ANALYTICAL STUDY FOR PREDICTING PRODUCTION, NATIONAL CONSUMPTION AND SELF-SUFFICIENCY RATES OF THE MOST IMPORTANT LEGUME CROPS IN EGYPT

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Abstract

The United Nations announced in 2016 was as international year for Legumes crops. As a part of sustainable food production, legumes are playing a vital role in Egypt for providing people with their needs from plant protein and amino acids. In general, Egypt suffers a gap between domestic production of legumes and consumption needs, particularly of Faba bean, and lentil. Thus, self sufficiency ratios reached 39% and 1.6% for both crops in 2014 respectively [(1)]. Consequently, the imported amounts from both products were increasing during 1993 and 2014. So that the average of import value of Faba bean reached to LE 1.7 milliards alone, while lentil reached to LE 583.4 millions during 2010 and 2014, which represent about 66.2% and 22.3% respectively from the average import value of legume crops. Due to spread Balkiros injury in 2011, the cultivated area and domestic production of Faba bean has been significantly declined so that import value was increased. While, Faba bean domestic production represents about 78% of total legumes production, lentil represents only 1.3% as average of the period (1993-2014)[(2)].

The present paper aims to: (a) Identify the most important productivity and consumption indicators for leguminous crops in Egypt by using the equations of general time trend during the period (1993-2014). (b) Analyze statistical methods for predicting the most important economic indicators for legumes during the future period (2015-2024). ARIMA models were used to forecast production, consumption, and self-sufficiency after eliminating time series non-stationary and transferring it into stability or stationary series. This was done to be able to use PC-application econometric software package E-views 8 program. (c) Review, explain and interpret the results of ARIMA forecasting and the general time trend models as guidelines to draw agricultural production policy for legumes.

Key words:

General time trend models, ARIMA models [(3)], tests stationary of time series, testing unit root, tests assessing prediction.

INTRODUCTION

The most serious problems facing developing countries over the world is food shortages, The General Assembly of United Nations (UN) declared at its 68th session in 2016 as the International Year of pulses, leguminous crops as part of a sustainable food production aimed to achieving food security and nutrition, where pulses provide a vital source of plant protein, amino acids and alternative to meat. It should be eaten as a part of a healthy diet to treat obesity and prevent chronic diseases, also contribute in the animal food.

Recently, Egypt suffers increasing gap between domestic production and national consumption of some pulses such as Faba bean, lentil and dry Kidney Beans crops. This is due to decline of cultivated area and production and while an increases of consumption due to rapid growing population and

([1]) Ministry of Agriculture and land reclamation, economic affairs sector, the Central Administration of Agricultural Economics, Public Administration of agricultural economic resources, food balance Bulletin, various issues.
([2]) Ministry of Agriculture and land reclamation, economic affairs sector, the Central Administration of Agricultural Economics, Foreign trade of agricultural exports and imports Bulletin, various issues.
[(3)] (Autoregressive Integrated Moving Average).

significant increase in Relative profitability of competitive crops which led farmers to grow clover and vegetables at the cost of Faba bean and lentil.

. Where, the average legumes area decreases from about 402 thousand Fadden for the period (1993-1997) to about 150.4 thousand Fadden for the period (2010-2014). Particularly, the grown areas of Faba bean and lentil decreased from about 314 and 13 thousand Fadden, respectively during the period (1993-1997)) Table 1 [(1)],Which represents about 78%, 3.2% respectively of the average area of pulses, To about 121.5 , 1.69 thousand Fadden respectively. And its represents about 81.5%,1% respectively of the average area of pulses for the period (2010-2014) Table 1 [(2)].

METHODOLOGY AND DATA SOURCES

Statistical analysis using ARIMA technique – according to Box-Jenkins time series analysis method -was used to predict variables of production, consumption, and self sufficiency of legume crops in nearly future. It is known that forecasted values using ARIMA techniques takes into account the effects of other independent variables that can be set out in the error term of forecasted equation. (ARIMA) Model characterized by three orders, According to the methodology of Box-Jenkins in time series analysis, denoted as the (p, d, and q), (p) is the order of autoregressive, (d) is order of integration, that is the number of differencing operations which make the series stationary and (q) is order of moving average.

Estimation model through four steps:-

First step Model Identification:

1. Test stationary time series by estimating the autocorrelation function (ACF), which ranges its value between +1 and-1 and estimate the partial autocorrelation function (PACF) that measures the partial effect of addition lag values in the model according to the Q- Statistics.
2. Procedure testing unit root by Phillips-Perron ($\tilde{t}_\alpha$), Augmented Dickey Fuller (ADF).

$$pp = \tilde{t}_\alpha = t_\alpha(\gamma_0/f_0)^{1/2} - [T(f_0 - \gamma_0)\,(se\,(\hat{\alpha}))/2\,f_0^{1/2}\,s]$$

where:- $\hat{\alpha}$ is the estimate , $t\alpha$ the $\tilde{t}$-ratio of α, $se(\hat{\alpha})$ is coefficient standard error , and (s) is the standard error of the test regression , γ_0 is the consistent estimate of the error variance (calculated as $(T-K)\,s^2/T)$, *and* f_0 is an estimate of the residual at frequency zero.

(ADF) = $\Delta\gamma_t = \alpha\,\gamma_{t-1} + x_t'\,\delta + \beta_1\Delta\gamma_{t-1} + \beta_2\Delta\gamma_{t-2} + \ldots\ldots + \beta_\rho\Delta\gamma_{t-\rho} + \mathcal{V}_t$.

Second step Parameter Estimation and Selection:

Selecting the candidate model, that uses to make prediction of the indicators. Through the experience of many of the attempts for the variable under study by models autoregressive, integrated and moving average.

$$\Delta Y_t = \beta_0 + \beta_1\Delta Y_{t-1} + \ldots.. + \beta_p\Delta Y_{t-p} + \Delta\varepsilon_t + \theta_1\Delta\varepsilon_{t-1} + \ldots.. + \theta_q\Delta\varepsilon_{t-q}$$

Where:- Δ= Differences to minimize error term, β_0= Constant,(β_1, β_p ,

θ_1,..... θ_q, Coefficient of regression model),(Y_{t-1} ,Y_{t-2},……Y_{t-p} , ε_{t-1} , ε_{t-q} independents variables with number of lag), Δ ε_t= Error term.

Third stage Diagnostic Checking:

[(1),(2)] Ministry of Agriculture and land reclamation, economic affairs sector, the Central Administration of Agricultural Economics, Public Administration of agricultural economic resources, food balance Bulletin, various issues.

[2]

Different models are examined after the estimation to identify the best estimation accordance to the nature of the data and the significant estimated parameters, in addition to the AIC, SC, HQ criteria.

Akiake Information Criterion (AIC) = $-2(L/T) + 2(K/T)$

Schwarz Criterion (SC) = $-2L/T + (k \log T)/T$

Hannan- Qunin Criterion(HQ)= $-2(L/T) + 2K\,Log(Log(T))/T$

Where: Log – Likelihood (L) = $-T/2\{(1+Ln(2*\pi) + ln(RSS/T)\}$, T = number of observation.

Durbin Watson (D.W) = $\sum_{t=2}^{T}(\hat{e}_t - \hat{e}_{t-1})^2 / \sum_{t=1}^{T}\hat{e}_t^2$

It is the ratio of the sum of squares differences between the values of successive residuals from one to the sum of squares of residuals values ($\hat{e}_t$).

Fourth step Forecasting:

$$\sqrt{\frac{\Sigma\ (d_e - d_a)^2}{\Sigma\ d^2{}_a}}$$

Forecasting of chosen model by least squares method. Then test the model's ability to predict through tests assessing prediction as Theil's Inequality Coefficient, the lowest value for the standards root mean squares Error (RMSE),and Mean Absolute Error(MAE).this methodology Box- Jenkins have used in estimating the area, national production, consumption, gap and self-sufficiency ratios for Faba bean and during the period (2015-2024).

