



Forecasting Egyptian Onion Exports to International Markets

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Abstract: The study aimed to predict the future of the export of Egyptian onions to the most important international markets during the period (2021-2025). It relied on data from data published in government agencies as well as the World Trade Map website, and used to predict ARIMA models estimated using the statistical analysis program Minitab. It is a study showing that the most important countries importing Egyptian onions during 2020 are Saudi Arabia, the United Kingdom, the Russian Federation, the Netherlands, Germany, Kuwait, Syria, and the United Arab Emirates. Studying the development of Egyptian onion exports in the first three countries during the period (2001-2020), it was found that there was an annual decline in the amount of exports of onions exported to the Saudi market amounted to 2%, while it was found that there was an annual increase in that amount in the markets of the United Kingdom and the Russian Federation amounted to 19% and 7% each respectively. The annual increase in the value of Egyptian onion exports to the three markets was 8%, 24% and 15% respectively. One of the most important results of forecasting the amount of exports of Egyptian onions to the three markets during the period (2021-2025) reached the maximum amount of 188.81 thousand tons and the minimum amount in the Saudi market reached 125.81 thousand tons, and in the UK market reached the maximum amount of exported Egyptian onions to 76.093 thousand tons and the minimum amount reached 62.08 thousand tons, while in the Russian Federation the maximum amount exported to 75.44 thousand tons and the minimum amount reached 68.53 thousand tons. The study recommends the importance of increasing the local production of Egyptian onions because of its importance in the local market and its competitive advantage in international markets. It also recommends studying the international markets that import Egyptian onions to study the possibility of increasing the quantities exported to them, especially countries where the indicators of competitive efficiency of Egyptian onions have decreased. Interest in studying the demand for Egyptian onions in international markets and opening new markets for it during the coming years. The study recommends the importance of increasing the local production of Egyptian onions because of its importance in the local market and its competitive advantage in international markets. It also recommends studying the international markets that import Egyptian onions to study the possibility of increasing the quantities exported to them, especially countries where the indicators of competitive efficiency of Egyptian onions have decreased. Interest in studying the demand for Egyptian onions in international markets and opening new markets for it during the coming years.

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1. Introduction:

Onion is one of the most important strategic vegetable crops in Egypt. It is widely consumed locally. Also, it is an export product of high economic value. Egyptian onions have a high competitive advantage compared to similar products in other countries. Onion is grown in Egypt in several agricultural groves during the year. It is grown in Winter, Summer, and Nile groves, but the winter onions is the most important of them, It has the most cultivated area and the total production of it. In 2020, the cultivated area of winter onions reached 189.35 thousand Fadden, the total production of it reached 2092 million tons, representing 97.68% of the onions

produced in Egypt during this year, which amounted to 2.81 million tons. Onion in Egypt may be consumed in the stage of growth (green onions) or after full maturity (dry onions). This study is limited to dry onions only.

Onions has therapeutic importance, as it is an antiseptic that eliminates germs, purifies the blood, and regulates blood circulation. It is also useful for people with asthma and severe cough. In 2020, Onions are of great economic importance because their monetary value amounted to 6.57 billion LE, or 1.23% of the total value of plant production, which amounted to 534.24 billion LE. And the amount of

Egyptian onion exports amounted to 354.28 thousand tons. Its cash value is 175.1 million dollars.

2. Objective:

The research aimed of study the future of the export of Egyptian onions to the most important international markets. It studied the development of the production, export of Egyptian onions, and the competitive indicators of onion in Egypt. Also, It studied predicting of the amount of production and export of onions.

3. Methodology:

Data analysis in research relied on descriptive and quantities methods. It used arithmetic mean, percentile, and Indicators of competitive ability and efficiency. It also used method of ARIMA to calculate the amount of onion production and export.

The research relied on data published in some official bodies such as the Ministry of Agriculture and land reclamation. Data illuminated in some websites such as the International trade map, and others.

