available maize for use in Egypt

Table (1), presents the development of available maize for use in Egypt (in million tons) during the period from 2007 to 2021. It shows that the available maize in Egypt reached its lowest point in 2007 at approximately 11.4 million tons, while it peaked in 2019 at about 18.3 million tons, with an average of around 14.4 million tons over the period (Ministry of Agriculture and Land Reclamation, Food Balance Bulletin, Annual Publications). The trend analysis of available maize for use (in million tons) during the period 2007-2021, as shown in Table (2), indicates that it has been increasing by approximately 443.70 thousand tons annually. The statistical significance of this increase has been confirmed, with a coefficient of determination (R^2) of 0.81, meaning that time accounts for 81% of the variations in available maize for use. The statistical significance of the mathematical model used has also been verified.

2. Development of the Maize Gap in Egypt

Table (1), illustrates the development of the maize gap (in million tons) during the period from 2007 to 2021. It indicates that the maize gap in Egypt was at its lowest in 2014, at about 5.1 million tons, and reached its highest point in 2019 at approximately 11.4 million tons, with an average of around 7.5 million tons over the period (Ministry of Agriculture and Land Reclamation, Food Balance Bulletin, Annual Publications). The trend analysis of the maize gap (in million tons) during the period 2007-2021, as shown in Table (2), reveals an annual increase of about 350 thousand tons. The statistical significance of this increase has been confirmed, with an R^2 of 0.66, indicating that time accounts for 66% of the variations in the maize gap. The statistical significance of the mathematical model used has also been verified.

3. Development of animal feed from maize in Egypt

Table (1), shows the development of animal feed from maize (in million tons) during the period from 2007 to 2021. It indicates that animal feed from maize in Egypt reached its lowest point in 2007 at approximately 4.9 million tons, while it peaked in 2019 at about 12.7 million tons, with an average of around 8.2 million tons over the period (Ministry of Agriculture and Land Reclamation, Food Balance Bulletin, Annual Publications). The trend analysis of

animal feed from maize (in thousand tons) during the period 2007-2021, as shown in Table (2), demonstrates an increase of about 600 thousand tons annually. The statistical significance of this increase has been confirmed, with an R^2 of 0.87, meaning that time accounts for 87% of the variations in animal feed from maize. The statistical significance of the mathematical model used has also been verified.

4. Development of remaining maize for human consumption in Egypt

Table (1), presents the development of remaining maize for human consumption (in thousand tons) during the period from 2007 to 2021. It shows that the remaining maize for human consumption in Egypt reached its lowest point in 2021 at approximately 2.5 million tons, while it peaked in 2010 at about 5.9 million tons, with an average of around 4.6 million tons over the period (Ministry of Agriculture and Land Reclamation, Food Balance Bulletin, Annual Publications). The trend analysis of remaining maize for human consumption (in million tons) during the period 2007-2021, as shown in Table (2), indicates a decrease of about 229 thousand tons annually. The statistical significance of this decrease has been confirmed, with an R^2 of 0.80, indicating that time accounts for 80% of the variations in remaining maize for human consumption. The statistical significance of the mathematical model used has also been verified.

5. Development of net food from maize in Egypt

Table (1), illustrates the development of net food from maize (in million tons) during the period from 2007 to 2021. It shows that net food from maize in Egypt reached its lowest point in 2021 at approximately 2.4 million tons, while it peaked in 2010 at about 5.6 million tons, with an average of around 4.4 million tons over the period (Ministry of Agriculture and Land Reclamation, Food Balance Bulletin, Annual Publications). The trend analysis of net food from maize (in million tons) during the period 2007-2021, as shown in Table (2), indicates a decrease of about 219 thousand tons annually. The statistical significance of this decrease has been confirmed, with an R^2 of 0.80, indicating that time accounts for 80% of the variations in net food from maize. The statistical significance of the mathematical model used has also been verified.