Theil's Inequality Coefficient T =

$$\sqrt{\frac{\Sigma\ (y_e - y_a)^2}{n-K}}$$

Where:- d_e = Change in the expected value of the dependent variable ,d_a = Change in the actual value of the dependent variable.

RMSE =

Where:-

y_e= Actual value of the dependent variable during the period outside the sample.

y_a= The expected value of the dependent variable during the period outside the sample, n =number of observation, K =number of parameter.

The research drew its data from official sources of the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Central Administration of Agricultural Economics, General Department of Statistics records, the bulletin of foreign trade exports and imports of agricultural statistics, and bulletin food balance. The using of studies and researches related to the field of research, Ministry of Planning, monitoring and administrative reform, in addition site on the web.

RESULTS AND DISCUSSION

(I) Economic Indicators for current legumes group (Tables 1 and 2)

(a) Total cultivated area for legumes ranged between a minimum of 106 thousand feddans in 2010, which represent about 0.7% of Total Cropped Area[(1)] and a maximum of 469 thousand feddans in 1998, which represent about 3.4%of Total Cropped Area[(2)], reflecting a small relative importunacy of legumes within Egyptian cropping pattern.

(b) Faba Bean is the most important crop within legumes in Egypt, representing in a minimum of ca. 66% in 2002 and a maximum of ca. 85% in 2014.

(c) Lentil is the second imported crop and the fourth important crop with ca.1.3% of total cultivated legume area on average of 1993 – 2014.

Table 1: Development of Faba Bean and Lentil Areas, Production, Consumption, net production Available for Consumption and Self-sufficiency Rates in Relation to the total of leguminous the period (1993-2014).

Year	Faba bean Area	Lentil Area	Total legumes Area	The percentage of the Faba bean and lentil to the total legumes Area		National Production		National consumption		Net food available for consumption		Other total uses		Gap*		Import		Self – sufficiency ratio	
	(Thousand Feddan)					(Thousand metric tons)													
				Faba bean	lentil	Faba bean	lentil	Faba bean	lentil	Faba bean	Lentil	Faba bean	Lentil	Faba bean	lentil	Faba bean	lentil	**Faba bean**	**lentil**
1993	**265.865**	**20.093**	**361.045**	**73.64**	**5.57**	**43**	**12**	**193**	**72**	**193**	**58**	**105**	**6**	**-150**	**-60**	**263**	**66**	**22.28**	**16.7**
1994	**324.618**	**15.524**	**437.206**	**74.25**	**3.55**	**314**	**12**	**322**	**73**	**322**	**58**	**113**	**4**	**-8**	**-61**	**121**	**64**	**97.52**	**16.4**
1995	**294.662**	**10.945**	**377.786**	**78.00**	**2.9**	**373**	**7**	**437**	**31**	**437**	**25**	**66**	**2**	**-64**	**-24**	**133**	**32**	**85.35**	**22.6**
1996	**329.329**	**7.761**	**404.652**	**81.39**	**1.92**	**435**	**6**	**388**	**80**	**388**	**64**	**133**	**4**	**47**	**-74**	**88**	**78**	**112.1**	**7.5**
1997	**355.01**	**9.059**	**429.55**	**82.65**	**2.11**	**480**	**6**	**371**	**77**	**371**	**62**	**133**	**4**	**109**	**-71**	**29**	**77**	**129.4**	**7.79**
1998	**384.911**	**10.664**	**469.419**	**82.00**	**2.27**	**517**	**7**	**392**	**81**	**392**	**65**	**132**	**4**	**125**	**-74**	**18**	**80**	**131.9**	**8.64**
1999	**318.579**	**5.025**	**404.354**	**78.79**	**1.24**	**422**	**6**	**400**	**82**	**400**	**66**	**129**	**3**	**22**	**-76**	**88**	**78**	**105.5**	**7.32**
2000	**270.524**	**4.767**	**387.64**	**69.79**	**1.23**	**333**	**4**	**247**	**84**	**247**	**67**	**93**	**4**	**86**	**-80**	**74**	**84**	**134.8**	**4.76**
2001	**333.693**	**5.359**	**416.157**	**80.18**	**1.29**	**403**	**4**	**397**	**91**	**377**	**87**	**131**	**4**	**6**	**-87**	**197**	**113**	**101.5**	**4.40**
2002	**257.693**	**4.945**	**390.506**	**65.99**	**1.27**	**427**	**4**	**550**	**100**	**523**	**96**	**161**	**5**	**-123**	**-96**	**288**	**100**	**77.64**	**4.00**
2003	**252.256**	**4.151**	**320.554**	**78.69**	**1.29**	**341**	**3**	**501**	**61**	**476**	**59**	**143**	**3**	**-160**	**-58**	**308**	**61**	**68.06**	**4.92**
2004	**240.854**	**3.538**	**303.238**	**79.43**	**1.17**	**332**	**3**	**503**	**87**	**478**	**84**	**140**	**4**	**-171**	**-84**	**314**	**89**	**66**	**3.45**
2005	**198.72**	**2.532**	**257.449**	**77.19**	**0.98**	**283**	**2**	**511**	**105**	**485**	**101**	**142**	**4**	**-228**	**-103**	**380**	**108**	**55.38**	**1.9**
2006	**175.353**	**1.515**	**233.294**	**75.16**	**0.65**	**257**	**1**	**539**	**74**	**512**	**71**	**156**	**3**	**-282**	**-73**	**459**	**77**	**47.68**	**1.35**
2007	**211.97**	**1.875**	**265.889**	**79.72**	**0.71**	**305**	**2**	**476**	**82**	**452**	**79**	**115**	**3**	**-171**	**-80**	**301**	**84**	**64.08**	**2.44**
2008	**170.11**	**1.456**	**211.769**	**80.33**	**0.69**	**247**	**1**	**692**	**53**	**657**	**51**	**159**	**2**	**-445**	**-52**	**655**	**70**	**35.69**	**1.89**
2009	**205.99**	**1.908**	**272.159**	**75.69**	**0.7**	**298**	**1**	**630**	**97**	**599**	**93**	**146**	**4**	**-332**	**-96**	**518**	**106**	**47.3**	**1.03**
2010	**183.69**	**3.285**	**231.802**	**79.24**	**1.42**	**234**	**2**	**558**	**106**	**530**	**102**	**136**	**10**	**-324**	**-104**	**480**	**126**	**41.94**	**1.89**
2011	**131.43**	**2.523**	**169.648**	**77.47**	**1.49**	**175**	**2**	**393**	**90**	**373**	**86**	**90**	**4**	**-218**	**-88**	**313**	**97**	**44.53**	**2.22**
2012	**97.906**	**0.807**	**119.754**	**81.76**	**0.67**	**141**	**1**	**304**	**65**	**289**	**62**	**72**	**3**	**-163**	**-64**	**250**	**80**	**46.38**	**1.54**
2013	**104.917**	**0.862**	**125.049**	**83.9**	**0.69**	**158**	**1**	**465**	**63**	**442**	**60**	**103**	**3**	**-307**	**-62**	**425**	**69**	**33.98**	**1.59**
2014	**89.707**	**0.975**	**105.633**	**84.92**	**0.92**	**134**	**1**	**341**	**61**	**324**	**59**	**77**	**3**	**-207**	**-60**	**305**	**77**	**39.3**	**1.64**
Average	**236.263**	**5.435**	**304.298**	***78.06**	***1.31**	**302**	**4**	**437**	**78**	**421**	**71**	**122**	**4**	**-135**	**-74**	**273**	**83**	**64.24***	***3.83**

-* The average of the percentage and self-sufficiency ratio has been calculating on the basis of geometric mean.
- ** Self-sufficiency ratio= domestic production/ domestic consumption (in percentage) - Other total uses = wastage + seeds + animal feed + industry. - GAP* = total domestic consumption - total domestic production, Figures in brackets refer to { (+) surplus ,(-) deficit }.