Indicators of competitiveness and efficiency of Egyptian onions in international markets:

1- Revealed Comparative Advantage (RCA):

The indicator the competitive advantage of goods and their potential opportunities in the future. When the value of this indicator is equal the correct one, it means that there is a comparative advantage of this commodity. There is an equation for calculation the index of Revealed Comparative Advantage:

$$RCA = [(Total\ value\ of\ Agricultural\ export\ of\ the\ country) / (Total\ value\ of\ Agricultural\ export\ of\ the\ World)] \div [(Value\ of\ the\ country's\ exports\ of\ the\ commodity) / (Value\ of\ World\ commodity\ exports)].$$

2- Relative Importance of the Egyptian Onion Market:

The choice of markets that import Egyptian onions is made according to the highest rate of this indicator.

3- Market Share (MS):

Estimating this indicator shows that extent to which export competitiveness can be improved. Increasing this indicator is one of the objectives to develop and increase the volume of exports of the studied commodity. This indicator is calculated according to the formula:

$$MS = (The\ amount\ of\ a\ country's\ export\ to\ a\ particular\ market\ of\ a\ particular\ commodity) \div (All\ imports\ of\ this\ market\ from\ the\ countries\ of\ the\ world\ of\ that\ commodity).$$

4- Price Competitiveness (PC):

Export price is one of the important indicators to attract new export markets for the commodity. Provided that the type and quality for the commodity. Provided that the type and quality of the commodity with the same in other countries. The lower the export price compared to that of other competing countries, it means there is a price advantage for the exported commodity and better competitiveness. This indicator is less than the correct exporting that commodity. This indicator is calculated according to the formula:

$$PC = (Export\ price\ of\ a\ certain\ commodity\ at\ a\ certain\ price) \div (Export\ price\ of\ the\ competing\ country\ for\ the\ same\ year).$$

5- Export Efficiency:

This indicator is used to compare the sale of a commodity in international markets with its sale in the domestic market. If the export price of a commodity is higher than the sale price in the local market, the export will be better than the sale in the local market. This indicator is calculated according to formula:

$$EE = (Commodity\ value\ at\ Export\ prices) \div (Item\ value\ at\ whole\ sale\ price).$$

Time series probabilistic models used to predict Egyptian onion exports in international markets:

Time series assumes that all of its notes are distributed randomly through the optimal distribution, that is, the notes of the time series are distribution through a set of variables linked together and distributed randomly. Therefore, probabilistic models of time series have certain probabilistic characteristics. These properties are assumed to be constant in relation to time. One of the most important methods that uses probabilistic models to predict future values is the Box-Jenkins method. The primary goal of using this method is to predict the future values of Egyptian onion exports in international markets using ARIMA models.

Integrative self-regression model and moving average ARIMA (p,d,q):

Time series means a set of observation arranged according to their occurrence in time. Time series analysis is one of the important methods in statistical skills used to predict the values of future phenomena, the Box-Jenkins methodology is one of the best methods used in time series analysis, which relies on the integration of models of self-ones and moving averages. ARIMA model (Autoregressive Integrated Moving Average) relies on the extraction of Mean-

sense variables as a model for future prediction, but after settling the data in terms of variance or directionality and then estimating the remainder (random error) using the method of self-Regression (AR) with the Moving Average (MA), this is explained by the following equation.

$$Y_t = a_0 + a_1 Y_{t-1} + a_2 Y_{t-2} + \dots + a_p Y_{t-p} + e_t - \beta_1 e_{t-1} - \beta_2 e_{t-2} - \dots - \beta_q e_{t-q}$$

Where that:

Y_t = values of the predicted variable (Y)

$Y_{t-1}, Y_{t-2}, Y_{t-p}$ = values of the variable (Y) that are late in time during the period

a, a_1, a_2, a_p = parameters of the self-Regression model

$e_t, e_{t-1}, e_{t-2}, e_{t-q}$ = random errors

$\beta_1, \beta_2, \beta_q$ = parameters of the Moving Average model

This model is referred to as ARIMA of rank (p,d,q):

p: self-Regression rank

d: degree of variances

q= the rank of the Moving Average random errors used in the model

Before applying this equation, it must be ensured that the time series is stable, i.e. the dependent variable must have a constant mean and variance over the research period. If it turns out to be unstable, i.e. its variation is not constant and its direction is increasing or decreasing, it must be converted into a stable series by finding the first difference (d) of this variable, as follows:

$$Y_t = \Delta Y - Y_{t-1}$$

If finding the first difference does not result in a stable series, then the first difference is taken for this difference. If a stable series is not obtained, the difference process is repeated several times until a stable series is obtained.