Egyptian Maize Imports

A. Development of Egyptian maize imports.

1. Development of import quantity of maize.

Table (3), shows the development of the quantity of Egyptian maize imports (in million tons) during the period from 2007 to 2022. It indicates that the quantity of maize imports in Egypt was at its lowest in 2008 at approximately 3 million tons, while it peaked in 2013 at about 13 million tons, with an average of around 7.4 million tons over the period (www.trademap.org). The trend analysis of the quantity of Egyptian maize imports (in million tons) during the period 2007-2022, as shown in Table (4), reveals an annual increase of about 321 thousand tons. The statistical significance of this increase has been confirmed, with an R^2 of 0.37, indicating that time accounts for 37% of the variations in the quantity of Egyptian maize imports. The statistical significance of the mathematical model used has also been verified.

2. Development of the value of Egyptian maize imports.

Table (3), illustrates the development of the value of Egyptian maize imports (in million dollars) during the period from 2010 to 2022. It shows that the value of maize imports in Egypt was at its lowest in 2009, at approximately 836.6 million dollars, while it peaked in 2022 at about 2.5 Billion dollars, with an average of around 1.8 Billion dollars over the period (www.trademap.org). The trend analysis of the value of Egyptian maize imports during the period 2007-2022, as shown in Table (4), indicates an annual increase of about 83.2 million dollars.

The statistical significance of this increase has been confirmed, with an R^2 of 0.62, indicating that time accounts for 63% of the variations in the value of Egyptian maize imports. The statistical significance of the mathematical model used has also been verified.

3. Development of the price of Egyptian maize imports.

Table (3), shows the development of the price of Egyptian maize imports (in dollars per ton) during the period from 2007 to 2022. It indicates that the price of maize imports in Egypt reached its lowest point in 2013 at approximately 152.3 dollars per ton, while it peaked in 2022 at about 345.5 dollars per ton, with an average of around 245.7 dollars per ton over the period (www.trademap.org). The trend analysis of the price of Egyptian maize imports during the period 2007-2022, as shown in Table (4), indicates a decrease of about 0.02 dollars per ton annually. The statistical significance of this decrease has not been confirmed, suggesting that there has been no significant change in the price of maize imports during the study period and that prices fluctuate around their mean. The statistical significance of any of the mathematical models used has not been confirmed.

B. Geographic distribution and relative importance of Egyptian maize imports

1. Geographic distribution and relative importance of Egyptian maize import quantities

Table (5), presents the geographic distribution and relative importance of Egyptian maize imports during the period from 2018 to 2022. It is evident that most maize imports are primarily concentrated in Brazil, Argentina, and Ukraine (www.trademap.org). The average quantity of Egyptian maize imports from these countries during the study period was approximately 7.397 million tons, accounting for 86.22% of the average quantity of Egyptian maize imports during this period.

The average quantities imported from these countries, in that order, were 2.7 million tons, 2.7 million tons, and 2.037 million tons, which correspond to approximately 31.30%, 31.18%, and 23.74% of the average quantity of Egyptian maize imports, respectively.

Table 3. Development of Quantity, Value, and Price of Egyptian Maize Imports during the Period 2007-2022

Years	Quantity (Million Tons)	Value (Million Dollars)	Price (Dollar/Ton)
2007	4.47	938.5	210
2008	3.02	979.1	324
2009	3.52	836.6	238
2010	5.19	1270.7	244
2011	7.05	2179.9	309
Average	4.65	1240.9	267
2012	6.27	1958.5	312
2013	13.03	1985.0	152
2014	7.56	1951.6	258
2015	8.17	1780.9	218
2016	8.74	1852.7	212
Average	8.76	1905.7	218
2017	8.41	1735.6	206
2018	9.29	1917.2	206
2019	9.56	1998.7	209
2020	8.51	1880.9	221
2021	8.29	2411.1	291
2022	7.24	2500.9	346
Average	8.55	2074.1	243
General Average	7.39	1761.1	238
Minimum	3.02	836.6	152
Maximum	13.03	2500.9	346

Source: www.trademap.org
Ministry of Agriculture and Land Reclamation, Foreign Trade Bulletin, Various Editions.

Table 4. General Time Trend Equations for the Development of Total Quantity, Value, and Price of Egyptian Maize Imports from 2007 to 2022

y	Variable	Estimated Model	R^2	F
1	Quantity of Imports (Million Tons)	Y = 4.667 + 0.321 Xi (4.317)** (2.872)**	0.37	$(8.25)^{**}$
2	Value of Imports (Million Dollars)	Y = 1053.956 +83.194 Xi (6.343)** (4.842)**	0.63	(23.44)**
3	Average Import Price (Dollar/Ton)	Y = 247.49 Xi 0.021- (8.446)** (- 0.007)^{ins}	0.00	$(0.000)^{ins}$

Y = Estimated Value of the Dependent Variable for Egyptian Maize Imports

Xi = Time Variable where (3, 2, 1, ..., 16)

The value in parentheses indicates the calculated T value.