- Source: Ministry of Agriculture and land Reclamation - Economic Affairs Sector - Central Administration of Agricultural Economy - General Department of Statistics -food balance Bulletin - different numbers.

[(1,2)]Ministry of Agriculture and land reclamation, economic affairs sector, the Central Administration of Agricultural Economics, Public Administration of agricultural economic resources, statistical agricultural Bulletin, various issues, 1998,2010
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(d) With exception of 6 years 1996 – 2001, Faba beans production cover domestic consumption and there was a surplus in production, so that the gap was ranging between 445 thousand metric ton in 2008 as maximum and 8 thousand metric tons in 1994, averaging ca.134 thousand metric ton for the whole period of time between 1993 and 2014.

(e) Production of both Faba bean and lentil have witnessed decreasing time trends of about 9.85 thousand and 0.31 thousand metric tons respectively (Table 2). This is due to significantly decreasing time trends of cultivated areas for both crops. An important reason for the decreasing trend in Faba bean area is due to 2011 spreading jury of "Mosaic Faba bean virus" "Balkiros " in the most important the provinces of Upper Egypt, especially in the governorates of Minya and Assiut , Which caused loss for Faba bean farmers, led to the reluctance of farmers for the cultivation of this crop. Table 1 shows a significant time trend decrease in cultivated area of Faba bean during the period (1993-2014). Faba bean and lentil areas were declined from about 314 and 12.7 thousand Feddan as an average of 1993- 1997 to about 121.5 and 1.7 thousand Feddan as an average of 2010- 2014 of both crops respectively. The estimated determination coefficient indicates that 80% of the changes in the Faba bean area are explained due to the factors that reflected the element of time (Table 2).

Table 2: Coefficients of General Time Trend Equations for the indicators of area, production, National consumption, gap, Self-sufficiency ratio and imports of Faba bean and lentil in Egypt During the period (1993-2014)

Variable	Unit	A	B	T_b	R^2	F	Mean	Growth Rate
Faba bean cropped area	(Thousand Fadden)	373.331	-11.919	(-8.872) **	0.80	(78.71) **	236.263	-5.05
Domestic production	(thousand tons)	415.649	-9.8509	(-2.754)**	0.27	(7.584)**	302.00	-3.262
National consumption		349.065	7.631	(2.014) *	0.17	(4.056)*	437.00	1.75
Net food available for consumption		350.156	6.180	(1.737) --	0.13	(3.0196) --	421.00	1.468
Gap of Faba bean		-66.584	17.482	(4.643) **	0.52	(21.555)**	134.00	13.052
Total other uses		125.74	- 0.361	(- 0.372) --	0.007	(0.138)--	122.00	-0.297
Imports of Faba bean		67.403	17.882	(4.1868)**	0.47	(17.530)**	273.00	6.550
Self-sufficiency ratio	%	111.513	-3.419	(-3.697)**	0.41	(13.664)**	64.24	-5.32
Cropped area of Lentil	(Thousand Feddan)	13.109	-0.667	(-7.381) **	0.73	(54.477) **	5.435	-12.28
Domestic production	(thousand tons)	9.195	-0.452	(- 8.561)**	0.79	(73.285)**	4.00	-11.3
National consumption		74.442	0.305	(0.499)--	0.012	(0.249)--	78.00	0.392
Net food available for consumption		59.286	0.991	(1.653)--	0.12	(2.733) --	71.00	1.402
Gap of lentil		65.247	0.7572	(1.222) --	0.07	(1.4938) --	74.00	1.024
Total other uses		3.974	-0.006	(-0.101) --	0.001	(0.010) --	4.00	-0.141
Imports		68.584	1.214	(1.879)--	0.15	(3.530)--	83.00	1.500
Self-sufficiency ratio	%	14.057	-0.724	(-6.182) **	0.66	(382.15)**	5.72	-12.7

Where:- α = constant, β = regression coefficient, F=value (F) calculated, R^2= determination coefficient, T_b = refers to the value of (t) calculated for the regression coefficients, Growth Rate = annual change / Mean of (Y) for the period x 100, (**) Indicate significance at the 5% level, (--) Indicate non- significance at the 5% level.

Source: computed from Table (1).

(f) The profitability per unit of land among winter competitive crops is one of the most important factors that have played a role of keeping grown area of Faba bean on its minimum.

(g) As result of rapid population growth national consumption of both Faba bean and lentil has increased and thus the value of imports to ca. 273 and 83 thousand tons annually on average in

last 22 years. This has increased the burden on both the trade balance and the Egyptian balance of payments (Table 1).

(h) Time trends were statistically estimated for the economic indicators of Faba bean and lentil and the results are shown in table 2. In general, the results indicate decreased time trends of area, production, and self-sufficiency of ca. 12 thousand Feddan, 10 thousand ton, and 3.4% decrease of self-sufficiency ratio for Faba bean and similarly 0.667 thousand Feddan, 0.452 thousand ton, and 0.72% decreasing in self-sufficiency ratio of lentil. With decreasing an annual rate growth of about 12.28%, 11.3%, 12.7% of the average of the cultivated area, production and self-sufficiency ratio of lentil.

(i) **T**he results in Table 2 indicates that the national consumption and the gap that also has taken the decreasing trend, amounted to about 7.631,17.482 thousand tons respectively during the period, at an annual growth rate an increasing amounted about 1.75%, 13.05 % of the annual average for national consumption and gap of Faba bean.

(j) As it is clear also that the high ratio of the loss of Faba bean, which represents about 23.7% of average total other uses, which amounting to about 122 thousand tons during the period. Therefore, the Egypt loses part of the production can provide by reducing the size of the losses to fill part of the needs of national consumption.

(k) As it turns out that the total other uses of lentil has taken decreasing general trend. Total other uses of lentil depends on the size of the losses ,the seed ,heading for industry amounting about 3.7, 0.4, 0.02 thousand tons, representing each about 89%,10.5%,0.5% respectively of average total other uses, amounting about 4.1 thousand tons during the study period.

(l) As the same table indicates that imports of lentil in the same period of the study has taken an increasing general trend, amounted to about 1.214 thousand tons, growing at an annual growth rate of about 1.46%.

(m) All regression coefficients and statistical fitness of estimated models were significant at level 0.05. As shown in Table 2, all T-test values, F-test and R^2 values were significantly proved.

(II) Prediction of Faba Bean Production Indicators until 2024 using ARIMA* & General Trend Models

1. The first scenario is the most pessimistic model for area ,production and self- sufficiency ratio of Faba bean:-

    a) The tables No. (3),(4),(5) and Equation (1) indicates to the continuing decrease in the predicted total area of the Faba bean using ARIMA model(1,0,0) during the period (2015-2024), where the area is predict to reach 11.818 thousand Feddan, ranging from a maximum of about 90 thousand Feddan and a minimum of about 66.6 thousand Feddan in 2020.
    b) Predicted area using ARIMA technique is lower than that of using a general time trend model, expecting to reach ca. 39.6 thousand Feddan in 2020.
    c) The results of ARIMA model are more accurate those of the general time trend model, through the stability and stationary for time series, than select the best models according to the criteria AIC, SC, where amounted to (10.398), (10.497)respectively. As the most important problems of measurement have been eliminated, where amounted the value of the Test Durbin Watson (about 2.359), as well as the criteria of the evaluating the model's ability on predict such as the value of Theil's coefficient amounting to about (0.057),the value of root mean squared-errors amounting to about (28.486) and the value of the mean absolute –errors amounting to about (22.394). Where the ARIMA a dynamic model that takes effect the rest of the other variables on the dependent variable.

