Journal of Agri-Food and Applied Sciences
Available online at jaas.blue-ap.org
©2017 JAAS Journal. Vol. 5 (2), pp. 35-45, 30 June, 2017
E-ISSN: 2311-6730

CURRENT STATUS AND FUTURE PERSPECTIVE OF WHEAT PRODUCTION AND CONSUMPTION IN EGYPT

Dawoud, S. D.Z.

Department of Agricultural Economics, Faculty of Agriculture, Damietta University, Damietta, Egypt.

Corresponding Author: Dawoud, S. D.Z.

Received: 26 May, 2017 *Accepted: 09 June, 2017* *Published: 30 June, 2017*

ABSTRACT

Wheat is one of the most important food commodities in Egypt. It is consumed at a high level to feed the Egyptian individual because it is relatively cheap compared to other sources. The domestic production of wheat is still insufficient to meet the consumer needs, which increased the food gap of wheat. This paper analyses the main features of the production and consumption of wheat in Egypt. Descriptive and quantitative analysis are used depending on data from the Ministry of Agriculture and Land Reclamation for the period (2000-2014). From the results, the total wheat production and consumption in Egypt are increased with an annual significant growth rate of 2.63% and 3.64%, respectively. Wheat self-sufficiency is about 55.78% in 2014. Water productivity for wheat is less than long clover and onion crops, with net return per unit of water 1954.09, 3655.71, and 4078.70 LE/1000M^3, respectively. As average, the profitability per season for wheat is about 0.94 which is less than the profitability for long clover and onion crops representing 3.79 and 2.26, respectively. The area supply of wheat is investigated by using Marc Nerlove's model. Farmers are responsive inelastic to the price changes, net return, and production cost, for the period 2000 to 2014. Short and long run price elasticities of supply are 0.17 and 019 respectively. Farm price and net return of wheat are found to be an important variables affecting farmer's decision in terms of area allocated to wheat. The major factors influence the wheat consumption are the population growth and domestic production. While, the domestic production, number of population, and per capita consumption are the factors influence the wheat gap. The forecasting results of the ARIMA Models show that wheat production and consumption will increase over the next years, and the food gap of wheat would increase to about 12457.64 thousand tons with self-sufficiency rate of 46.43% for the year 2025. Thus, more efforts should be done by the state to increase cultivated area of wheat and its productivity during the next years, raising the farm prices until its net return equal with net return of competing winter crops, introducing new technologies in wheat production and rationalizing per capita consumption to reduce the food gap of wheat.

Keywords: *Egypt, Food gap of wheat, wheat crop, supply response, ARIMA.*
©2017 JAAS Journal All rights reserved.

INTRODUCTION

Wheat is one of the most important source of nutrition in Egypt. Resulting from its economic and social dimensions and eating habits, the Egyptian population depends mainly on baladi bread as a source of food meals being considered relatively cheap compared to other alternative sources such as rice and potatoes. Despite the increase of wheat cultivated area from about 2463 thousand *Feddan* in 2000 to about 3393 thousand *Feddan* in 2014, but its production is not sufficient to cover consumer needs of wheat and flour for baladi bread. Total annual production of Egyptian wheat had reached about 9280 thousand tons in 2014, while the consumption to about 16637 thousand tons, with a wheat gap of 7357 thousand tons in 2014. This is because of the growing of population and then the increase in the required amounts of wheat and flour, and the rise in the prices of the other food commodities in the last decades, in addition to the decline in the wheat production in 2014 (9280 thousand tons). The self-sufficiency rate reached to about 55.78% in 2014, indicating that the 44.22% of local wheat consumption is covered by imports [7].

There are many difficulties that prevent the attainment of the highest possible efficiency, the most important is the increase in the exchange rate of Egyptian pound against the U.S Dollar [9], as well as many of the conflicting policies such pricing policy, subsidy policy and rationalizing consumption policy. Therefore, there is an urgent need to study the economics of wheat in Egypt. And the most important studies in relation to the interest of the Egyptian national food security.

Despite the observed increase in wheat production in Egypt during the period (2000-2014), there is a wide gap between the domestic production and consumption of wheat, where the average gap accounted for about 6157 thousand tons with self-sufficiency ratio was about 56.63% during the period (2000-2014). This gap is covered through wheat imports which negatively affect Egypt's agricultural trade balance. The analysis of variables associated with production and consumption of over time reveals a clear picture of expected food gap of wheat and flour.