(R^2): Coefficient of Determination (F) Significance of Regression Model

(**)Indicates Significance of Regression Coefficient or Overall Model at Level 0.01.

(*) Indicates Significance of Regression Coefficient at Level 0.05

(ins) Indicates insignificance of Regression Coefficient or Overall Model at Level 0.01.
Source: Collected and calculated from the data in Table .(4-2)

Table 5. Geographical Distribution and Relative Importance of the Quantity of Egyptian Maize Imports (Tons)

Countries	2018	2019	2020	2021	2022	Average	%
Brazil	2227388	2991070	2160855	2075728	3970332	2685074.6	31.30
Argentina	2489176	2715515	3312130	3055051	1802954	2674965.2	31.18
Ukraine	2469195	2984044	2225956	1519436	985372	2036800.6	23.74
USA	1765004	246116	61588	342528	29873	489021.8	5.70
Romania	275502	405495	513646	380528	317379	378510	4.41
Other Countries	61969	218015	233800	925294	132094	314234.4	3.66
World	9288234	9560255	8507975	8298565	7238004	8578606.6	100.00

Source: www.trademap.org

In contrast, the average imports from other countries were 1.2 million tons, accounting for about 13.78% of the average quantity of maize imports during the study period. The table also shows minimal imports from the United States and Romania, averaging 489 thousand tons and 378.5 thousand tons respectively, with relative importance of 5.70% and 4.41% of the average quantity of Egyptian maize imports during the study period.

2. Geographic distribution and relative importance of the value of Egyptian maize imports

Table (6), illustrates the geographic distribution and relative importance of the value of Egyptian maize imports during the period from 2018 to 2022. Most maize imports are primarily concentrated in Brazil, Argentina, and Ukraine (www.trademap.org). The average value of Egyptian maize imports from these countries during the study period was approximately 1.85 Billion dollars, accounting for 86.04% of the average value of Egyptian maize imports during this period. The average values of imports from these countries, in that order, were 707.5 million dollars, 664.9 million dollars, and 481.7 million dollars, which correspond to approximately 32.83%, 30.86%, and 22.35% of the average value of Egyptian maize imports, respectively. The average value from other countries was 300.7 million dollars, accounting for about 13.96% of the average value of Egyptian maize imports during the study period. Additionally, the table indicates low import values from the United States and Romania, averaging 111.5 million dollars and 91.3 million dollars respectively, with relative importance of 5.17% and 4.55% of the average value of Egyptian maize imports during the study period.

3. Average price of Egyptian maize imports

Table (7), shows the average price of maize imports (in dollars per ton) from the main exporting countries to Egypt during the period from 2018 to 2022. The average price of maize imports during the study period was approximately 251.2 dollars per ton(www.trademap.org). The average prices from the main exporting countries Brazil, Argentina, and Ukraine were about 263.5 dollars per ton, 248.6 dollars per ton, and 236.5 dollars per ton, respectively. For the United States, the average import price was 228 dollars per ton, the lowest price during the study period, while the average import price from Romania was approximately 241.1 dollars per ton during the same period.

Standard estimation of key factors affecting Egyptian maize import quantities and consumption

Food security is a fundamental component of national security due to its political, economic, and social dimensions. Thus, ensuring food availability is among the primary strategic issues that agricultural and economic policymakers prioritize (M.K.R, 2021).