Table 3: Coefficients of ARIMA models for indicators of area, production and Self-sufficiency ratio of Faba bean in Egypt during the period (2015-2024).

ARIMA Model				C	AR(1)	AR(2)	AR(3)	MA(1)	MA(2)	R^2	F
Equation	1	(1,0,0)		54.347	0.9556					0.79	70.409
			t-Statistic	(0.103)	(-8.391)						
			Prob.*	(0.919)	(0.000)						(0.0000)
	2	(2,0,0)		221.624	0.685	-0.1838				0.77	28.969
			t-Statistic	(1.2028)	(6.065)	(-1.145)					
			Prob.*	(0.2455)	(0.000)	(0.268)					(0.0000)
	3	(0,0,1)		72.6233				0.9309		0.43	15.278
			t-Statistic	(6.6341)				(16.726)			
			Prob.*	(0.0000)				(0.0000)			(0.0009)

Where:- C = constant, AR = Autoregressive, MA = Moving Average, R^2 = determination coefficient, F = value (F) calculated, Figures in brackets refer to the p- value (Prob.*) and the value of (T-Statistic) calculated for the regression coefficients. .

Source: computed and applied using E-views 8 program.

Table 4: Criteria for assessing ARIMA model for indicators of area, production and Self-sufficiency ratio of Faba bean in Egypt during the period (2015-2024).

Equation	ARIMA Model	Log-likelihood	AIC	SC	HQC	D.W	Theil's	R.M.S.E	M.A.E
1	(1,0,0)	-107.18	10.398	10.497	10.42	2.359	0.057	28.486	22.394
2	(2,0,0)	-107.556	11.055	11.205	11.085	2.219	0.055	36.435	28.205
3	(0,0,1)	-102.58	9.508	9.607	9.531	2.192	0.107	17.365	13.575

Source: computed and applied using E-Views 8 program.

Table 5: Prediction of indicators Area, national production and the percentage of self-sufficiency for Faba bean using ARIMA and Time Trend models in Egypt during the period (2015-2024)

Items	Year	ARIMA Model (1)Faba bean Area (Thousand Feddan)			The predicted Area by time trend Equation	ARIMA Model (2)Faba bean national production (Thousand metric tons)			The predicted production by time trend Equation	ARIMA Model (3)Faba bean percentage self-sufficiency (Thousand metric tons)			The predicted self-sufficiency by Linear Regression Equation
		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected	
1	2015	155.198	9.625	82.411	99.196	217.794	14.398	116.096	179.227	57.527	-7.05	25.238	32.879
2	2016	142.054	-5.469	68.293	87.277	199.73	-7.067	96.332	169.376	53.5	-12.286	20.607	29.46
3	2017	128.986	-20.639	54.174	75.358	181.809	-28.675	76.567	159.525	49.513	-17.562	15.976	26.042
4	2018	115.99	-35.879	40.055	63.439	164.025	-50.419	56.803	149.674	45.565	-22.876	11.345	22.623
5	2019	103.062	-51.189	25.937	51.52	146.368	-72.292	37.038	139.823	41.653	-28.227	6.713	19.204
6	2020	90.199	-66.564	11.818	39.601	128.834	-94.286	17.274	129.972	37.775	-33.611	2.082	15.785
7	2021	77.399	-82.001	-2.301	27.682	111.413	-116.395	-2.491	120.121	33.929	-39.027	-2.549	12.366

Source: computed and applied using E-Views 8 program.

d) The tables No. (3),(4),(5) and Equation (2) using ARIMA model (2,0,0) predicted estimation for Faba bean production in 2020 would amount ca. 17.274 thousand tons, ranging from a maximum of about 128.83 thousand tons and a minimum of about –94.286 thousand tons when using ARIMA model, but 129.972 thousand when using general time trend.

e) The criteria AIC, SC for Faba bean production amounted to (11.06), (11.21) respectively, and the value of the Test Durbin Watson (about 2.22), the Theil's coefficient amounting to about (0.055), as well as the value of root mean squared-errors and the value of the mean absolute –errors amounting to about (36.435), (28.205) respectively.

f) Showing also from the same tables and Equation (3) the continued decrease in the Predicted self-sufficiency ratio of Faba bean by using ARIMA model (0,0,1) during the same period, that amounts to about 3.08% in 2020.while using a general time trend model, expecting to reach ca. 15.8% in 2020.

g) The criteria AIC, SC, the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute –errors for Faba bean self-sufficiency ratio those of amounting to about(9.51),(9.61),(2.19),(0.107), (17.356), (13.575) respectively.

2. The second scenario is the most optimistic model for Faba bean production and Self-sufficiency ratio:-

a. The tables No. (6),(7),(8) and Equation (1) indicates to the continuing decrease in the Predicted estimation for Faba bean production using ARIMA model (0,0,1) during the period (2015-2024),where production is predict to reach ca.13.58 thousand tons, ranging from a maximum of about 138.7 thousand tons and a minimum of about -111.5 thousand ton in 2024.

b. Predicted production using ARIMA technique is lower than that of using a general time trend model, expecting to reach ca. 90.57 thousand tons in 2024.

c. According to the criteria for assessing and criteria of the evaluating the model's ability on predict to ARIMA model is good, where the criteria AIC, SC, where amounted to (11.314),(11.464) respectively, the value of the Test Durbin Watson (about 2.409), the value of Theil's coefficient amounting to about (0.062), as well as the value of root mean squared-errors and the value of the mean absolute –errors amounting to about (59.398), (46.617).

Table 6: Coefficients of ARIMA models for production and Self-sufficiency ratio of Faba bean in Egypt during the period (2015-2024).

ARIMA Model				C	AR(1)	AR(2)	AR(3)	MA(1)	MA(2)	R^2	F
Equation	1	(0,0,1)		455.087				0.9171		0.74	27.408
			t-Statistic	(8.567)				(12.582)			
			Prob.*	(0.0000)				(0.0000)			(0.0000)
	2	(3,0,2)		86.926	0.9751	0.1219	-0.302	-1.914	0.994	0.97	56.716
			t-Statistic	(2.187)	(3.561)	(0.296)	(-1.51)	(-5.381)	(14.801)		
			Prob.*	(0.0493)	(0.004)	(0.773)	(0.157)	(0.0002)	(0.000)		(0.0000)

Where:- C = constant, AR = Autoregressive, MA = Moving Average, R^2 = determination coefficient, F = value (F) calculated, Figures in brackets refer to the p- value (Prob.*) and the value of (T-Statistic) calculated for the regression coefficients. .

Source: computed and applied using E-views 8 program.