This method goes through the following four stages:

(1) Definition Stage:

It is stage of model recognition in the sense of recognizing the rank (p, q, d) to formulate a number of models that accurately describe the stable series, and this is done by the following steps:

- The original data is predicted in a graph in order to take an idea of the course of the time series and determine the data, and to know the stability of the data in terms of average and variance or not.
- Perform a graph to examine partial self-correlation coefficients and correlation coefficients for certain slow periods, and the graphic signature, the graphic signature of (PAC) and (AC) through the aggregate test of your statistics (Ljung-Box statistic) for all partial

self-correlation (for each individual self-correlation) which is the limits of acceptance of the nihilistic assumption of the insignificance of the squares of correlation coefficients.

- The unity Root Test is a test to indicate whether the moral self-correlation equivalent to unity or not, which is a test complementary to the previous test and on the basis of which the first difference of the data of the time series of change is taken, in the case of acceptance of the nihilistic assumption of the test.
- Examine the self-correlation correlation (AC) and through (PAC) the degree of self-regression can be determined, while through (AC) the degree of moving average can be determined.

(2) Appreciation phase:

After selecting the appropriate model to describe the time series, its parameters are estimated using statistical estimates of stability on a model from ARIMA (p, q, d) than can simulate the time path of actual data, and this model is taken as an adjustable prototype.

(3) Stage of diagnostic examination:

Tests are carried out to see how much the views match the calculated values from the selected model, and in case of passing these tests it is chosen as the final model of the prediction.

(4) Prediction phase:

The appropriate model is used to make a prediction for future years, where the model's ability to predict is measured by the average error boxes the best models, which has the lowest average error boxes.

4. Results:

(1) Onion production in Egypt:

Onions in Egypt are grown in the winter and summer onions, but the area of cultivation of winter onions is larger than in the summer onions, and therefore the production of winter onions is greater than that of the summer onions. From the table (1) it is clear that the total amount produced from winter and summer onions during (2001-2020) increased to reach the maximum in 2015 and reached 3.04 million tons, and decreased to reach the lowest in 2001 and reached 1.11 million tons, the average period was 2.08 million tons, the annual growth rate was 5%, the standard deviation was 619.5.

(2) Exported quantity of Egypt onions:

From the table (1) it is clear that the exported quantity of Egyptian onions increased during the period (2001-2020) to reach the maximum in 2019

and amounted to 825.38 thousand tons representing 27.74% of the total quantity produced from onions in the same year, and decreased to reach the lowest in 2001 and amounted to 166.357 thousand tons representing 14.88% of the quantity produced from

onions in the same year. The average period amounted to 404.013 thousand tons with a ratio of 19.44% of the average period of quantity produced during the period, the growth rate was 1%. The standard deviation.

Table (1): Quantity of dry onions produced and exported in Egypt during the period (2001-2020)

