Determinants of Foreign Demand for Egyptian Onions and Garlic Exports in Major World Markets

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Abstract : Onions and garlic are two of the major vegetable crops grown in Egypt, with exports about 20% and 0.89% representing of exports value of vegetables. the research aims to identify determinants of demand for both crops in, Findings indicate that major import markets for Egyptian onions are the Saudi and Russian markets, where both absorbed 60% of the average quantity, factors affecting Egyptian onion exports inside the Saudi market include: prices of Egyptian, Yemeni and Indian onions, and the ratio between the export price of Egypt and the USA. As regards the Russian market, findings factors affecting demand for Egyptian onions in that market include the export prices of Turkish onions and the quantity of onion imports by Russia. Turning to Egyptian garlic exports, findings Dutch and Italian markets are the two major importing markets, where both absorb 40%, and factors affecting Egyptian garlic exports include the export price of Chinese and German garlic, in addition to Dutch imports of garlic. factors affecting Egyptian garlic exports to the Italian market, the export price of Chinese garlic, price ratio between the export prices of Egyptian and French garlic, and quantity of garlic imported by Italy. Applying sensitivity analyses to the suggested geographic distribution indicate that Egyptian onion exports to the UK can be increased by 68.08 thousand tons, also indicate that the quantity of garlic exports to Brazil can be increased by 750 tons.
The research recommends stabilizing Egyptian export policy and maximizing the benefits of Egyptian onion and garlic exports by maintaining such foreign markets in which Egypt enjoys a high competitive advantage, which can be achieved by devoting more attention to fulfilling the standard specifications required by such markets, in addition to adjusting the export prices of both crops to match the prevalent international export prices.
Keywords : export- onion- garlic- sensitivity analyses.

1. Introduction

Onion is one of the major vegetable crops grown in Egypt given the vast area it occupies compared to other vegetable crops. In addition to its importance as a food crop, it ranks fifth after cotton, rice, potatoes and oranges [1] in terms of contribution to total value of Egyptian agricultural exports that reached 4.7% over the period 2012-2014. On the other hand, Egyptian garlic occupies a distinguished position among major export crops due to the comparative advantage Egypt enjoys in its production, which makes Egypt's competitiveness high in foreign exports markets of garlic in the light of the World Free Trade Agreement. However, in recent years, Egypt's garlic exports declined due to non-conformity to export standards, in addition to facing competition from Chinese garlic in most of the export markets. Therefore, it is important to devote great attention to addressing this problem by planting garlic in new lands and expanding in the production of export-oriented varieties like Sids 40 [2] in order to raise exported quantities and maintain major export markets.

Research Problem

Export quantities of Egyptian onions to major markets have been fluctuating, which lead to diminishing importance in the structure of Egyptian agricultural exports, where it represented only 3.9% of Egypt's total agricultural exports in 2014 [3]. Such problem can be attributed to non-conformity of Egyptian onions to standards required in export markets, in addition to damaging a large quantity during transport. As for Egyptian garlic exports, many of the importing markets refrain to import from Egypt due to infection with white mold, in addition to facing competition from Chinese garlic [4]. The high export prices of Egyptian onions and garlic in comparison to the export prices of competing markets complicated the problem. Such factors expose Egyptian exports of onions and garlic to substitution in their traditional markets and fierce competition from other countries in new markets. In addition, exported quantities do not match the produced quantities [5].

Research Objective

The research aims to identify the geographic distribution of Egyptian onions and garlic exports to main world blocks; factors affecting external demand for both crops in major foreign markets in the presence of competing countries; and finally the geographic distribution that maximizes the value of Egyptian onions and garlic exports to main world markets.

Methodology and Sources of Data

The research mainly relied on data published by the Central Agency for Public Mobilization and Statistics, the United Nations Website and Website of the Food and Agriculture Organization of the United Nations.

As regards the Methodology, the research applied both descriptive and quantitative statistics to estimate the demand functions in different forms, in addition to sensitivity analysis results obtained from applying linear programming to data concerning the study crops.