Table 7: Criteria for assessing ARIMA model for indicators of production, Self-sufficiency ratio of Faba bean in Egypt during the period (2015-2024)

Equation	ARIMA Model	Log-likelihood	AIC	SC	HQC	D.W	Theil's	R.M.S.E	M.A.E
1	(0,0,1)	-121.464	11.314	11.464	11.350	2.409	0.092	59.398	46.617
2	(3,0,2)	-61.958	7.257	7.606	7.316	2.208	0.547	8.794	6.123

Source: computed and applied using E-Views 8 program.

d. Showing also from the same tables and Equation (2) the continued decrease in the Predicted self-sufficiency ratio of Faba bean by using ARIMA model (3,0,2) during the same period, that amounts to about 14.9% in 2024.while using a general time trend model, expecting to reach ca. 2.1% in 2024.
e. According to the criteria for assessing and criteria of the evaluating the model's ability on predict to ARIMA model is beater than that of using a general time trend model, where the criteria AIC, SC, the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute –errors for Faba bean self-sufficiency ratio those of amounting to about (7.257), (7.06),(2.208),(0.547), (8.794)and (6.123) respectively.
f. According to ARIMA model, the area of Faba beans will decrease until reaching its minimum in 2020. Socio-economic variables such as real income, produced prices, new varieties, new production technology must be investigated to overcome negative impacts of lower predicted area of Faba bean in 2020 for the first scenario that is the most pessimistic model
g. As clear from previous results, ARIMA model are more accurate than those of the general time trend model, after transform time series to the stability and stationary series, and according to using criteria of the evaluating the model's ability on predict and criteria assessing model for two scenarios to Faba bean production and self-sufficiency.

Table 8: Prediction of indicators national production, self-sufficiency rtio for Faba bean using ARIMA and Time Trend models during the period (2015-2024).

Items	Year	ARIMA Model (1)Faba bean national production (Thousand metric tons)			The predicted production by time trend Equation	ARIMA Model (2)Faba bean percentage self-sufficiency (Thousand metric tons)			The predicted self-sufficiency by Linear Regression Equation
		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected	
1	2015	245.044	38.472	141.758	179.227	48.630	23.930	36.28	32.879
2	2016	232.775	22.256	127.516	169.376	46.920	21.229	34.07	29.460
3	2017	220.636	5.911	113.274	159.525	45.159	18.330	31.74	26.042
4	2018	208.619	-10.557	99.031	149.674	43.382	15.298	29.34	22.623
5	2019	196.717	-27.139	84.789	139.823	41.615	12.189	26.90	19.204
6	2020	184.922	-43.829	70.547	129.972	39.877	9.039	24.46	15.785
7	2021	173.229	-60.620	56.305	120.121	38.182	5.875	22.03	12.366
8	2022	161.630	-77.505	42.062	110.270	36.534	2.708	19.62	8.947
9	2023	150.119	-94.479	27.820	100.420	34.936	-0.456	17.24	5.528
10	2024	138.691	-111.536	13.578	90.569	33.383	-3.619	14.88	2.109

Source: computed and applied using E-Views 8 program.

3. Prediction of National consumption and Gap of Faba bean:-

a. Equation (1) in the tables No.(9),(10) and table (11) summarize the results of ARIMA prediction for national consumption of Faba bean using ARIMA model (0,0,1) during the same period ,and refers to the continuing increase that amounts to about 561.768 thousand tons, ranging from a maximum of about 888.7 thousand tons and a minimum of about 234.8 thousand tons in 2024.
b. As it is clear the estimate of the predicted national consumption by using ARIMA model approaching from the predicted by using general time trend model, expecting to reach ca. 593,25 thousand tons in 2024.

c. The criteria AIC, SC for Faba bean national consumption amounted to (12.17),(12.27) respectively, and the value of the Test Durbin Watson (about1.90),the Theil's coefficient amounting to about (0.116),as well as the value of root mean squared-errors and the value of the mean absolute –errors amounting to about (103.87), (81.21)respectively.

d. Equation (2) in the same tables summarize the results of ARIMA prediction for size of the gap of Faba bean using ARIMA model (1,0,1) during the same period ,that would reach to ca.560 thousand tons, ranging from a maximum of about 818.42 thousand tons and a minimum of about 301.58 thousand tons in 2024

Table 9: Coefficients of ARIMA models for indicators of national consumption and gap of Faba bean in Egypt during the period (2015-2024).

		ARIMA Model		C	AR(1)	AR(2)	AR(3)	MA(1)	MA(2)	R^2	F
Equation	1	(0,0,1)		433.299				0.686		0.32	9.543
			t-Statistic	(11.938)				(4.252)			
			Prob.*	(0.000)				(0.0004)			(0.0058)
	2	(1,0,1)		188.917	0.8967			-0.2959		0.63	15.462
			t-Statistic	(1.0607)	(6.550)			(-1.0632)			
			Prob.*	(0.3028)	(0.000)			(0.3017)			(0.000)

Where:- C = constant, AR = Autoregressive, MA = Moving Average, R^2 = determination coefficient, F = value (F) calculated, Figures in brackets refer to the p- value (Prob.*) and the value of (T-Statistic) calculated for the regression coefficients. .

Source: computed and applied using E-views 8 program.

Table 10: Criteria for assessing ARIMA model for indicators of national consumption and gap of Faba bean and lentil during the period (2015-2024)

Equation	ARIMA Model	Log-likelihood	AIC	SC	HQC	D.W	Theil's	R.M.S.E	M.A.E
1	(0,0,1)	-131.86	12.169	12.268	12.192	1.904	0.116	103.868	81.206
2	(1,0,1)	-125.56	12.243	12.393	12.276	1.905	0.254	96.195	80.634

Source: computed and applied using E-Views 8 program.

Table 11: Prediction of indicators national consumption and the gap for Faba bean using ARIMA and Linear Regression models during the period (2015-2024).

Items	Year	ARIMA Model (4)Faba bean National Consumption (Thousand metric tons)			The predicted consumption by Time Trend Equation	ARIMA Model(5)Faba bean Gap (Thousand metric tons)			The predicted Gap by Time Trend Equation
		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected	
1	2015	777.921	231.52	504.721	524.571	585.439	130.463	357.951	335.494
2	2016	789.118	233.001	511.059	532.202	610.49	150.311	380.401	352.975
3	2017	800.63	234.166	517.398	539.833	635.77	169.931	402.85	370.457
4	2018	812.441	235.032	523.736	547.464	661.27	189.33	425.3	387.938
5	2019	824.534	235.616	530.075	555.094	686.982	208.518	447.75	405.42
6	2020	836.893	235.934	536.413	562.725	712.898	227.502	470.2	422.902
7	2021	849.502	236.002	542.75	570.356	739.009	246.291	492.65	440.383
8	2022	862.347	235.834	549.091	577.986	765.305	264.894	515.1	457.865
9	2023	875.413	235.445	555.429	585.617	791.78	283.319	537.55	475.347
10	2024	888.686	234.849	561.768	593.248	818.424	301.575	559.999	492.828

Source: computed and applied using E-Views 8 program.

e. As shown decline in estimation of the predicted gap using ARIMA model about the estimation using a general time trend amounting to about 492.83 thousand tons in 2024.
f. According to the criteria for assessing and criteria of the evaluating the model's ability on predict to ARIMA model is beater than that of using a general time trend model, where the criteria AIC, SC, the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute –errors for Faba bean self-sufficiency ratio those of amounting to about (7.257), (7.06),(1.91),(0.254), (96.195) and (80.63) respectively.

(III) Prediction of lentil Production Indicators until 2024 using ARIMA & General Trend Models*

1. Prediction of area ,production and National consumption of lentil :-

a) Equations 1 and 2 in Table No. (12),(13) and (14) summarize the results of ARIMA prediction for lentil. Predicted production and area would reach its maximum in 2024.
b) It is clear from ARIMA model takes technique the First differencing operation for prediction area and production of lentil, which makes the series stability and stationary.
c) ARIMA model (0,1,2) indicates to the continuing increase in the predicted area of lentil, expecting to reach ca. 0.644 thousand Feddan in 2024. while it is clear the estimates of the predicted area continuing to decreased by using general time trend during the predicted period.
d) As clear from previous results of ARIMA model, that the total predicted area of the lentil crop will be increasing very slightly, during the future period.
e) The results of the criteria AIC, SC for lentil prediction area amounted to (3.651) ,(3.799) respectively, the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute –errors those of amounting to about (2.223),(0.566), (1.731) and (1.226) respectively.
f) As It is clear from the same tables predicted lentil production in 2024 would amount ca. 0.498 thousand tons when using ARIMA model (2,1,1) but continuing to decline when using general time trend during the predicted period.
g) The results of the criteria AIC, SC for lentil prediction production amounted to (2.55) ,(2.75) respectively. the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute – errors those of amounting to about (2.031), (0.578),(0.716) and (0.578)respectively.