Years	Winter onions		Summer onions		Quantity product of Egyptian onion)	Quantity export of Egyptian onion)	(%)
	Area (thousand Fadden)	Product (thousand ton)	Area (thousand Fadden)	Product (thousand ton)			
2001	81.42	859.8	29.59	258.3	1118.1	166.357	14.88
2002	102.97	1099.8	26.69	266.9	1366.7	293.430	21.47
2003	98.07	1137.9	23.49	233.7	1371.7	320.233	23.35
2004	93.17	1176.1	28.18	294	1470.1	328.031	22.31
2005	130	1603.2	19.93	245.1	1848.3	300.996	16.29
2006	78.45	951.01	22.22	284.1	1235.2	204.654	16.57
2007	105.87	1317.6	18.06	252.2	1569.8	201.240	12.82
2008	121.88	1598.3	14.07	228.1	1826.4	246.989	13.52
2009	129.73	1708.9	15.42	260.8	1969.7	235.151	11.94
2010	135.71	1831.3	17.44	298.1	2129.4	510.551	23.98
2011	136.92	1896.1	13.46	204.9	2101	490.922	23.37
2012	140.98	1966.7	9.06	116.7	2083.4	319.248	15.32
2013	126.29	1847.5	7.08	121.2	1968.7	349.063	17.73
2014	166.13	2438.4	6.07	109.9	2548.4	416.697	16.35
2015	197.77	2843.4	13.06	196.9	3040.6	551.678	18.14
2016	162.83	2865.8	2.09	32.2	2349.9	445.087	18.94
2017	184.42	2317.7	3.64	42.9	2848.5	566.278	19.88
2018	194.95	2805.6	4.84	67.1	2933	445.991	15.21
2019	195.93	2865.8	4.06	57.7	2975.2	825.379	27.74
2020	189.35	2917.5	3.79	64.2	2807.9	354.279	12.62
Maximum	197.77	2917.5	29.59	298.1	3040.6	825.379	27.74
Minimum	78.45	859.8	2.09	32.2	1118.1	166.357	11.94
Average	138.64	1796.3	14.22	181.76	2078.1	404.013	19.44
Growth rate	4%	6%	-10%	-7%	5%	1%	-
Standard deviation	39.41	693.93	5.80	93.92	619.49	157.97	-

Source: Ministry of Agriculture and land reclamation, Economic Affairs Sector, Agriculture economics bulletin, sporadic years.

(3) The export situation of Egyptian onions compared to the international situation:

From table (2), The quantity of Egyptian exports of onions increased during the period (2001-2020) and reached a maximum in 2019 and amounted to 825.38 thousand tons representing 8.84% of the total amount of world exports of onions in the same year amounted to 9.337 million tons, and fell to the lowest in 2001 amounted to 166.357 million tons by exports of onions in the same year amounted to 4.209 million tons. The average period amounted to 404.013 thousand tons, representing 5.77% of the average amount of international exports during the

period and amounted to about 7 million tons. The annual growth rate was 1%. The standard deviation is 157.97. From table (2), It is also clear that the export price of Egyptian onions during the study period rose to a maximum in 2009 and amounted to 716.82 dollars/ton, which is higher than the average international export from the same year by 196.4% which amounted to 364.91 dollars/ton, and fell below in 2002 it was reached 80.82 dollars/ton, representing 3.95% it is lower than the average world export price for the same year by 34.89%, which amounted to 230.08 dollars/ton, which indicates the high export price of Egyptian onions and the increase in demand

to buy it At reasonable prices during the study period. The average period was 494.24 dollars/ton, It is higher than the average international export rice during the study period by 114.85% which amounted to 430.337 dollars/ton. The growth rate was 10%. The standard deviation was 191.02.

The study of the exports of Egyptian onions during the study period shows that it increased to a maximum in 2015 and amounted to 268.958 million dollars, which amounted to 8% of the value of

international exports of onions in the same year, which amounted to 3.362 billion dollars, and fell to the lowest in 2001 and amounted to about 14.212 million dollars, which amounted to 1.43% Of the value of international exports of onions in the same year, which amounted to 990.833 million dollars. The average period was 158.959 million dollars, 5.97% of the average period of the amounted to 2.664 billion dollars. The growth rate was 11%. The standard deviation was 87.693.

Table (2): Development of Egypt's onions exports during the period (2001-2020)