Therefore, this paper aims to analyze econometrically wheat production and consumption in Egypt. Three aims for this study can be specified as follows: First; estimating growth rates for economic indicators of wheat and the productivity and profitability of wheat crop, Second; estimating major factors influencing wheat economic such as the supply response function and the most important factors influencing the consumption and gap of wheat, Finally; forecasting the future production, consumption, food gap and import of wheat to give food policy recommendations eliminating wheat gap in Egypt. This paper is organized while conclusion has been made in section 4.

2. Methodology and Data

This paper applies descriptive and statistical methods to analyze the data in order to achieve the aims of the study. Simple regression is used to estimate growth rates for economic indicators of wheat such as cultivated area, yield, production, consumption, food gap, and import of wheat crop. A multiple regression analysis and the stepwise method with double logarithmic form are used to determine the most important factors influencing the consumption and gap of wheat, in addition to, some statistical methods: Marc Nerlove's1958 partial adjustment lagged model is used to estimate area response to some economic variables. And the Auto Regressive Integrated Moving Average (ARIMA) model is used for forecasting the production, consumption, food gap, and imported quantity of wheat in Egypt.

2.1 Area Supply Response Models

2.1.1 Nerlove Supply Response Model

The agricultural production is determined by natural conditions, where the agricultural products generally take time to adjust to the changes in economic variables. Thus, the producers allocate their land resource, depending on their expected net return, Lagged prices of crop and the competing crops. The Nerlove model is a dynamic model, indicating that the cultivated area is a function of expected price and other exogenous variables which influence supply. It shows the farmers' decisions to plant more of the crop, the response of farmers to policies, and the relationship between the farmers' past and future behavior. Therefore, the partial adjustment lagged model is widely used by many economists[6], [11], and [12], to measure the farmers behaviour using time series data.

A typical specification can be written as follows:

$$A_t^* = a + bP_{t-1} + \varepsilon \qquad (1)$$

Where A_t^* is the desired area of crop in the year t. P_{t-1} is the price of crop in the previous year, ε error term. Since the desired area of crop is unobservable and depends on the crop price in the previous year. The Nerlove formulation can be specified as follows:

$$A_t - A_{t-1} = \beta(A_t^* - A_{t-1}) \quad 0 \prec \beta \prec 1$$

$$A_t = A_{t-1} + \beta(A_t^* - A_{t-1}) \qquad (2)$$

This equation states that the actual area of crop plus a proportion of the difference between desired area in period t and area in period t-1.

$$A_t = \beta A_t^* + (1-\beta)A_{t-1} \qquad (3)$$

By substituting the above equation into equation 1, the following equation can be obtained:

$$A_t^* = a + bP_{t-1} + (1-\beta)A_{t-1} + \varepsilon \qquad (4)$$

The β parameter represents the cause of difference between the short-run and long-run supply elasticities. $A_t - A_{t-1}$ refers to the actual change, and $A_t^* - A_{t-1}$ refers to the desired change. The β coefficient determines how the farmers are adjusting to their expectations and ranges between 0 and 1. When the value of this parameter close to one, the farmers are quickly adjusting to the changing of economic variables.

$$A_t = a + bA_{t-1} + bP_{t-1} + \varepsilon_t \qquad (5)$$

This Equation specified the partial adjustment model and the parameters of this model can be estimated using OLS [6].

The short run and long run elasticities are derived from supply response model.
The short run elasticity(SE) is defined as:

$$SE = b_2 \frac{\bar{P}_{t-1}}{\bar{A}_t} \tag{6}$$

Where $\bar{P}_{t-1}$, $\bar{A}_t$ are the mean price and crop area
The long run elasticity (LE) is calculated as follows:

$$LE = \frac{SE}{1-\lambda} \tag{7}$$

The applied models in the first stage of the supply analysis can be written as follows:

$$A_t = a + b_1 A_{t-1} + b_2 P_{t-1} + E_t \tag{8}$$

$$A_t = a + b_1 A_{t-1} + b_2 N_{t-1} + E_t \tag{9}$$

$$A_t = a + b_1 A_{t-1} + b_2 C_{t-1} + E_t \tag{10}$$

Where:

P_{t-1} Farm prices of wheat lagged by one year

N_{t-1} Net return of wheat lagged by one year

C_{t-1} Production costs of wheat lagged by one year

2.1.2 Wheat Area Supply Response to competing crops

The applied models in the second stage can be formulated as follows:

$$A_t = a + b_1 A_{t-1} + b_2 P_{t-1} + b_3 P_{t-1} + b_4 P_{t-1} + E_t \tag{1}$$

$$A_t = a + b_1 A_{t-1} + b_2 N_{t-1} + b_3 N_{t-1} + b_4 N_{t-1} + E_t \tag{2}$$

$$A_t = a + b_1 A_{t-1} + b_2 C_{t-1} + b_3 C_{t-1} + b_4 C_{t-1} + E_t \tag{3}$$

a is a constant, i.e. supply without the effect of price,

A_t Area under wheat

P_{t-1} Farm prices of wheat and competing crops lagged by one year

N_{t-1} Net return of wheat and competing crops lagged by one year

C_{t-1} Production costs of wheat and competing crops lagged by one year

t Time (year)

E_t Error term represents the impact of other factors not included in the model

The Model states that the current area of wheat depend on the lagged prices of wheat and competitive crops and on a one year lag of the area. The short run and the long run elasticities of supply with respect to net return and production cost are obtained in the same way of price elasticity

2.2 ARIMA Forecasting Model

Several statistical and econometric models have been developed in the literature for forecasting various issues. This paper applies Auto Regressive Integrated Moving Average (ARIMA) forecasting model which introduced by Box-Jenkins (1976) [1]. This model is widely used in practice for forecasting time series data [10]. The application of the model involves certain four steps: Identification of the model (based on Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF), estimation of model parameter, diagnostic using tests on the parameters and residual of the model, and forecasting the studied variables. The model in general forms can be specified as follows [1], [8], and [10]:

The corresponding (AR) of Autoregressive model of order p can be written as follows:

$Y_t = \theta + \delta_1 Y_{t-1} + \delta_2 Y_{t-2} + \delta_p Y_{t-p} + E_t$

Where Y_t is the response variable at time t, θ is the constant, $\delta_1, \delta_2, \delta_p$ are the parameters of the model and E_t is the terms of error at time t, $Y_{t-1}, ..., Y_{t-P}$ are respective variables at time lag $t-1$, p is the number of values. In AR process, the value of time series variable depends on its previous values.

The MA (q) is the Moving Average model of order q, which can be expressed as:

$Y_t = \theta + E_t + \gamma_1 E_{t-1} + \gamma_2 E_{t-2} ..... + \gamma_q E_{t-q}$

Where E_{t-1}, ….. E_{t-q} are the forecast error terms at time $t-1$,… $t-q$ respectively, $\gamma_1 \cdots \gamma_q$ are the coefficients of the estimated error term. The forecast errors represent the effect of variable which not explained by the model.

Combining both the model is called as the simple form of ARMA (p, q) which has general form as:

$Y_t = \theta + \delta_1 Y_{t-1} + ... + \delta_p Y_{t-p} + \gamma_1 E_{t-1} + ... + \gamma_q E_{t-q} + E_t$

The number of differences required to make the series stationary is denoted by d.

The ARIMA (p, d, q) model can be expressed as follows:

$\Delta_d Y_t = \theta + \delta_1 \Delta_d Y_{t-1} + ... + \delta_p \Delta_d Y_{t-p} + \gamma_1 E_{t-1} + ... + \gamma_q E_{t-q} + E_t$

ARIMA model is applied to forecast annual future production, consumption, food gap and imported quantity of wheat in Egypt using the SPSS 17 computer package,. The details of the estimation are presented and discussed below.

Data Sources

The study is mainly based on secondary data for the period of 2000- 2015 covering the time period starting from 2000 to 2014 which reported and published data by the Government of Egypt: the Ministry of Agriculture and Land Reclamation (MALR), the Agricultural Statistics Department. Also, data was obtained from Central Agency for Public Mobilization and Statistics of Egypt (CAPMAS): Annual bulletin for consumption of food commodities and statistical Year Book. In addition data is related to references and research associated with the subject of this paper.