Table 12: Coefficients of ARIMA models for indicators of Area, Production and National consumption of lentil in Egypt during the period (2015-2024)

ARIMA Model				C	AR(1)	AR(2)	AR(3)	MA(1)	MA(2)	R^2	F
Equation	1	(0,1,2)		-0.4384				-0.0244	-0.9702	0.56	11.298
			t-Statistic	(-1.444)				(-0.1225)	(-4.895)		
			Prob.*	(0.1658)				(0.9309)	(0.0001)		(0.0006)
	2	(2,1,1)		-0.3399	0.1354	-0.2198		-0.349		0.22	1.4435
			t-Statistic	(-2.914)	(0.806)	(-1.573)		(-1.228)			
			Prob.*	(0.0010)	(0.433)	(0.137)		(0.238)			(0.269)
	3	(0,0,2)		77.923				0.1107	-0.052	0.016	0.160
			t-Statistic	(18.445)				(0.4718)	(-0.219)		
			Prob.*	(0.000)				(0.6424)	(0.8288)		(0.853)

Where:- C = constant, AR = Autoregressive, MA = Moving Average, R^2 = determination coefficient, F = value (F) calculated, Figures in brackets refer to the p- value (Prob.*) and the value of (T-Statistic) calculated for the regression coefficients. .
Source: computed and applied using E-views 8 program.

h) Equation 3 in Table No. (12),(13) and (14) summarize the results of ARIMA prediction for lentil. Predicted national consumption would reach its maximum in 2024 when using

ARIMA model (0,0,2), that amounts to about 85.046 thousand tons, ranging from a maximum of about 108.786 thousand tons and a minimum of about 61.306 thousand tons in 2024.

Table 13: Criteria for assessing ARIMA model for indicators of area, production and national consumption lentil in Egypt during the period (2015-2024).

Equation	ARIMA Model	Log-likelihood	AIC	SC	HQC	D.W	Theil's	R.M.S.E	M.A.E
1	(0,1,2)	-35.331	3.651	3.7998	3.683	2.223	0.566	1.7308	1.2258
2	(2,1,1)	-20.268	2.554	2.753	2.588	2.031	0.578	0.716	0.578
3	(0,0,2)	-93.968	8.815	9.964	8.85	1.947	0.112	17.768	14.218

Source: computed and applied using E-Views 8 program.

Table 14: Prediction of indicators area, production and national consumption for lentil using ARIMA and Linear Regression models during the period (2015-2024).

Items	Year	ARIMA Model(6)lentil Area (Thousand Feddan)			The predicted Area by Time Trend Equation	ARIMA Model (7)Lentil production (Thousand metric tons)			The predicted production by Time Trend Equation	ARIMA Model (8) Lentil Consumption (Thousand metric tons)			The predicted consumption by Time Trend Equation
		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected	
1	2015	3.1	-2.894	0.103	-2.239	0.924	-0.75	0.087	-1.195	102.997	60.984	81.99	81.468
2	2016	3.169	-2.843	0.163	-2.906	0.97	-0.706	0.132	-1.647	103.578	61.081	82.33	81.773
3	2017	3.239	-2.793	0.223	-3.574	1.017	-0.661	0.178	-2.098	104.177	61.162	82.669	82.078
4	2018	3.31	-2.743	0.283	-4.241	1.063	-0.616	0.224	-2.55	104.792	61.226	83.009	82.384
5	2019	3.382	-2.695	0.343	-4.908	1.11	-0.571	0.27	-3.002	105.422	61.275	83.349	82.689
6	2020	3.454	-2.647	0.404	-5.575	1.157	-0.527	0.315	-3.453	106.067	61.309	83.688	82.995
7	2021	3.527	-2.6	0.464	-6.243	1.204	-0.482	0.361	-3.905	106.727	61.328	84.028	83.3
8	2022	3.601	-2.554	0.524	-6.91	1.251	-0.438	0.407	-4.357	107.401	61.334	84.367	83.606
9	2023	3.676	-2.508	0.584	-7.577	1.299	-0.394	0.452	-4.809	108.087	61.326	84.707	83.911
10	2024	3.752	-2.464	0.644	-8.245	1.346	-0.35	0.498	-5.26	108.786	61.306	85.046	84.217

Source: computed and applied using E-Views 8 program.

i) The estimate of the predicted consumption by using ARIMA model approaching from the expected estimate when using general time trend. So expecting to reach ca.84.217 thousand tons in 2024.

j) The results of the criteria AIC, SC for lentil prediction consumption amounted to (8.815), (9.96), respectively. the value of the Test Durbin Watson, the Theil's coefficient, the value of root mean squared-errors and the value of the mean absolute – errors those of amounting to about (1.95), (0.112),), (17.768)) and (14.218)respectively.

2. Prediction of Gap and self- sufficiency ratio of lentil :-

a) Equations 1 and 2 in Table No. (15),(16) and (17) summarize the results of ARIMA prediction for lentil. Predicted gap and self-sufficiency ratio would reach its maximum in 2024.

b) . As shown in Table 17 the continuous increase in the predicted gap of lentil when using the ARIMA model (0,0,2), where the size of the expected gap ca. 88.887 thousand tons, ranging from a maximum of about 139.171 thousand tons and a minimum of about 38.603 thousand tons in 2024.

c) The predicted gap by using ARIMA model (0,0,2) approaching from the predicted estimate by using general time trend amounting to about 89.477 thousand tons in 2024.

Table 15:Coefficients of ARIMA models for indicators of gap and Self-sufficiency ratio of lentil in Egypt during the period (2015-2024).

ARIMA Model				C	AR(1)	AR(2)	AR(3)	MA(1)	MA(2)	R^2	F
Equation	1	(0,0,2)		73.664				0.2432	0.0955	0.052	0.529
			t-Statistic	(13.681)				(1.0594)	(0.4151)		
			Prob.*	(0.000)				(0.3026)	(0.6827)		(0.597)
	2	(0,1,2)		-0.7853				-0.584	0.9928	0.22	2.605
			t-Statistic	(-1.971)				(-2.493)	(0.405)		
			Prob.*	(0.064)				(0.022)	(0.690)		(0.101)

Where:- C = constant, AR = Autoregressive, MA = Moving Average, R^2 = determination coefficient, F = value (F) calculated, Figures in brackets refer to the p- value (Prob.*) and the value of (T-Statistic) calculated for the regression coefficients. .

Source: computed and applied using E-views 8 program.

Table 16: Criteria for assessing ARIMA model for indicators of gap and Self-sufficiency ratio of lentil in Egypt during the period (2015-2024)

Equation	ARIMA Model	Log-likelihood	AIC	SC	HQC	D.W	Theil's	R.M.S.E	M.A.E
1	(0,0,2)	-94.478	8.862	9.01	8.897	1.989	0.119	17.943	14.633
2	(0,1,2)	-54.062	5.435	5.584	5.467	1.935	0.845	3.577	1.722

Source: computed and applied using E-Views 8 program.

Table 17: Prediction of the gap and self-sufficiency ratio for lentil using ARIMA and Linear Regression models during the period (2015-2024).