Economic Importance of Egyptian Onions and Garlic Exports

Results in Table (1), which presents the relative importance of Egyptian onions and garlic exports value indicate that the total value of Egyptian vegetable exports reached US$ 969.7 million representing around 24.5% of Egypt's total agricultural exports value, estimated at US$ 3955.6 million over the period 2010-2014. Onions and garlic exports value accounted for US$ 194.4 and 8.6 million representing 20% and 0.89% of Egypt's total exports value of vegetables. And despite the low contribution of garlic exports value in total exports value of vegetables, its importance emits from the fact that it acts as a safeguard and treatment for many health problems given the sulfur compounds, vitamin c, vitamin B6, potassium, magnesium and other natural chemicals contents used in developing and processing various important medicines. Therefore, it is very important to devote more attention to boosting the production of garlic.

Table (1): Relative Importance of Egyptian Vegetables' Exports Value Over the Period (2010-2014) (US$ Million)

Crop	2010	2011	2012	2013	2014	Average	%
Lettuce	12.10718	10.57877	9.150542	7.849648	6.548546	9.246937	**0.95**
Cucumber	0.855838	0.841552	0.558247	0.743737	1.433994	0.886674	**0.09**
Potatoes	261.8991	280.6537	297.3508	315.8985	366.791	304.5186	**31.40**
Tomatoes	26.05349	29.09745	28.73455	60.5311	70.93646	43.07061	**4.44**
Onion	231.3357	215.6174	157.2884	202.55	165.1797	194.3943	**20.05**
Garlic	6.175664	10.65949	14.25963	7.223471	4.748158	8.613281	**0.89**
Green Beans	63.58113	54.69016	48.12306	57.79783	53.13268	55.46497	**5.72**
Dried Vegetables	130.9148	173.6109	152.53	185.2176	144.6706	157.3888	**16.23**
Strawberry	55.1237	66.18985	74.1257	88.21496	111.2587	78.98258	**8.14**
Artichoke	32.05698	29.15896	44.25164	49.5841	55.89632	42.1896	**4.35**
Green Peppers	19.23614	22.56913	25.08975	30.15925	36.12598	26.63605	**2.75**
Total Vegetables	834.2982	986.0307	804.3056	1038.785	1185.198	969.7235	**95**
Total Agric. Exports	4008.313	3931.415	3550.929	4101.014	4186.579	3955.65	**24.515**

Source: www.Un.comtrade [3]

Geographic Distribution of Onion Exports to Major Economic Blocks and Markets

Figures in Table (2) indicate the geographic distribution of Egyptian onion exports to major economic blocks over the period 2012-2014. It can be noted that the Gulf Cooperation Council ranks on top of the economic blocks to which Egyptian onion is exported, where it absorbed an average of 206.46 thousand tons representing 54.8% of Egypt's total onions exports quantity, whereas average exports value of Egyptian onions exported to the Gulf Cooperation Council reached US$ 89.9 million representing 51.4%. It is also clear from Table (3) that the Saudi market ranked on top of the markets importing Egyptian onions at the level of the Gulf Cooperation Council, where it absorbed an average of 176.2 thousand tons representing 42.2% of Egypt's total onion exports, worth a value of US$78.05 million representing 40.15% of Egypt's total exports value of onions. The Russian Federation ranked second, followed by Kuwait and Holland that ranked third and fourth, respectively.