Year	International exports of onions			Egyptian exports of onions				
	Quantity (thousand tons)	Average price (dollars /ton)	Value (million dollars)	Quantity (thousand tons)	% of international exports	Average price (dollars/ton)	Value (million dollars)	% of the value of international exports
2001	4209.38	235.39	990.83	166.36	3.95	85.43	14.21	1.43
2002	4679.68	230.09	1076.73	293.43	6.27	80.28	23.56	2.19
2003	5322.14	258.79	1377.32	320.23	6.02	103.07	22.01	2.40
2004	5568.90	281.53	1567.83	328.03	5.89	102.07	33.67	2.15
2005	5682.29	275.47	1565.28	300.99	5.30	103.02	31.01	1.98
2006	6200.95	302.16	1873.70	204.65	3.30	116.47	23.84	1.27
2007	6109.63	388.65	2374.52	201.24	3.29	179.01	36.02	1.52
2008	6388.71	380.93	2433.68	246.99	3.87	395.02	97.56	4.01
2009	6667.78	364.91	2433.15	235.15	3.53	716.82	168.56	6.93
2010	7353.85	434.68	3196.57	510.55	6.94	453.11	231.34	7.24
2011	7097.57	454.15	3223.37	490.92	6.92	439.21	215.62	6.69
2012	7982.23	336.96	2689.71	319.25	4	492.68	157.29	5.85
2013	7672.87	475.02	3644.79	349.06	4.55	580.27	202.55	5.56
2014	7641.37	412.53	3152.29	416.70	5.45	396.40	165.18	5.24
2015	8202.90	409.83	3361.78	551.68	6.73	487.53	268.96	8
2016	8202.56	412.11	3380.48	445.08	5.43	452.35	201.33	5.96
2017	8203.58	397.10	3257.67	566.28	6.90	365.97	207.24	6.36
2018	8404.97	427.09	3589.71	445.99	5.31	264.24	117.85	3.28
2019	9337.05	447.85	4181.63	825.38	8.84	295.49	243.89	5.83
2020	9059.55	430.34	3898.66	354.28	3.91	494.24	175.10	4.49
Maximum	9337.05	475.02	4181.63	825.38	-	716.82	268.96	-
Minimum	4209.38	230.09	990.83	166.36	-	80.28	14.21	-
Average	6999.42	367.78	2663.49	404.01	-	389.49	158.96	-
Growth rate	4%	3%	7%	1%	-	10%	11%	-
Standard deviation	1444.95	77.48	974.21	157.97	-	191.02	87.69	-

Sours: Collected and calculated from the world Trade Map website data (www.trademap.com).

(4) Indicators of Competitiveness and Efficiency of the Egyptian onions in International markets:

Revealed Comparative Advantage:

In 2020, Revealed Comparative Advantage of the Egyptian onion was estimated at 2.84, which means that there is a relative advantage of the

Egyptian onion for the higher index than the correct one.

Relative importance of the Egyptian onion market:

In 2020, Saudi Arabia is the largest importer of onions, the value of exports of Egyptian onions to the Saudi market amounted to 36.9 million dollars, representing 20.9% of the total Egyptian exports of onions. Followed by the United Kingdom, the value of exports of Egyptian onions, to it amounted to 32 million dollars representing 18.4%. Followed by the Russian Federation, the value of exports of Egyptian onions to it amounted to 25 million dollars representing 14.3%. Followed by the Netherlands, Germany, Kuwait, Syria and United Arab Emirates, the value of exports of Egyptian onions to them reached 15.7, 9.8, 5.03, 3.93 and 3.56 million dollars, in proportion to 8.97%, 5.6%, 2.87%, 2.25%, and 2.03% respectively.

Market Share:

From table (3), It shown that the most important markets importing Egyptian onions according to this indicator in 2020 are Saudi Arabia and Russian Federation, they were the forefront importing countries for Egyptian onions where they represent imports from the rest of the world. United Kingdom evades them by 18.4%, followed by Netherlands by 14.5%, followed by Kuwait,

Germany, United Arab Emirates and Malaysia, each representing 18.21%, 7.69%, 1.95% and 1.12% each respectively. These results show that the markets where imports of Egyptian onions and declining should be studied to find out the reasons for this decline and the extent of the possibility of increasing exports of Egyptian onions in the future.