Items	Year	Model ARIMA (9) Lentil Gap (Thousand metric tons)			The predicted Gap by Time Trend Equation	Model ARIMA (10) Lentil self-sufficiency (Thousand metric tons)			The predicted self-sufficiency by Time Trend Equation
		Upper Limits	Lower Limits	Expected		Upper Limits	Lower Limits	Expected	
1	2015	125.781	38.746	82.264	82.662	4.058	-3.614	0.222	-2.608
2	2016	127.122	38.878	83.000	83.42	4.128	-3.568	0.280	-3.332
3	2017	128.503	38.968	83.735	84.177	4.200	-3.522	0.339	-4.057
4	2018	129.924	39.019	84.471	84.934	4.272	-3.477	0.398	-4.781
5	2019	131.381	39.033	85.207	85.691	4.346	-3.433	0.456	-5.506
6	2020	132.875	39.012	85.943	86.448	4.421	-3.391	0.515	-6.231
7	2021	134.402	38.956	86.679	87.206	4.496	-3.349	0.574	-6.955
8	2022	135.961	38.868	87.415	87.963	4.573	-3.308	0.632	-7.680
9	2023	137.552	38.750	88.151	88.720	4.650	-3.269	0.691	-8.404
10	2024	139.171	38.603	88.887	89.477	4.729	-3.23	0.750	-9.129

Source: computed and applied using E-Views 8 program.

d) The criteria AIC, SC, where amounted to (8.862), (9.01), respectively. As the value of the Durbin Watson Test amounted (about 1.99), the Theil's coefficient amounting to about (0.119), as well as the value of root mean squared-errors amounting to about (17.943), and the value of the mean absolute –errors amounting to about (14.632).

e) As also shown in Table 17 ARIMA model takes technique the First differencing operation and continuous a slight increase in the predicted self-sufficiency ratio of lentil when using the ARIMA model(0,1,2), where the expected predicted ca. 0.75%,ranging from a maximum of about 4.73% and a minimum of about -3.23% in 2024.While continuous decline when using general time trend through the same period of prediction.

f) The criteria AIC, SC, Durbin Watson Test , Theil's coefficient where those of amounted to (5.43),(5.58),(1.94),(0.845),as well as the value of root mean squared-errors and the mean absolute –errors amounting to about (3.577),(1.722) respectively.

CONCLUSIONS

Major findings of existing study are when comparing the results of ARIMA models with those gained by the general time trend models, shows an agreement between the results of the predicted estimates resulted by ARIMA and general time trend models with the exception of the predicted estimates of area, production and self-sufficiency ratios for lentil crop , where was found that the predicted results by ARIMA models reverse the predicted results by general time trend models.

Reasons are due to converting time-series to stability and stationary chains during the study period by applying autoregressive, integration which make the number of differencing operations, moving average, and after eliminated the most important problems of Econometrics and tests the modeling accuracy which has been proven according to the criteria of the evaluating the ability of the model on predict. Than ARIMA results seem to be more accurate. So the study suggests relying on ARIMA to predict production and consumption for important crops.

Existing study shows also decreased predicted values of production of Faba bean, reaching 13.578 thousand tons in 2024 according to the second scenario. This is to be compared with increased predicted consumption value of about 561.768 thousand tons at the end of forecasting period in 2024. Consequently, the size of the food gap will continue increasing to reach about 559.999 thousand tons in 2024. Ratio of self-sufficiency would be affected adversely achieving its lowest value at about 2.109% in 2024.

As for lentil, ARIMA model predicted grown area (and production) would be about 0.644 thousand Feddan (0.498 thousand tons) in 2024. Meanwhile, consumption of lentil would also increase at about 85.05 thousand tons in 2024.

It leads to increase in the size of the gap between production and consumption, that affecting negatively on achieved self-sufficiency ratio where, the results showed the continued increasing size of the predicted gap reaching about 88.89 thousand tons in 2024, while increasing self-sufficiency slight increase almost to contact to about 1% in the same year.

Generally speaking that Egypt will depend mainly in the future period (2015 -2024) on imports, in the provision of food needs of leguminous crops (beans and lentil), Resulting in a decline in the trade balance and balance of Egyptian payments. But regarding the plan approved by the Government to increase the agricultural area of about 1.5 million Feddan, it is expected self-sufficient rates will rise in some agricultural crops, according to the plan.

RECOMMENDATION

- It is suggested that the area of legumes, especially Faba bean and lentil, as explained in research decreasing the total pulses area, should be increased so we need to allocate area for the cultivation of leguminous crops is estimated at about 213.6 , 112.8 thousand Feddan for crops of Faba bean and lentil, that equivalent of about 14.24% , 7.5% of new agricultural land (a million and a half Feddan) from Development project of the 4 million-Feddan, in the case of constant productivity ,This is due to high its nutritional importance, in addition to the importance of leguminous crops to improve soil properties and therefore not to use synthetic Nitrogen fertilizer in the planting of legumes which reduces environmental pollution. along with filling portion of food imports, which accounted for about 62.5%,89% of the total consumption of Faba bean and lentil, which represents a burden on the balance of Egyptian payments.

- The need to activate the role of Field Crops and Plant Pathology Research Institute in the fight against virus "Mosaic Faba bean" beside the importance of the role of agricultural extension to treat the problems facing the Faba bean farmers.

- Directing scientific research to produce high-yield varieties, which are appropriate for the new land to increase the national production of leguminous crops.
- It is clear from the previous results, the wastage ratios from Faba bean and lentil are estimated at 23.7%, 0.89%respectively. Therefore, the government must inject investments to reduce wastage an minimize the gap between national consumption and production , through improving the storage and harvesting methods
- Setting pricing policy that encourages farmers to cultivated these crops ,through adopt policies farmers support, as well as the tendency towards contract farming and establishment department of databases ,that provides information for farmers about cultivated area that hopeful, optional cropping patterns at the level of the republic, and prices that to guide farmers in order to increase production and reduce dependence on imports
- Should dependence on statistical models to predict in future studies as a guide to give the most accurate indicators useful in agricultural policy-making and put plans for production and investment to rationalize the financial and economic decisions for agricultural policies planners and decision -makers.

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دراسة تحليليه للتنبؤ بالإنتاج والإستهلاك القومي وبنسب الإكتفاء الذاتي لأهم محاصيل البقول في مصر

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باحث – معهد بحوث الاقتصاد الزراعي – مركز البحوث الزراعية

أعلنت الجمعية العامة للأمم المتحدة في دورتها الثامنة والستين عام 2016 سنة دولية للبقول، فالبقوليات كجزء من الإنتاج المستدام للأغذية يهدف لتحقيق الأمن الغذائي والتغذية، وتوفِّر البقول مصدراً حيوياً من البروتين النباتي والأحماض الأمينية وإنخفاض محتواها من الدهون وبديلاعن اللحوم وينبغي تناولها كجزء من نظام غذائي صحي لمعالجة البدانة وللوقاية من الأمراض المزمنة ، كما تساهم بنسبة في غذاء الحيوان .

هذا وتعاني مصر من وجود فجوة بين الإنتاج المحلي والإستهلاك القومي من بعض محاصيل البقول كالفول البلدي والعدس والفاصوليا الجافة واللوبياء الجافة بخاصة في السنوات الاخيرة والتي تستورد منها مصر كميات كبيرة لسد الفجوة الغذائية مما ترتب عليه تحمل الدولة أعباء استيراد حيث بلغت قيمة واردات البقول نحو2.617 مليار جنيه خلال الفترة (2010- 2014) وما يصاحب ذلك من تزايد حجم العجز في الميزان التجاري.