Table (2): Geographic Distribution of Egyptian Onions' Exports to Major World Economic Block Over the Period (2012-2014) (Quantity in Thousand Tons and Value in US$ Million)

Economic Block	2012				2013				2014				Average			
	Q	%	V	%	Q	%	V	%	Q	%	V	%	Q	%	V	%
Gulf Cooperation Council	*175.6*	*55*	*69.3*	*44*	*215.8*	*54.8*	*54.8*	*48.5*	*228*	*54.7*	*101.8*	*61.5*	*206.46*	*54.81*	*89.8*	*51.3*
European Union	38.4	12	47.2	30	51.5	13:07	13:07	34.5	69.6	16.7	36.8	22.2	53.16	14.11	51.3	29.3
COMESA	6.4	2	6.3	4	14.9	3.8	3.8	3.8	8.9	2.1	4.5	2.7	10.00	2.65	6.23	3.56
NAFTA	0.03	0.009	0.05	0.03	0.02	0.005	0.005	0.01	0.05	0.01	0.03	0.01	0.03	0.0079	0.04	0.022
Total Exports of Egyptian Onions	319.2	100	157.3	100	394	100	100	100	416.7	100	165.4	100	376.63		175.06	

Source: The Central Agency for Public Mobilization and

Table (3): Geographic Distribution of Egyptian Onion Exports to Major Import Countries over the Period 2010-2014 (Quantity in Thousand Tons and Value in US$ Million)

Importing Country	Quantity		Value	
	Q	%	Q	%
Saudi Arabia	176.2	42.2	78.05	40.15
Russia	72.7	17.4	25.4	13:07
Kuwait	20.2	4.8	9.03	4.65
Holland	20.1	4.8	10.5	5.4
Syria	15.9	3.8	7.1	3.65
Romania	14.4	3.5	3.4	1.75
Libya	11.6	2.8	5.6	2.88
Ukraine	8.4	2	3.5	1.8
Rest of the World	78	18.7	51.82	26.65
Total Exports of Egyptian Onions	417.3	100	194.4	100

Source: www. Fao.org [7]

Determinants of Demand for Egyptian Onion inside the Saudi Market

The market of Saudi Arabia proved to be number one market for Egyptian exports, where it ranks on top of the countries importing Egyptian onion over the period 2010-2014. Therefore, the research focused on estimating the external demand function for Egyptian onion inside the Saudi market in order to identify the main factors affecting exports of the crop to that market. To achieve that, the research estimated the relationship between Egyptian onion exports as the dependent variable, and a number of explanatory variables assumed to affect it over the period 2000-2014, including:

Y = Egyptian onion exports to the Saudi market in thousand tons,
X_1 = Saudi market imports of Egyptian onion in thousand tons,
X_2 = Export price of Egyptian onion (US$/ton),
X_3 = Quantity produced of Saudi onion (US$/ton) in thousand tons,
X_4 = Yemen's Export price (US$/ton),
X_5 = India's Export price (US$/ton),
X_6 = USA's Export price (US$/ton),
X_7 = Holland's Export price (US$/ton),
X_8 = Price ratio between Egypt's export price and Yemen's export price (US$/ton),
X_9 = Price ratio between Egypt's export price and India's export price (US$/ton),
X_{10} = Price ratio between Egypt's export price and USA's export price (US$/ton),
X_{11} = Price ratio between Egypt's export price and Holland's export price (US$/ton),

Applying stepwise regression analysis proved that the double log form is the best for estimating the demand function. Results indicate that, after neglecting the variables with weak effect on the dependent variables, the following is the estimated demand function:

$$\text{Log } y\hat{}t = 1.23 - 1.26 \text{ Log}X2t + 0.69 \text{ Log}X4t + 0.77 \text{ Log}5t + 0.42 \text{ Log}10t$$

$$(-2.99) \qquad (2.25) \qquad (2.36) \qquad (2.12)$$

$$R\text{-}2 = .0.82 \qquad F = 61.25$$

The estimated demand function indicates that major factors affecting demand for Egyptian onion in the Saudi market include Egyptian, Yemeni and Indian export prices, in addition to the ratio between Egypt's export price and USA's export prices. Findings indicate a positive relationship between Egyptian onion exports to the Saudi market and both Yemeni and Indian export prices; a positive relationship between Egyptian onion exports to the Saudi market and the ratio between Egypt's export price and USA's export prices, where 1% increase in the value of each of the mentioned variables leads to increasing Egyptian onion exports to the Saudi market by 0.69%, 0.77% and 0.42%, respectively. However, findings also indicate a negative relationship between Egyptian onion exports to the Saudi market and Egyptian export price, where 1% increase in price leads to reducing the quantity exported of Egyptian onion to the Saudi market by 1.26%. The estimated model proved statistically significant at 0.01 level; coefficient of determination reached 0.82, indicating that 84% of the changes in the quantity of onion exported to the Saudi market over the period (2000-2014) is explained by the explanatory variables included in the equation.