3. Results and Discussion

3.1 Current Situation of Wheat Production and Consumption in Egypt

Wheat is the primary source in meals food of the Egyptians because it is relatively cheap compared to other sources. This section of the paper is organized as: development of cultivated area, yield, and production for wheat crop during the period of (2000-2014), development trend of the consumption, self-sufficiency, gap, and import for wheat. The growth rates of the most important economic indicators for wheat crop including the total cost, net return, return/cost, and farm price during the same period are estimated. In addition the productivity and profitability of wheat crop are calculated.

3.1.1 Development of Cultivated Area, Yield, and Production for Wheat Crop in Egypt

The cultivated area, yield, and production for wheat crop during the period (2000-2014) are presented in Table 1 in the Appendix. The estimated growth rates for cultivated area, yield, and production for wheat crop during the study period are shown in Table 1. Resulting from the efforts made by the state to increase cultivated area of wheat during the last decades, wheat cultivated area increased from about 2463 thousand *Feddan* in 2000 to about 3393 thousand *Feddan* in 2014. A simple linear trend shows that cultivated area of wheat increased by an annual growth rate of 1.99% of the average total cultivated area (2814 thousand *Feddan*) during the studied period. While, the yield of wheat crop showed a stagnant position during the study period, as the time response coefficient was statistically insignificant. The production of wheat crop increased from 6564 thousand tons in 2000 to 9280 thousand tons in 2014. Under the rising impact of cultivated area of wheat crop, the production registered a significant growth rate of 2.

Table 1. Time Trend Equations of Cultivated Area, Yield, and Production for Wheat Crop in Egypt During (2000-2014).

Crop	Intercept	b_1	R^2	F	Annual Average	Growth Rate %
Cultivated Area	2365.55	56.060	0.40	8.56**	2814.07	1.99
Yield	2.65	0.005	0.05	0.69	2.69	N.s.
Production	6133.74	203.910	0.77	43.21**	7765.00	2.63

Source: Calculated Based on Data from MALR, Various Issues.

** Indicates significant at one percent level of significance.

3.1.2 Development of The Consumption, Self-sufficiency, Gap, and Import for Wheat in Egypt

The Egyptian population depends mainly on *baladi* bread as an important source of food meals. It is considered relatively cheap compared to other commodities such as rice and potatoes. Thus, the consumption of wheat increased from a minimum of 9073 thousand tons in 2001 to a maximum of 18182 thousand tons in 2011, as shown in Table 1 in the Appendix. The trend of wheat consumption increased with an annual significant growth rate of 3.64% of the average total consumption (13922 thousand tons) during the period of (2000-2014). Per capita consumption of wheat increased from 170 kg/year in 2000 to 199 kg/year in 2014, with an annual growth rate of 2.13% of the average per capita consumption during the same period (186.02 kg/year).

Despite the increase of domestic wheat production, it is not sufficient to cover the increase in the consumer needs of wheat and flour for *baladi* bread which increased the food gap of wheat. This is because of the growing number of population and the rise in the prices of the other food commodities in the last decades. It reached about 4302 thousand tons in 2000 and increased to 7357 thousand tons in 2014, with an annual significant growth rate of 5.81% of the average total wheat gap (6157 thousand tons) during the same period. The self-sufficiency rate of wheat decreased from 60.41% in 2000 to 55.78% in 2014 with an annual growth rate of 1.57%. Therefore, the imported quantity of wheat changed from the minimum reached about 2818 thousand tons in 2001 to the maximum of 9788 thousand tons in 2011, then decreased to 6759 thousand tons in 2014. The decrease in the quantity of wheat imported (3974 thousand tons) in 2009 as a result of many transactions resulted from the global financial crises. The trend of wheat imported increased with a statistically significant rate of 5.56%, as shown in Table 2.

Table 2. Time Trend Equations of The Consumption, Per Capita Consumption, Self-sufficiency, Gap, and The Import for Wheat in Egypt during (2000-2015)

Crop	Intercept	Regression Coeff. b_1	R^2	F	Annual Average	Growth rate
Consumption	9430.89	561.39	0.87	86.10**	13922.00	3.64
Per Capita Consumption	154.51	3.96	0.63	21.98**	186.20	2.13
Wheat Food Gap	3297.14	357.48	0.74	37.49**	6157.00	5.81
Self-sufficiency	63.71	-0.89	0.45	10.69**	56.63	-1.57
Quantity of Import	3117.77	311.75	0.46	10.91**	5611.80	5.56

Source: Calculated Based on Data from MALR: Economic Affairs Sector, Central Administration Agricultural Economy, Various Issues.
** Indicates significant at one percent level of significance.