Price Competitiveness:

From table (4), It is clear that the calculation of the secret Competitiveness Index for 2020 shows that the price of Egyptian onions has price Competitiveness compared to the price of Indian onions in both Saudi Arabia and Russian Federation and Germany, were represents the export price of Egyptian onions relative to the export price of Indian onion for each of them, respectively 0.96, 0.78, 0.44. Thus, Egypt has opportunities and possibilities to increase its exports of Egyptian onions to these countries because the secret ratio is less than the correct one. As for the countries of United Kingdom, Russian Federation, Netherland, Kuwait, United Arab Emirates and Malaysia, the ratio between the Egyptian and India export prices represents 1.12, 2.64, 1.24, 6.96, 1.34 each separately, and therefore according to this indicator there are no opportunities and possibilities to increase exports of Egyptian onions to it because the price ratio is more than correct one.

Table (3): the most important counties importer of Egyptian onions according to the value of onions exported to them in 2020.

Country	Exported quantity of onions (thousand tons)	Value of onions exported to it (million dollars)	Relative importance of export value (%)
Saudi Arabia	74.112	36.629	20.92
United Kingdom	65.063	32.157	18.36
Russian Federation	50.575	24.997	14.28
Netherland	31.780	15.707	8.97
Germany	19.824	9.798	5.596
Kuwait	10.172	5.027	2.871
Syria	7.962	3.935	2.247
United Arab Emirates	7.196	3.557	2.031
Total export these countries	266.684	131.807	75.27
Total exports	3544.279	175.100	100

Sours: Collected and calculated from the world Trade Map website data (www.trademap.com).

Export Efficiency:

In 2020, The Export Efficiency Index reached 129.64%(The index was calculated as the international price of onions 494.24 dollars/ton in 2020, the exchange rate reached 16 LE, The wholesale price of Egyptian onions reached 6100 LE/ton.), which means that the export price of a ton of Egyptian onions to international markets exceeds that whole sale price of Egyptian onions in the local market by 29.64%, thus it is clear that the Egyptian onions achieved export efficiency in this year.

(5) Onion exports in the top three international markets:

The most important countries that Egyptian onions are Saudi Arabia, United Kingdom and Russian Federation. The following is the evolution of the export situation of Egyptian onions of these three market.

a- Saudi Arabia:

The quantity exported from Egyptian onions to Saudi Arabia market increased during the period (2001-2020), it reached its maximum in 2018 and reached 285.56 thousand tons with a cash value of 71.556 million dollars. It declined to its lowest level in 2007, reaching 42.016 thousand tons with cash value of 3.835 million dollars. The average period amounted to 163.696 thousand tons with an average cash value of 52.992 million dollars. The annual rate of decline of Egyptian onion exports to this market during the study period was 2%. The annual growth

rate in the monetary values of Egyptian onions during the same period was 8%.

b- United Kingdom:

The quantity exported from Egyptian onions to this market increased during the period (2001-2020), it reached its maximum in 2011 and reached 124.98 thousand tons with a cash value of 40.883 million dollars. It declined to its lowest level in 2006, reaching 7.74 thousand tons with cash value of 8.387 million dollars. The average period amounted to 15.395 thousand tons with an average cash value of 10.349 million dollars. The annual growth rate of Egyptian onion exports to this market during the study period was 19%. The annual growth rate in the monetary values of Egyptian onions during the same period was 24%.

C- Russian Federation:

The quantity exported from Egyptian onions to this market increased during the period (2001-2020), it reached its maximum in 2011 and reached 124.98 thousand tons with a cash value of 40.883 million dollars. It declined to its lowest level in 2006, reaching 7.74 thousand tons with cash value of 1.121 million dollars. The average period amounted to 45.198 thousand tons with an average cash value of 15.183 million dollars. The annual rate of decline of Egyptian onion exports to this market during the study period was 7%. The annual growth rate in the monetary values of Egyptian onions during the same period was 15%.

Table (4): Development of Egyptian onion exports in the three most important international markets during the period (2001-2020).