Determinants of Demand for Egyptian Onion inside the Russian Market

The Russian market is considered one of the major markets for Egyptian exports, where it ranked second in terms of Egyptian onion imports over the period 2010-2014. Therefore, the research focused on estimating the external demand function for Egyptian onion inside the Russian market in order to identify the main factors affecting exports of the crop to that market. To achieve that, the research estimated the relationship between Egyptian onion exports as the dependent variable, and a number of explanatory variables assumed to affect it over the period 2000-2014, including:

Y   = Egyptian onion exports to the Russian market in thousand tons,
X_1 = Russian market imports of Egyptian onion in thousand tons,
X_2 = Export price of Egyptian onion (US\$/ton),
X_3 = Quantity produced of Russian onion (US\$/ton) in thousand tons,
X_4 = Holland's Export price (US\$/ton),
X_5 = China's Export price (US\$/ton),
X_6 = Turkey's Export price (US\$/ton),
X_7 = Iran's Export price (US\$/ton),
X_8 = Price ratio between Egypt's export price and Holland's export price (US\$/ton),
X_9 = Price ratio between Egypt's export price and China's export price (US\$/ton),
X_{10} = Price ratio between Egypt's export price and Turkey's export price (US\$/ton),
X_{11} = Price ratio between Egypt's export price and Iran's export price (US\$/ton),

Applying stepwise regression analysis proved that double log is the best form for estimating the demand function. Results indicate that, after neglecting the variables with weak effect on the dependent variables, the following is the estimated demand function:

$$\text{Log } \hat{y}_t = 1.99 - 2.01 \text{ Log}X_{2t} + 0.55 \text{ Log}X_{5t} + 0.62 \text{ Log}1_t$$

                (-3.01)   (2.11)   (2.25)
   R-2=.0.79   F=45.02

The estimated demand function indicates that major factors affecting demand for Egyptian onion in the Russian market include Egyptian and Turkish onion export prices in addition to Russia's imports of onions. Findings indicate a positive relationship between Egyptian onion exports to the Russian market and both Turkish export price of onions and Russia's imports of onions, where 1% increase in each of the two mentioned variables leads to increasing Egyptian onion exports to the Russian market by 0.55% and 0.62%, respectively. On the other hand, findings indicate an inverse relationship between Egyptian onion exports to the Russian market and the export price of Egyptian onion, where 1% increase in the export price leads to reducing the quantity exported to the Russian market by 2.01%. The estimated model proved statistically significant at 0.01 level; coefficient of determination reached 0.79, indicating that 79% of the changes in the quantity of onion exported to the Russian market over the period (2000-2014) is explained by the explanatory variables included in the equation.

Geographic Distribution of Garlic Exports to Major Economic Blocks and Markets

Figures in Table (4) indicate the geographic distribution of Egyptian garlic exports to major economic blocks over the period 2012-2014. It can be noted that the European Union ranks on top of the economic blocks to which Egyptian garlic is exported, where it absorbed an average of 1786.7 thousand tons representing 34% of Egypt's total garlic exports quantity. On the other hand, average exports value of Egyptian garlic exported to the European Union reached US\$ 2635 thousand representing 30.1%. It is also clear from Table (5) that the Dutch market ranked on top of the markets importing Egyptian garlic at the level of the European Union countries, where it absorbed an average of 1043 thousand tons representing 16% of Egypt's total garlic exports, worth an average value of US\$ 1.48 million representing 17.18% of Egypt's total garlic exports value. Italy, Russia and Syria ranked second, third and fourth, respectively.