3.1.3 An analysis of Economic Indicators for Wheat Crop

There are many factors that affecting the producers decision to cultivate wheat crop. The important of these factors include the increase in the price and net return and the decrease in the production costs. The growth rate of the most important economic indicators during the period of (2000-2014) are calculated and presented in Table 3. It indicates that the prices and the production costs of wheat crop increased by growth rate of 10.51% and 8.63% of the average annual prices and the production costs of wheat crop, respectively. Therefore, a simple linear trend shows that the net return of this crop grew at a significant annual rate of 10.26% of the average annual net return of wheat during the same period. Under the price effect, the growth rate of return/cost ratio showed a significant increase in the same period, where it grew by 10.93%.

Table 3. Time Trend Equations of Economic Indicators for Wheat Crop in Egypt During (2000- 2014).

Crop	Intercept	Regression Coeff. b_1	R^2	F-ratio	Annual Average	Growth Rate %
Total Cost	859.36	239.54	0.82	57.15**	2775.69	8.63
Net Return	960.12	551.42	0.87	90.38**	5371.50	10.26
Return/Cost	309.78	269.07	0.68	27.37**	2462.35	10.93
Price	37.41	24.70	0.86	878.91**	235.00	10.51

Source: Calculated Based on Data from MALR, Various Issues.
** Indicates significant at one percent level of significance.

3.1.4 Productivity and Profitability of Wheat Crop

The Productivity indicators of wheat and competiveness crops per *Feddan* in Egypt are summarized in Table 4. The clover, beans and onion crops are studied as the competitive crops in the same season for the wheat crop, where the substitution can be achieved. The average quantity of water applied for wheat is 2135 M^3/*Fedddan*, while, the quantities of water applied for clover, beans, and onion crops are 2951, 1854, and 1978 m^3/*Fedddan*, respectively. With respect to estimating land productivity, the net return per unit of land for wheat is more profitable as compared to beans, and onion crops with net return of 4172, 1881.33, and 8067.67 LE/*Feddan*, respectively. While, it is less than land productivity of long clover (10788 LE/*Feddan*). Water productivity for wheat is less than long clover and onion crops, with net return per unit of water of 1954.09, 3655.71, and 4078.70 LE/1000M^3, respectively. While water productivity for wheat is more than beans, with net return per unit of water of 1014.74 LE/1000M^3. Regarding profitability, the indicator of return on investment is used as a measure of profitability for the production of wheat crops. The results show that the average profitability per season is about 3.79 and 2.26 for long clover and onion, respectively which is higher than the profitability for wheat crop (0.94). This implies that the production of wheat is not profitable during the period as compared to long clover and onion crops. The substitution by long clover crops, which are mainly used as an animal feed and where a high net return per unit of area can be achieved. According the results of economic indicators in Table 4, the wheat is less efficient of land and water resources than long clover and onion crops.

Table 4. Productivity Indicator's for Wheat and competiveness Crops in Egypt, As Average Period (2010- 2014)

N	Indicator	Onion	Beans	Clover	Wheat
1	Water Applied (m^3/*Fed.*)	1978.00	1854.00	2951.00	2135.00
2	Production Costs	3562.33	3917.00	2866.67	4434.00
3	Land Productivity (L.E/*Fed.*)	8067.67	1881.33	10788.00	4172.00
4	Water Productivity (L.E/1000 M^3)	4078.70	1014.74	3655.71	1954.09
5	Profitability* per season	2.26	0.48	3.79	0.94

*Profitability = Net Return/ Total Cost

Source: Calculated Based on Data from MALR: Economic Affairs Sector, Central Administration Agricultural Economy, Various Issues.

3.2 Major Factors Influencing Wheat Production and consumption

3.2.1 Area Decision in Supply Response of Wheat in Egypt.

This section deals with the estimation of supply response for wheat. The statistical form used is a Nerlove area response model. The reason for choosing area, it shows the farmer decision to cultivate more of the crop. It is a good indicator of farmers' response to policies, as producers will decide how many Feddans to cultivate wheat given the policy. The statistical analysis is based on secondary data covers a period starting from 2000-2015. The study assumes that the current area of wheat depends on one year lag of the crop area, crop prices, net return, and net return of competitive crops. The competing crops for wheat are long clover and beans.