Years	Saudi Arabia			United Kingdom			Russian Federation		
	Quantity (thousand tons)	Price (dollars /ton)	Value (million dollars)	Quantity (thousand tons)	price (dollars /ton)	Value (million dollars)	Quantity (thousand tons)	price (dollars /ton)	Value (million dollars)
2001	101.00	73.77	7.45	1.86	235.52	0.44	0	0	0
2002	195.74	64.95	12.71	4.79	222.27	1.06	12.51	112.67	1.41
2003	146.66	68.15	9.99	5.40	320.13	1.73	38.82	155.88	6.05
2004	164.11	65.36	10.73	4.66	368.16	1.72	27.95	136.93	3.83
2005	167.37	82.38	13.79	6.37	351.74	2.24	23.63	144.24	3.41
2006	106.01	86.52	9.17	9.22	325.20	3.00	7.74	144.83	1.12
2007	42.02	91.27	3.84	10.41	214.94	2.24	46.15	181.73	8.39
2008	105.23	421.71	44.37	11.59	584.72	6.77	20.61	296.22	6.11
2009	145.76	679.99	99.12	8.49	1002.1	8.51	9.48	717.08	6.80
2010	214.66	453.90	97.43	9.40	697.46	6.55	69.17	401.16	27.75
2011	168.57	494.65	83.39	11.99	561.83	6.74	124.28	327.12	40.88
2012	155.46	492.69	76.59	13.88	492.72	6.84	26.99	492.70	13.30
2013	125.25	497.55	62.32	17.93	3411.2	61.18	74.49	255.57	19.04
2014	216.89	325.19	70.53	17.80	778.38	13.85	67.81	383.96	26.04
2015	239.50	450.82	107.97	10.30	670.23	6.91	59.55	524.52	31.24
2016	258.46	448.47	115.91	10.02	596.15	5.97	35.89	538.11	19.31
2017	224.94	413.36	92.98	11.62	430.00	5.00	107.20	294.11	31.53
2018	285.56	250.58	71.56	15.78	418.84	6.61	33.37	218.36	7.29
2019	136.63	244.25	33.37	61.32	447.98	27.47	67.04	375.82	25.20
2020	74.11	494.24	36.63	65.06	494.24	32.16	50.58	494.26	25.00
Maximum	42.02	64.95	3.84	1.86	214.94	0.44	7.74	112.67	1.12
Minimum	285.56	679.99	115.91	65.06	3411.2	61.18	124.98	717.08	40.88
Average	163.70	309.99	52.99	15.40	631.19	10.35	45.20	309.76	15.18
Growth rate	-2	10	8	19	4	24	7	8	15
Standard deviation	63.34	198.45	38.96	16.90	684.16	14.53	32.95	180.82	12.40

Sours: Collected and calculated from the world Trade Map website data (www.trademap.com).

(6) Forecasting the future of Egyptian onion production and export:

In the following section, the future production of Egyptian onions, the export of onions internationally, the export of Egyptian onions in general and the export to the three most important international markets in particular were predicted using ARIMA models, which were estimated using the statistical program Minitab. The prediction was estimated for all the previous variables separately during the period (2021-2025), and several different models were used for each of them and then the best ones were selected statistically and economically. From Table (5) shows the following:

- **Forecasting the quantity produced from Egyptian onions:**

From Table (5) the use of ARIMA was predicted (1,0,1) it was found that the average

quantity that was predicted rose to a maximum in 2025 and reached 3.58 million tons, and fell below in 2021 and reached 3.17 million tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 102.938 + 0.904 MA_1$$

$$(16.437)** \quad (6.110)**$$

Chi square = 11.2, p-value= 0.34, SS= 56309.4, MS=3312

Forecasting the quantity of onions exported internationally:

From the table it was shown that the use of ARIMA was predicted (0,1,1) and it was shown that the average quantity that was predicted rose to a maximum in 2025 and reached 10.47 million tons, and fell below in 2021 and amounted to 9.51 million

tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 240.446 + 0.907 MA_1$$

$$(12.122)^{**} \quad (6.201)^{**}$$

Chi square = 12.3, p-value= 0.27, SS= 1389673, MS=81745

Forecasting the quantity exported from Egyptian onions:

From the table it was shown that the use of ARIMA was predicted (0,1,1) and it was shown that

the average quantity that was predicted rose to a maximum in 2025 and reached 650.25 thousand tons, and fell below in 2021 and amounted to 576.62 thousand tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 18.410 + 0.887 MA_1$$

$$(5.870)^{**} \quad (3.860)^{**}$$

Chi square = 7.9, p-value= 0.64, SS= 274561, MS=16151

Table (5): Predict the amount of onions produced in Egypt, the amount of onions exported international and the amount exported from Egyptian onions to the most important international markets during the period (2021-2025).