Table (4): Geographic Distribution of Egyptian Garlic Exports to Major World Economic Block over the Period (2012-2014) (Quantity in Thousand Tons and Value in US$ Million)

Economic Block	2012				2013				2014				Average			
	Q	%	V	%	Q	%	V	%	Q	%	V	%	Q	%	V	%
European Union	1963	33	3222	22.59	1843	29.37	2396	33.17	1554	43.95	2288	48.18	1786.7	34	2635	30.1
Gulf Cooperation Council	476	8	142.6	1	514	8.2	135.4	1.87	70	1.97	56.9	1.19	353.3	6.73	111.63	1.28
COMESA	350	5.89	31	0.217	420	6.69	39.8	0.55	70.7	1.99	56.9	1.19	280.2	5.33	39.23	0.44
Total Exports of Egyptian Garlic	5946	100	14259	100	6274	100	7223	100	3536	100	4748	100	5252		8743.3	

Source: The Central Agency for Public Mobilization and Statistics, Unpublished Data [6]

Table (5): Geographic Distribution of Egyptian Garlic Exports to Major Import Countries over the Period 2010-2014 (Quantity in Thousand Tons and Value in US$ Million)

Importing Country	Quantity		Value	
	Q	%	Q	%
Holland	1043	16.02	1480.1	17.18
Italy	882.3	13.55	1071.9	12.45
Russia	858.2	13.18	1146.2	13.31
Syria	803.5	12.34	1166.5	13.54
Belgium	506	7.32	712.6	8.27
England	477	6.4	623.6	7.24
France	417	6.14	534	6.2
Poland	400	7.77	642.9	7.46
Libya	360	5.53	685.6	7.96
Rest of the world	765	11.75	549.6	6.38
Egypt's Total Exports of Garlic	6512	100	8613	100

Source: www. Fao.org [7]

Determinants of Demand for Egyptian Garlic inside the Dutch Market

The Dutch market is considered of the major markets for Egyptian exports, where it ranked first in terms of Egyptian garlic imports over the period 2010-2014. Therefore, the research focused on estimating the external demand function for Egyptian garlic inside the Dutch market in order to identify the main factors affecting exports of the crop to that market. To achieve that, the research estimated the relationship between Egyptian garlic exports as the dependent variable, and a number of explanatory variables assumed to affect it over the period 2000-2014, including:

Y = Egyptian garlic exports to the Dutch market in thousand tons,
X_1 = Dutch market imports of Egyptian garlic by the in thousand tons,
X_2 = Export price of Egyptian garlic (US$/ton),
X_3 = Quantity produced of Dutch garlic (US$/ton) in thousand tons,
X_4 = China's Export price (US$/ton),
X_5 = Germany's Export price (US$/ton),
X_6 = Belgium's Export price (US$/ton),
X_7 = Spain's Export price (US$/ton),
X_8 = Price ratio between Egypt's export price and China's export price (US$/ton),
X_9 = Price ratio between Egypt's export price and Germany's export price (US$/ton),
X_{10} = Price ratio between Egypt's export price and Belgium's export price (US$/ton),
X_{11} = Price ratio between Egypt's export price and Spain's export price (US$/ton),

Applying stepwise regression analysis proved that double log is the best form for estimating the demand function. Results indicate that, after neglecting the variables with weak effect on the dependent variables, the following is the estimated demand function:

$$\text{Log } \hat{y}_t = 2.0 + 0.51 \text{ Log}X4t + 0.49 \text{ Log}X6t + 0.39 \text{ Log}X1t$$
$$\qquad\qquad (2.09) \qquad\quad (1.99) \qquad\quad (1.38)$$
$$R\text{-}2=0.71 \qquad\qquad F=39.66$$

The estimated demand function indicates that major factors affecting demand for Egyptian garlic in the Dutch market include export prices of Chinese and German garlic, in addition to Dutch imports of garlic. Findings indicate a positive relationship between Egyptian garlic exports to the Dutch market and both China's export price of garlic and Holland's imports of onions, where 1% increase in each of the mentioned variables leads to increasing Egyptian garlic exports to the Dutch market by 0.51%, 0.49% and 0.39%, respectively. The estimated model proved statistically significant at 0.01 level; coefficient of determination reached 0.71, indicating that 71% of the changes in the quantity of garlic exported to the Dutch market over the period (2000-2014) is explained by the explanatory variables included in the equation.