First, the study estimates the influence of one year lagged of the area and other economic variables on the crop area. The estimated regression equations for wheat area response for the period 2000-2015 are presented in Table 5. The variables that appear statistically significant are shown in the Table 5. The estimated coefficients on lagged area and price have expected sign. The response coefficient of 0.92 and 0.89 indicates the speed of adjustment. The elasticity of current area with respect to previous economic variables is rather low.

The overall significant of the model indicates that wheat area supply to price and other factors is inelastic. The coefficient of lagged net return of wheat has a positive sign with elasticity of 0.16 and 0.17 respectively for the short rand long run, which indicates that with 1% increase in the net return of the wheat in previous year, the area increased by 0.16% in the short run and 0.17% in the long run. Also, the price elasticity is around 0.17-0.19 for the short run long run and significant. This indicates an increase in crop price by 1% leads to an increase in cultivated area under wheat by 0.17% and 0.19% respectively for the short and long run. This indicate that price policies are effective in the promotion of wheat production. The cultivated area of wheat affects the wheat area of the following year.

This means that the decision to allocate an area for wheat is completely interrelated with the area decision of the next year. The lagged production cost of wheat has a negative sign and it is not significant This indicates production cost of wheat has a little influence on area allocated to wheat. This suggests that production costs are not effective in the promotion of wheat production. And the most important significant factors are prices and net return for area decision.

Table 5. Estimates of Area Supply Response to Economic Variables for wheat in Egypt

Economic Variable	Intercept	Regression coefficients					F-ratio
		b_1 Lagged area	b_2 Net Return	b_3 Price	b_4 T. Cost	R^2	
Net Return (X_1)	2155.98	0.075	0.201			0.58	8.41**
	3.85**	0.343	3.51**				
Price (X_2)	2035.03	0.11		0.34		0.47	5.03*
	3.19**	0.427		2.57*			
Total costs (X_3)	634.41	0.78			-0.010	0.48	5.46*
	0.97	2.88**			-0.11		
Annual Response Coefficient $(1-\beta)$			0.92	0.89	0.23		
Response period			1.08	1.12	4.35		
Elasticity Coefficients in Short run			0.16	0.17	-0.01		
Elasticity Coefficients in Long run			0.17	0.19	-0.04		

Where: Dependent variable is cultivated area under crop, the independent variables are X_1 area under crop the past year, X_2 net return per unit of land, X_3 farm prices, X_4 total costs.

Source: Computed Based on Data from MALR

** significant at one percent, * significant at five percent level of significance.

Table 6. presented the estimates of area supply response to economic variable of wheat and its competitive crops. The lagged variables of wheat and competitive crops are used in estimated wheat area relationship, as the area decision of wheat are mostly made in the previous period and they are not changed on real time due to change in of the factors. Net return and prices of wheat are found to be important factors determining the area allocated to wheat in the current season with variables statistically significant. Elasticity coefficients indicate a 1 % increase in net return and/or price of wheat would result in a 0.22% and 0.19 % respectively increase in the area allocated to wheat. The coefficient of lagged area is not significant, which indicates the horizontal expansion in area limited in Egypt due to scarcity of agricultural land, any increase in wheat production will come through increasing the productivity. The relationships have a negative sign as wheat could be replaced with its substitutes such as clover or beans. In another way, as increase of wheat area is attached to an increase in its farm prices or net return, the farmer prefers to cultivate other crops and he becomes eligible for the substitution in the long run. Regardless of the negative relationship between production costs and area allocated to wheat, the production cost is statistically insignificant, implying that the production costs did not play an important part of influencing farmer's decision in current allocation of area to wheat.