هذا وتبين النتائج تراجع المساحة والإنتاج المحلي من الفول نتيجة أصابة محصول الفول" بفيرس "موازيك الفول" الذي انتشر منذ عام 2011 ، وتزايد الإستهلاك القومي نتيجة التزايد في أعداد السكان مما أدي الي التزايد في حجم الفجوة وتناقص نسبة الإكتفاء الذاتي نتج عنه زيادة حجم الواردات لسد الاحتياجات، حيث تستورد مصر حوالي 62.5% من متوسط استهلاكها خلال فترة الدراسة. كما يتضح إرتفاع نسبة حجم الفاقد من الفول حيث تمثل نحو 23.7% من متوسط إجمالي الإستخدامات الأخري البالغة نحو 122 ألف طن خلال الفترة وبالتالي تفقد الدولة جزء من الإنتاج.

كما تبين أن المساحة والإنتاج قد أخذا اتجاهاًعاماً متناقصاً بلغ حوالي667 فدان،0.451 ألف طن علي الترتيب بمعدل نمو متناقص بلغ نحو 12.28%،11.3% من المتوسط السنوي للمساحة المزروعة والإنتاج خلال فترة الدراسة علي الترتيب، وقد ثبتت معنوية هذا التناقص إحصائياً. كما يتضح أن الإستهلاك القومي والغذاء الصافي قد أخذتا إتجاهاً عاماً متزايداً وكذلك متوسط حجم الفجوة بمقدار بلغ نحو 305، 991 ،757 طن متري، بمعدل نمو متزايداً بلغ نحو 0.93%،1.40%، 1.02% من المتوسط السنوي للإستهلاك القومي والغذاء الصافي وحجم الفجوة، ولم تثبت المعنوية الإحصائية للزيادة. كما يتضح تناقص نسبة الإكتفاء الذاتي من العدس بنسبة بلغت نحو 0.724% وقد ثبتت المعنوية الإحصائية للتناقص، وأن الواردات من العدس بنفس فترة الدارسة أخذت إتجاهاً عاماً متزايداً بمقدار بلغ نحو1.214 ألف طن ، وبمعدل نمو متزايداً بلغ نحو1.46%، ولم تثبت معنوية الزيادة احصائيا.

في حين تبين من نتائج التنبؤ أن نماذج التنبؤ ARIMA أدق من نماذج الإتجاهات الزمنية العامه لإعطاءها المؤشرات جيدة ويرجع ذلك بصفة خاصة الي خضوع تلك النماذج لدرجات اعلي من التحليل حيث يتم من خلالها تحويل السلاسل الزمنية الممتدة لأكثر من 20 عام الي سلاسل زمنية مستقرة وإجراءعدد من العمليات كالإنحدار الذاتي والتكامل وإستخدام االمتوسطات المتحركة والتخلص من جذر الوحدة وفقا لعدد من المعاييرمثل AIC,SC, HQC للتاكد من إستقرارتلك السلاسل الزمنية إستخدامها في علمية التنبؤ ، ثم التخلص من أهم مشاكل القياس التي تواجه عمليات التحليل ،وإجراء عدد من الإختبارات للتاكد من مقدرة النماذج علي التنبؤ مثل معامل عدم التساوي لثايل، ومعياري أقل قيمة لجذر متوسط مربعات خطأ والمتوسط المطلق للخطأ وهذا وفقا لمنهجية Box- Jenkins في تحليل السلاسل الزمنية.

تلك النتائج والمؤشرات جيدة ذات أهمية بالنسبة لمتخذي القرار تساعد في رسم السياسات الإنتاجية للحاصلات البقولية حيث أوضحت النتائج توقع إستمرار إنخفاض الإنتاج من الفول البلدي بإستخدام نموذج ARIMA(2,0,0) حيث تبلغ أدني قيمة عام 2020 وفقا للسيناريور الأول وهو النموذج الأكثر تشاؤما ، كما يتبين من السيناريور الثاني وهو النموذج الأكثر تفاؤلا إستمرار إنخفاض الإنتاج من الفول البلدي وفقا للنموذج ARIMA(0,0,1) حتي يصل الي حوالي 13.578ألف طن متري خلال عام 2024 بنهاية فترة التنبؤ.

مما يتبين منه أن مصرسوف تعتمد علي الإستيراد من الخارج مما يكلف الدولة عبء توفير العملات الأجنبية وبالتالي تتحول مصر من مرحلة العجز الحرج التي سادت خلال فترة الثمانيات حتي الآن الي مرحلة الإعتماد الكلي علي الواردات لأهم محصول بقولي يعتمد عليه االشعب المصري في غذائه بإعتباره أهم مصادر البروتين النباتي. أما بالنسبة الي محصول العدس تبين أن المساحة المزروعة المتوقعة و الإنتاج الكلي خلال الفترة المستقبلية سوف تتزايد زيادة طفيفة . كما يتبين تناقص نسب الاكتفاء الذاتي مع إستمرار تزايد الواردات المتوقع من الفول والعدس وحجم الفجوة خلال الفترة(2015- 2024) نتيجة للتزايد المضطرد لعدد السكان وما يتبعه من إرتفاع في معدلات الإستهلاك ،الأمر الذي يستلزم ضرورة بذل الجهود لزيادة الانتاج وضرورة معالجة المشاكل التي تواجه المزارعين والعمل علي رفع نسب الإكتفاء الذاتي والحد من الفاقد لتقليل الاعتماد على الخارج في استيراد الكميات المطلوبة لسد احتياجات السوق المحلي حيث يخصص نسبة كبيرة من الميزانية العامة للدولة مما يؤدي الي حدوث خلل في ميزان المدفوعات نتيجة لتزايد حجم الواردات عن حجم الصادرات وما يحمل الدولة عبئا لتوفير العملات الأجنبية لاستيراد البقول خاصة الفول البلدي والعدس.

وذلك من خلال عدد من الإجراءات السريعة علي المدي القصير للتغلب علي الصعوبات التي تواجه منتجي الفول وبصفة خاصة بالمحافظات التي إنتشر بها "مرض موزايك الفول " كتفعيل و تكثيف دورالإرشاد الزراعي بنقل نتائج بحوث معهد بحوث المحاصيل الحقلية و معهد بحوث أمراض النبات للمنتجيين ، توجيه البحث العلمي الي إستباط أصناف عالية الإنتاجية تصلح للآراضي الجديدة لزيادة حجم الإنتاج المحلي من المحصولين بتفعيل دور معهد بحوث المحاصيل الحقلية ، ضرورة تخفيض نسبة الفاقد لتقليل حجم الفجوة البالغة نحو 23.7%،89% للفول والعدس علي الترتيب لسد جزء من إحتياجات الإستهلاك القومي وذلك بتحسين إساليب التخزين والحصاد، ضرورة وضع سياسة سعرية التي تشجع المزارعين علي زراعة تلك المحاصيل من خلال تبني سياسات دعم المزارعين، بالإضافة الي التوجه نحو الزراعة التعاقدية وإنشاء قسم خاص بقواعد البيانات يوفر معلومات للمزارعين عن المساحات المأمول زراعتها والتركيب المحصولي التأشيري علي مستوي الجمهورية وكذلك الإسعار لتوجيه المزارعين حتي يتسني زيادة الإنتاج المحلي وتقليل الإعتماد علي الوارادت. إضافة الي ضرورة زيادة مساحة البقوليات من خلال تخصيص مساحة لزراعة المحاصيل البقولية بما يمثل نحو 14.24%، 7.5% من الأراضي الزراعية الجديدة (مليون ونصف فدان) من مشروع تنمية 4 مليون فدان وذلك في ظل ثبات الإنتاجية الفدانية يرجع ذلك الي أهميتهما الغذائية المرتفعة ، إضافة الي أهمية المحاصيل البقولية في تحسين خواص التربة وبالتالى عدم استخدام الاسمدة الازوتية المخلقة فى زراعات البقوليات المختلفة مما يقلل تلوث البيئة.