Table 6. Relative Importance of the Value of Egyptian Maize Imports (in Thousand Dollars)

Countries	2018	2019	2020	2021	2022	Average	%
Brazil	462183	624132	477249	602994	1370974	707506	32.83
Argentina	516504	566633	731521	887486	622568	664942	30.86
Ukraine	512358	622665	491628	441393	340254	481660	22.35
USA	380714	52536	14046	99659	10430	111477	5.17
Romania	38177	84613	113445	110542	109592	91273.8	4.24
Other Countries	7276	48099	52973	269056	47095	97996.6	4.55
World	1917212	1998678	1880862	2411130	2500913	2154856	100.00

Source: www.trademap.org

Table 7. Average Price of Egyptian Maize Imports (Dollar/Ton) During the Period 2007-2022

Countries	2018	2019	2020	2021	2022	Average
Brazil	207.5	208.7	220.9	290.5	345.3	263.5
Argentina	207.5	208.7	220.9	290.5	345.3	248.6
Ukraine	207.5	208.7	220.9	290.5	345.3	236.5
USA	215.7	213.5	228.1	291.0	349.1	228.0
Romania	138.6	208.7	220.9	290.5	345.3	241.1
Other Countries	117.4	220.6	226.6	290.8	356.5	311.9
World	206.4	209.1	221.1	290.5	345.5	251.2

Source: www.trademap.org;
Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Price Bulletins, Annual Publications.

Given that Egypt is a net importer of agricultural products, including maize, effective planning for maize imports is essential to meet required needs timely and at minimum cost, while minimizing the negative impacts of imports on the agricultural trade balance and the balance of payments.

Future planning for Egyptian maize imports, aimed at improving food security, necessitates identifying the key factors influencing maize imports (M.K.R, 2021). This will facilitate the formulation of policies and programs aligned with the desired objectives and the availability of agricultural resources in the country, ensuring optimal utilization of these resources in an economically efficient manner. It is also critical to evaluate previous policies to determine their effectiveness in improving the country's food situation, as maize is a vital component in human and animal nutrition. Available statistics indicate a significant increase in the value of maize imports, rising from approximately 938.49 million dollars in 2007 to about 2,411.13 million dollars in 2021, representing an annual increase of about 79.4 million dollars, which places a burden on the country's agricultural and food trade balance.

The quantity of Egyptian maize imports and consumption (in million tons) is generally influenced by various factors (M.K.R, 2021), primarily domestic maize production (in million tons), available maize for consumption (in million tons), area planted with maize, average import price of maize (dollars per ton), average import price from major maize-exporting countries to the Egyptian market (including Brazil, Argentina, and Ukraine), per capita GDP, exchange rate of the dollar, population size, actual capacity of poultry farms for broilers and table eggs (in thousands of birds), and the previous year's consumption quantity (in million tons). Thus, the mathematical model for the factors affecting the quantity of Egyptian maize imports can be expressed as follows:

$$Y = F(X1, X2, X9, X10, X12, X13)$$

Where:

Y (dependent variable): Estimated value of the quantity of Egyptian maize imports and consumption.

X1, X2, X9, X10, X12, X13 (independent variables): Various factors influencing the dependent variable as previously discussed.

The multiple linear and double logarithmic mathematical models are employed for the analysis. To avoid potential statistical issues during the estimation of this relationship, a correlation matrix is first constructed among the independent variables. This allows for the exclusion of one variable in cases where there is a strong correlation between two independent variables, thus avoiding the problem of multicollinearity. The Durbin-Watson test is also utilized to identify any issues of autocorrelation. The analysis is conducted using a stepwise regression method, which ensures the independent variables are entered into the model according to their significance.

A. Standard estimation of key factors influencing Egyptian maize import quantities

To identify the factors affecting Egyptian maize import quantities, the results of the statistical analysis in Table (8), demonstrate the superiority of the linear model based on the calculated F-value, the adjusted R-squared value (R^2), the significance of the regression coefficients ($T(\beta)$), and the absence of autocorrelation issues. It is evident that the most influential variables on Egyptian maize imports are the Egyptian import (M.K.R, 2021), price of maize (dollars per ton), the import price of maize from Brazil (dollars per ton), the average per capita GDP at current U.S. dollar prices, along with the size of the maize gap and the quantity of maize for animal feed.