Table 6. Estimates of Area Supply Response to Economic Variables of Wheat and its Competitive crops in Egypt(2000-2014)

Variable	Intercept	Regression coefficients					F-ratio
		b_1	b_2	b_3	b_4	R^2	
		Lagged area	wheat	Clover	Beans		
Net Return (X_1)	2032.43	0.13	0.25	-0.02	-0.016	0.60	3.78**
	2.70**	0.617	2.34**	0.86	0.95		
Elasticity Coefficients			0.20	-0.019	0.039	0.22	
Price (X_2)	1929.84	0.20	0.64	-0.205-	-0.127	0.55	2.86*
	2.93	0.75	2.32**	-0.39	-0.46		
Elasticity Coefficients			0.51	-0.10	-0.17	0.19	
Total costs (X_3)	1155.20	0.64	-0.80	0.65	0.38	0.61	3.89**
	1.69	2.40**	-1.80	1.36	1.60		
Elasticity Coefficients			-0.77	0.38	0.33	- 0.06	

Source: Computed Based on Data from MALR

** significant at one percent,** significant at five percent,*significant at ten level.

3.2.2 Factors Influencing the Wheat Consumption

`Multiple regression analysis is used to determine the most important factors that influence the wheat consumption. The double log functional form is chosen. According to the economic theory and the available of data, It is assumed that the factors influence the wheat consumption are the number of population (x_1), the average of per capita income (x_2), domestic production (thousand tons) (x_3), Imported quantity of wheat (kg) (x_4), and the import price($/ton) ($x_5$) during the period (2000-2014). The results of the model estimation are presented in the next Table:

Table 7. Estimates of the Determinants of the Wheat Consumption in Egypt During the Period (2000-2014)

Dependent Variable	Estimated Model	Intercept	b_1 Number of Population	b_3 Domestic Production	R^2	F
Amount of Wheat Gap	Double Logarithmic	-2.53	1.29	- 0.73	0.91	53.09**
		-1.66	3.33**	- 2.48*		

Where: Dependent Variable: The amount of Wheat consumption (thousand tons), b_1 is the parameter of (x_1) number of population (thousand tons), b_3 is the parameter of (x_3) domestic production.

Source: Calculated Based on Data from MALR, CAPMAS and FAO.

** significant at one percent level, * significant at five percent level of significance.

According the estimates in Table 7, the parameter of number of population variable is positive indicating that an increase in the number of population variable by 1% results in an increase in wheat consumption by about 1.29%. While the parameter of domestic production variable has a negative sign, where an increase in the domestic production variable by 1% results in an decrease in wheat consumption by about 0.73%.

3.2.3 Factors Influencing the Wheat Gap

Despite the increase of wheat production, it is not sufficient to meet the growing demand of the population as a result of many factors. Multiple regression analysis is used to determine the most important factors that influence the wheat gap. The double log functional form is chosen. According to the economic theory and the available of data, It is assumed that the factors influence the wheat gap are (x_1) the domestic production (thousand tons), (x_2) the number of population (x_3), average annual per capita consumption (kg), (x_4) the import price of wheat ($/ton), and ($x_5$) the average of per capita income during the period (2000-2014). The results of the model estimation as the following:

Table 8. Estimates of the Determinants of the Food Gap of Wheat in Egypt During the Period (2000-2014)

Dependent Variable	Estimated Model	Intercept	Regression Coefficients			R^2	F
			b_1 Domestic Production	b_3 Number of Population	b_2 Per Capita Consumption		
Amount of Wheat Gap	Double Logarithmic	-2.12	-1.11	1.98	2.34	0.97	105.73**
		-1.43	-2.78**	3.97**	8.62**		

Where: Dependent Variable: The amount of food gap of wheat (thousand tons), b_1 is the parameter of (x_1) domestic production of wheat (thousand tons), b_2 is the parameter of (x_2) number of population and b_3 is the parameter of (x_3) average annual per capita consumption of wheat (kg).

Source: Calculated Based on Data from MALR, CAPMAS and FAO.

** Indicates significant at one percent level of significance.

According the estimates in Table 8, the parameter of domestic production variable has a negative sign while the parameters of per capita consumption and number of population variables are positive. An increase in the quantity of wheat production results in a decrease in wheat gap by about 1.11%. While an increase in the number of population and per capita consumption of wheat by 1% leads to an increase in the gap of wheat by 1.98% and 2.34%, respectively.

3.3 Forecasting of Wheat Production, Consumption, Gap and import in Egypt

This section presents the projections of future production, consumption, food gap and imported quantity of wheat in Egypt, building on existing analysis. The projections are made for the years from 2016 to 2025 using the Auto-Regressive Integrated Moving Average (ARIMA). Diagnostic checking on residual terms is made applying the ACF and PACF functions of the time series data. By using best fitted model, the details of the estimation and forecasting process are discussed below. The forecasted values obtained from ARIMA model with 95 percent confidence level (lower and upper prediction intervals) for ten years are reported in the Table 9.