Determinants of Demand for Egyptian Garlic inside the Italian Market

The Italian market is one of the major markets for Egyptian exports, where it ranked second in terms of Egyptian garlic imports over the period 2010-2014. Therefore, the research focused on estimating the external demand function for Egyptian garlic inside the Italian market in order to identify the main factors affecting exports of the crop to that market. To achieve that, the research estimated the relationship between Egyptian garlic exports as the dependent variable, and a number of explanatory variables assumed to affect it over the period 2000-2014, including:

Y = Egyptian garlic exports to the Italian market in thousand tons,
X_1 = Italian market imports of Egyptian garlic in thousand tons,
X_2 = Export price of Egyptian garlic (US$/ton),
X_3 = Quantity produced of Italian garlic (US$/ton) in thousand tons,
X_4 = China's Export price (US$/ton),
X_5 = Holland's Export price (US$/ton),
X_6 = Spain's Export price (US$/ton),
X_7 = France's Export price (US$/ton),
X_8 = Price ratio between Egypt's export price and China's export price (US$/ton),
X_9 = Price ratio between Egypt's export price and Holland's export price (US$/ton),

X_{10} = Price ratio between Egypt's export price and Spain's export price (US$/ton),
X_{11} = Price ratio between Egypt's export price and France's export price (US$/ton),

Applying stepwise regression analysis proved that double log is the best form for estimating the demand function. Results indicate that, after neglecting the variables with weak effect on the dependent variables, the following is the estimated demand function:

$$\text{Log } \hat{y}t = 1.38 - 1.24 \text{ Log}X2t + 0.44 \text{ Log}X1t + 0.066 \text{ Log}4t + 0.22 \text{ Log}11t$$
$$(-2.33) \qquad\qquad (2.41) \qquad (2.99) \qquad (1.12)$$
$$R\text{-}2 = 0.81 \qquad\qquad F = 50.12$$

The estimated demand function indicates that major factors affecting demand for Egyptian garlic in the Italian market include the export prices of Egyptian and Chinese garlic, price ratio between the export prices of Egyptian and French garlic, and finally Italy's garlic imports. Findings indicate that 1% increase in the first three variables leads to increasing Egyptian garlic exports to the Italian market by 0.44%, 0.669% and 0.22%, respectively. By contrast, findings revealed an inverse relationship between the quantity of Egyptian garlic exports to the Italian market and Egypt's export price, where 1% increase in the export price of Egyptian garlic leads to 1.24% reduction in the quantity of garlic exported to the Italian market. The estimated model proved statistically significant at 0.01 level; coefficient of determination reached 0.81, indicating that 81% of the change in the quantity of garlic exported to the Italian market over the period (2000-2014) is explained by the explanatory variables included in the equation.

Sensitivity Analysis of the Suggested Geographic Distribution of Egyptian Onion Exports

Table (6) presents the results of applying sensitivity analysis to the changes occurring in average export price of Egyptian onion. It can be noted that the range of export price to the United Kingdom can be changed within a lower limit of US$ 585 per ton and an upper limit of US$ 1340 per ton, which is the actual export price of Egyptian onions to the UK. As for the results of applying sensitivity analysis to export restriction concerning Egyptian onions, it was found that onion exports to the UK can be increased to a maximum of 68.08 thousand tons, which will increase the value of onion exports to the UK to around US$ 91.32 million. It is also clear from the same table that onion exports to Syria, Ukraine, Romania, Lebanon and Greece must be minimized to amounts that can even reach zero. As for the quantities of onions exported to the rest of countries included in the suggested geographic distribution, they can be changed between zeros as the lower limits and the upper limits listed in the table without changing the pattern of the suggested geographic distribution of Egyptian onions, which is expected to maximize the value of Egyptian onion exports to around US$ 237.9% million, up by 22% compared to the actual value of Egyptian onion exports under currently prevailing geographic distribution (2010-2014).