Variable	Model	Year	Forecast	95% Limits	
				Lower	Upper
Quantity of Egyptian onions produced	ARIMA (1,0,1)	2021	3166.74	2760.60	3166.74
		2022	3269.68	3854.77	3269.68
		2023	3372.62	2949.12	3372.62
		2024	3475.55	3043.64	3475.55
		2025	3578.49	3138.32	3578.49
Quantity of international exports onions	ARIMA (0,1,1)	2021	9511.90	8951.40	10072.4
		2022	9752.30	9189.40	10315.2
		2023	9992.80	9427.50	10558.1
		2024	10233.20	9665.60	10800.9
		2025	10473.70	9903.60	11043.7
Quantity of Egyptian exports of onions	ARIMA (0,1,1)	2021	576.62	327.47	825.75
		2022	595.02	344.23	845.74
		2023	613.43	361.13	865.73
		2024	631.84	377.97	885.70
		2025	650.25	394.83	905.67
Quantity of Egyptian onions exported to Saudi Arabia market	ARIMA (1,0,1)	2021	125.81	15.84	235.78
		2022	153.09	34.18	271.99
		2023	167.95	48.41	287.48
		2024	176.49	56.87	293.11
		2025	188.81	61.49	302.14
Quantity of Egyptian onions exported to United Kingdom market	ARIMA (1,1,1)	2021	62.08	40.58	83.57
		2022	69.92	36.43	103.41
		2023	69.78	29.38	110.18
		2024	75.53	28.09	122.73
		2025	76.93	24.13	192.73
Quantity of Egyptian onions exported to Russian Federation market	ARIMA (1,1,1)	2021	68.53	14.21	122.85
		2022	69.61	13.91	125.31
		2023	71.58	15.19	127.98
		2024	73.51	16.19	130.62
		2025	75.44	17.63	133.25

Source: Addresses themes my accounts table (1) and (4) employment program (Minitab).

Forecasting the quantity exported from the Egyptian onion to the Saudi Arabia market:

From the table it was shown that the use of ARIMA was predicted (1,0,1) and it was shown that the average quantity that was predicted rose to a

maximum in 2025 and reached 188.81 thousand tons, and fell below in 2021 and reached 125.81 thousand tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 0.982 + 1.097 MA_1 + 0.509 AR_1$$

$$(2.982)^{**} \quad (3.60)^{**} \quad (1.540)$$

Chi square = 10.8, p-value= 0.29, SS= 11516.5, MS=767.8

Forecasting the quantity exported from the Egyptian onion to the United Kingdom market:

From the table it is shown that the use of ARIMA was predicted (1,1,1) and it is shown that the average quantity that was predicted increased to a maximum in 2025 and amounted to 76.93 thousand tons, and fell below in 2021 and amounted to 62.08 thousand tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 5.642 - 0.936 MA_1 - 0.509 AR_1$$

$$(4.850)^{**} \quad (-3.440)^{**} \quad (-1.80)$$

Chi square = 2, p-value= 0.099, SS= 1923.9, MS=120.2

Forecasting the quantity exported from the Egyptian onion to the Russian Federation market:

From the table it is shown that the use of ARIMA was predicted (1,1,1) and it is shown that the average quantity that was predicted increased to a maximum in 2025 and amounted to 75.44 thousand tons, and fell to reach below in 2021 and amounted to 68.53 thousand tons. By estimating the prediction equation for the amount produced by Egyptian onions during the same period, it turns out that it comes into the picture:

$$Y = 2.032 + 1.744 MA_1 - 0.274 AR_1$$

$$(2.460)^{**} \quad (3.80)^{**} \quad (-1.190)$$

Chi square = 10.8, p-value= 0.29, SS= 11516.5, MS=767.8

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