The first equation in Table (8), indicates that a decrease in the Egyptian import price and the import price from Brazil (in dollars per ton) results in an increase in maize imports by approximately 47,000 tons and 19,000 tons, respectively. Additionally, an

increase in the average per capita GDP at current U.S. dollar prices leads to an increase in maize imports by about 1,000 tons. Moreover, an increase in the maize gap (in million tons) results in an increase in maize imports by approximately 435,000 tons. These results align with economic logic, as the calculated F-value indicates the significance of the overall model at the 0.01 level. The adjusted R^2 value of around 0.80 suggests that approximately 80% of the variations in maize import quantities can be attributed to the aforementioned factors. The second equation illustrates the logical and significant impact of the variables, including the Egyptian import price of maize (dollars per ton), the import price of maize from Brazil (dollars per ton), the average per capita GDP at current U.S. dollar prices, and the quantity of maize for animal feed. An increase in the quantity of maize for animal feed (in million tons) leads to an increase in maize imports by approximately 341,000 tons.

B. Econometric estimation of factors influencing Egyptian maize consumption quantities

To determine the factors influencing Egyptian maize consumption quantities, the results of the statistical analysis in Table (9), indicate the superiority of the linear model based on the calculated F-value, the adjusted R-squared value (R^2), the significance of the regression coefficients (T(β)), and the absence of autocorrelation issues. The most influential variables on Egyptian maize consumption are the maize gap (in million tons) (M.K.R, 2021) and the quantity of Egyptian maize consumption in the previous year (in million tons), along with the average per capita GDP at current U.S. dollar prices.

The first equation in Table(9), shows that an increase in the maize gap (in million tons) results in an increase in maize consumption by approximately 927,000 tons. Similarly, an increase in the quantity of Egyptian maize consumption in the previous year (in million tons) leads to an increase in maize consumption by about 226,000 tons. The calculated F-value indicates the significance of the overall model at the 0.01 level. The adjusted R^2 value of around 0.80 suggests that approximately 97% of the variations in maize consumption quantities can be attributed to the aforementioned factors.

Table 8. Statistical Estimation Results of the Factors Affecting the Quantity of Egyptian Maize Imports During the Period 2008-2022

Model	Estimated Model	R-2	F
Linear (1)	$Y= 18.572 + 0.435\ X_9 -0.047X_1 -0.019X_2+0.001X_{12}$ $(3.486)^{**}\ (2.280)^{*}\ (-4.817)^{**}\ (-2.614)^{**}\ (3.100)^{**}$	0.80	14.73**
Linear	$Y= 21.976+ 0.341X_{10} -0.05X_1 -0.023X_2+0.001X_{12}$ $(3.880)^{**}\ (2.229)^{*}\ (-4.994)^{**}\ (-2.832)^{*}\ (2.244)^{**}$	0.79	14.47**

Y: Quantity of Egyptian Maize Imports (Thousand/Ton)

X_1 :Average Import Price in Egypt (Dollar/Ton)

X_2 :Import Price from Brazil (Dollar/Ton)

X_9 :Gap (Million Tons)

X_{10} :Animal Feed (Million Tons)

X_{12} :Average Per Capita GDP (at Current USD Prices)

(**)Indicates Significance of Regression Coefficient or Overall Model at Level 0.01.
Source: Collected and calculated from the data in Tables (1, 3) using www.trademap.org and Excel.

Table 9. Statistical Estimation Results of the Factors Affecting the Quantity of Egyptian Maize Consumption during the Period 2008-2022

Model	Estimated Model	R-2	F
Linear (1)	$Y= 4.133+ 0.927\ X_{10} + 0.226\ X_1$ $(5.133)^{**}\ (11.228)^{**}\ (2.927)^{**}$	0.97	(200.6)**
Linear (2)	$Y= 5.339 + 0.0004X_{13} +1.044X_{10}$ $(8.660)\ \ (2.060)^{*}\ \ (15.064)^{**}$	0.96	(157.2)**

Y =Quantity of Egyptian Maize Consumption (Million/Ton)

X_1 :Quantity of Egyptian Maize Consumption in the Previous Year (Million/Ton)

X_{10} :Gap (Million Tons)

X_{13} :Average Per Capita GDP (at Current USD Prices)

(**)ndicates Significance of Regression Coefficient or Overall Model at Level 0.01.
Source: Collected and calculated from the data in Tables (1, 3) using www.trademap.org and Excel.

The second equation illustrates the logical and significant impact of the maize gap (in million tons) and the average per capita GDP at current U.S. dollar prices. An increase in the average per capita GDP results in an increase in maize consumption by approximately 0.4 thousand tons.