Table (6): Sensitivity Analysis of the Suggested Geographic Distribution of Egyptian Onions over the Period 2010-2014

Country	Changes in Export Price (US$)				Changes in Export Restrictions (1000 Tons)		
	Q (1000 Tons)	*Export Price (US$/ton)*	*Lower Limit*	*Upper Limit*	*Q (1000 Tons)*	*Lower Limit*	*Upper Limit*
Saudi Arabia	176.16	443	-	1340	176.1	0	230.04
Russia	72.69	349	-	1340	72.69	0	126.77
Kuwait	20.14	449	-	1340	20.14	0	74.04
Syria	-	445	-	1340	20.16	0	74.04
Holland	20.26	521	-	1340	14.2	0	68.08
Ukraine	-	424	-	1340	6.5	0	60.38
Romania	-	453.09	-	-	15.4	0	38.9
England	68.08	1340	585	1340	5.88	0	59.76
Italia	6.5	574.35	-	1340	2.01	0	55.43
Jordan	15.4	472	-	1340	1.66	0	31.21
Lebanon	-	436	-	1340	0.38	0	54.26
United Arab Emirates	5.88	493	-	1340	11.49	0	11.49
Greece	-	493	-	1340	2.88	0	56.76
Amman	2.01	503	-	1340	1.09	0	54.97

Source: Results of Applying WinQsR2.O Software

Sensitivity Analysis of the Suggested Geographic Distribution of Egyptian Garlic Exports

Table (7) presents the results of applying sensitivity analysis to the changes occurring in average export price of Egyptian garlic. It can be noted that the range of export price to Brazil can be changed within a lower limit of US$ 1899 per ton and an upper limit of US$ 2183 per ton, which is the actual export price of Egyptian garlic to Brazil. As for the results of applying sensitivity analysis to export restriction concerning Egyptian garlic, it was found that the quantity of garlic exports to Brazil can be increased by a maximum of 750 tons, which will increase the value of garlic exports to Brazil by around US$ 1.64 million. It is also clear from the same table that garlic exports to Spain, Tunisia, Morocco and Turkey must be minimized to amounts that can even reach zero. As for the quantities of garlic exported to the rest of countries included in the suggested geographic distribution, they can be changed between zeros as the lower limits and the upper limits listed in the table without changing the pattern of the suggested geographic distribution of Egyptian garlic, which is expected to maximize the value of Egyptian garlic exports to around US$ 10.68% million, up by 15% compared to the actual value of Egyptian garlic exports under currently prevailing geographic distribution (2010-2014).

Table (7): Sensitivity Analysis of the Suggested Geographic Distribution of Egyptian Garlic over the Period 2010-2014

Country	Changes in Export Price (US$)				Changes in Export Restrictions (1000 Tons)		
	Q (1000 Tons)	**Export Price (US$/ton)**	**Lower Limit**	**Upper Limit**	**Q (1000 Tons)**	**Lower Limit**	**Upper Limit**
Holland	1.04	1419	-	2183	1.04	0	1.79
England	0.048	1305	-	2183	0.048	0	1.23
Italia	0.088	1215	-	2183	0.088	0	1.63
France	0.042	1281	-	2183	0.042	0	1.17
Poland	0.040	1604	-	2183	0.040	0	1.15
Russia	0.086	1336	-	2183	0.086	0	1.61
Germany	0.043	1409	-	2183	0.043	0	1.18
Libya	0.036	1899	-	2183	0.036	0	0.036
Spain	0	1348	-	2183	0.051	0	1.26
Tunisia	0	1171	-	2183	0.080	0	1.55
Belgium	0.051	1407	-	2183	0.009	0	0.084
Brazil	0.075	2183	1899	2183	0.010	0	0.085
Morocco	0	1002	-	2183	0.001	0	0.076
Turkey	0	1421	-	2183	0.032	0	1.07

Source: Results of Applying WinQsR2.O Software

Summary

Onions and garlic are two of the major vegetable crops grown in Egypt, with exports values accounting for US$ 194.4 and 8.6 million representing 20% and 0.89% of Egypt's total exports value of vegetables. Despite the low contribution of garlic exports value in total exports value of vegetables, its importance emits from the fact that it acts as a safeguard and treatment for many health problems. Although the two study crops have several benefits, there are many problems obstructing expansions in their exports to foreign markets. Therefore, the research aims to identify determinants of demand for both crops in major foreign markets and factors affecting quantities exported to such markets, in addition to assessing the geographic distribution of quantities exported to such markets in the light of restrictions on price, import capacities and required standards; in order to reach the geographic distribution that maximizes the value of Egyptian onions and garlic exports to main world markets. Findings indicate that major import markets for Egyptian onions are the Saudi and Russian markets, where both absorbed 60% of the average quantity of Egyptian onion exports for the study period 2010-2014, and that key factors affecting Egyptian onion exports inside the Saudi market include: the export prices of Egyptian, Yemeni and Indian onions, and the ratio between the export price of Egypt and the USA. As regards the Russian market, findings indicate that major factors affecting demand for Egyptian onions in that market include the export prices of Turkish onions and the quantity of onion imports by Russia, where 1% increase in each of the two mentioned variables leads to increasing Egyptian onion exports to the Russian market by 0.55%

and 0.62%, respectively. On the other hand, findings indicate an inverse relationship between Egyptian onion exports to the Russian market and the export price of Egyptian onion, where a 1% increase in the export price leads to reducing the quantity exported to the Russian market by 2.01%. Turning to Egyptian garlic exports, findings indicate that the Dutch and Italian markets are the two major importing markets, where both absorb 40% of the average quantity of Egyptian garlic exports for the period 2010-2014, and that key factors affecting Egyptian garlic exports to that market include the export price of Chinese and German garlic, in addition to Dutch imports of garlic, where 1% increase in each of the mentioned variables leads to increasing Egyptian garlic exports to the Dutch market by 0.51%, 0.49% and 0.39%, respectively. As for the factors affecting Egyptian garlic exports to the Italian market, findings indicate that they include the export price of Chinese garlic, price ratio between the export prices of Egyptian and French garlic, and finally quantity of garlic imported by Italy, where 1% increase in the first three variables leads to increasing Egyptian garlic exports to the Italian market by 0.44%, 0.669% and 0.22%, respectively, whereas 1% increase in the export price of Egyptian garlic leads to reducing the quantity of garlic exports to the Italian market by 1.24%. Findings of applying sensitivity analysis to the suggested geographic distribution indicate that Egyptian onion exports to the UK can be increased by 68.08 thousand tons, which will raise the value of Egyptian onion exports to that market to US$ 91.23 million. However, onion exports to Syria, Ukraine, Romania, Lebanon and Greece must be minimized to amounts that can even reach zero. Findings also indicate that the quantity of garlic exports to Brazil can be increased by 750 tons, which will increase the value of garlic exports to Brazil by around US$ 1.64 million. However, garlic exports to Spain, Tunisia, Morocco and Turkey must be minimized to amounts that can even reach zero. Finally, it was found that the suggested geographic distribution of Egyptian garlic is expected to maximize the value of Egyptian garlic exports to around US$ 10.68% million, up by 15% compared to the actual value of Egyptian garlic exports under currently prevailing geographic distribution.

Recommendations

The research recommends stabilizing Egyptian export policy and maximizing the benefits of Egyptian onion and garlic exports by maintaining such foreign markets in which Egypt enjoys a high competitive advantage, which can be achieved by devoting more attention to fulfilling the standard specifications required by such markets, in addition to adjusting the export prices of both crops to match the prevalent international export prices.

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