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الملخص العربي

دراسة اقتصادية قياسية للواردات المصرية من الذرة الشامية

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يعد محصول الذرة الشامية من أهم محاصيل الحبوب الاستراتيجية في مصر نظرا لأهميتها الاقتصادية والغذائية، وتعدد استخدامها في مصر سواء في تغذية الحيوان، أو الاستهلاك الآدمي. وعلى الرغم من تزايد المساحة المزروعة من الذرة الشامية في مصر، وتزايد الانتاج المحلى، الا ان الانتاج المحلى لا يكفي الاحتياجات الاستهلاكية منه، ووفقاً لإحصاءات خلال متوسط الفترة ٢٠١٧-٢٠٢١ فقد بلغ الانتاج المحلى نحو ٧,٣٢ مليون طن، بينما يقدر الاستهلاك المحلى نحو ١٧,٠٧٩ مليون طن، تتوزع على عدة استخدامات منها ١١,٨٨٨ مليون طن في تغذية الحيوان، ٢,٣٢٩ مليون طن للاستهلاك الآدمي. واستهدف البحث قياس مدى تأثر الطلب المصري بالواردات من الذرة الشامية وكذلك الاستهلاك المحلى وكذلك بالمتغيرات ذات التأثير الإيجابي، وهو الأمر الذي يساعد واضعي السياسات الزراعية في اتخاذ قرارات تسهم في توفير كمية الواردات المطلوبة.

خلال الفترة ٢٠١٧-٢٠٢١، بلغت الكمية المستهلكة من الذرة الشامية في مصر أدناها عام ٢٠٠٧ بحوالي ١١,٣٩٢ مليون طن، أقصاها عام ٢٠١٩ بحوالي ١٨,٣٢٢ مليون طن وبلغ متوسط الفترة حوالي ١٤,٣٩٣ مليون طن. وبلغت كمية الواردات المصرية من محصول الذرة الشامية أدناها عام ٢٠٠٨ بحوالي ٣,٠٢٢ مليون طن، بينما بلغت أقصاها عام ٢٠١٣ حيث قدرت بحوالي ١٣,٠٣٤ مليون طن، وبلغ متوسط الفترة حوالي ٧,٣٩٦ مليون طن. بلغت قيمة الواردات المصرية من محصول الذرة الشامية أدناها عام ٢٠٠٩ بحوالي ٨٣٦,٥٩٩ مليون دولار، بينما بلغت أقصاها عام ٢٠٢٢ بنحو ٢٥٠٠,٩١٣ مليون دولار، وبلغ متوسط الفترة حوالي ١٧٥٨,٩٤٨ مليون دولار. خلال الفترة ٢٠١٨-٢٠٢٢، تركزت واردات الذرة الشامية بصفة أساسية بدول كل من البرازيل والأرجنتين وأوكرانيا وقد بلغ متوسط كمية الواردات المصرية من الذرة بتلك الدول خلال فترة الدراسة حوالي ٧,٣٩٧ مليون طن، بنسبة ٨٦,٢٢% من متوسط كمية الواردات المصرية من الذرة الشامية خلال فترة الدراسة.

وبدراسة العوامل المؤثرة على كمية الواردات المصرية من الذرة الشامية، تبين أن أكثر المتغيرات تأثيراً تتمثل في سعر الاستيراد المصري للذرة الشامية دولار طن، وسعر استيراد الذرة الشامية من البرازيل دولار طن، ومتوسط نصيب الفرد من أجمالي الناتج المحلى بالأسعار الجارية للدولار الأمريكي، هذا بالإضافة الى حجم الفجوة من الذرة الشامية، وكمية الذرة الشامية لغذاء الحيوان. بينما تمثلت المتغيرات المؤثرة على الاستهلاك المصري من الذرة الشامية في الفجوة من الذرة الشامية مليون طن، كمية الاستهلاك المصري من الذرة الشامية العام السابق مليون طن، هذا بالإضافة الى متوسط نصيب الفرد من أجمالي الناتج المحلى بالأسعار الجارية للدولار الأمريكي. وقد ثبتت المعنوية الاقتصادية والاحصائية للمتغيرات، كما ثبتت المعنوية الإحصائية للنموذج الرياضي المستخدم.

الكلمات المفتاحية: محصول الذرة الشامية، الطلب، الواردات، مصر.