The model predicted overall an increase in wheat production. The prediction for 2025 is resulted approximately 11213.05 thousand tons at confidence interval 95%, representing about 20.83% over the production value in 2014. The lower and upper limits show an increase in production levels which may reach up to 10002.1 and 12424.01 thousand tons, respectively, by the year 2025.

The best fitted ARIMA model applied for wheat consumption is (0,1,1). The ARIMA model projects that consumption will increase from 16637 in 2014 to 24152.38 in 2025, with an increase ratio of about 45.17% more than its value in 2015 (Table 9). With 95% confidence interval, the upper limit of consumption would increase from 21147.76 thousand tons in 2016 to 26554.17 thousand tons in 2025. This increase may be due to an increase in population of Egypt and per capita consumption.

Table 9. Forecasted Values for the Wheat Production, Consumption, Gap and import in Egypt, with 95% Confidence Interval.

Year	Wheat, Production, ARIMA (0,1,1)			Wheat, Consumption ARIMA (0,1,1)			Wheat Gap ARIMA (0,1,1)			Wheat, Import, ARIMA (0,1,1)		
	Forecast	95 % Limit		Forecast	95 % Limit		Forecast	95 % Limit		Forecast	95 % Limit	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
2016	9387.61	8171.79	10603.44	18736.29	16324.83	21147.76	9122.01	6829.39	11414.62	8188.89	4487.58	11890.21
2017	9590.44	8374.61	10806.27	19338.08	16926.62	21749.54	9492.63	7200.02	11785.25	8511.03	4809.72	12212.34
2018	9793.27	8577.71	11008.82	19939.87	17528.94	22350.79	9863.26	7571.16	12155.36	8833.17	5132.68	12533.65
2019	9996.09	8780.99	11211.2	20541.65	18131.63	22951.68	10233.89	7942.64	12525.13	9155.30	5456.20	12854.41
2020	10198.92	8984.39	11413.45	21143.44	18734.56	23552.33	10604.51	8314.35	12894.68	9477.44	5780.08	13174.80
2021	10401.75	9187.87	11615.62	21745.23	19337.64	24152.81	10975.14	8686.21	13264.07	9799.58	6104.21	13494.94
2022	10604.57	9391.4	11817.74	22347.02	19940.82	24753.21	11345.76	9058.16	13633.37	10121.71	6428.49	13814.94
2023	10807.40	9594.96	12019.84	22948.8	20544.06	25353.55	11716.39	9430.16	14002.62	10443.85	6752.85	14134.85
2024	11010.23	9798.53	12221.92	23550.59	21147.32	25953.86	12087.02	9802.19	14371.84	10765.99	7077.25	14454.73
2025	11213.05	10002.1	12424.01	24152.38	21750.58	26554.17	12457.64	10174.22	14741.07	11088.12	7401.65	14774.60

LCL=Lower Confidence Limit and UCL=Upper Confidence Limit

Source: Calculated Based on Data from MALR.

The best fitted ARIMA model applied for wheat gap is (0,1,1). Forecasting results indicate that the forecast values of wheat gap is tend to increase over the next years. With 95% confidence interval, the maximum values would increase from 11414.62 thousand tons in 2016 to 14741.07 thousand tons in 2025. This can be resulted from the overpopulation or and change in the consumption patterns of Egyptian people. These forecast would be helpful for decision makers to foresee the future situation of wheat production, import, consumption and select appropriate policy. Egypt will import around 11088 thousand tons of wheat over the coming year (2025) to fill the wheat gap between consumption and production.

Conclusions and Recommendations

From the results above, despite the increase of wheat cultivated area during the study period (2000-2014), its production is not sufficient to cover consumer needs. This resulted in food gap and increased imported quantity of wheat. Wheat crop is less efficient in using water resources. Water productivity for wheat is less than long clover and onion crops. Regarding to major factors influencing wheat economic, Nerlove's model shows that the producers responsive to the prices and net return of wheat. Crop prices is most import factor influence wheat production decisions in the short and long run. The price elasticity coefficient suggested increase in the farm prices will lead to an increase in wheat cultivated area, efforts should therefore be put in place by the ministry of agriculture to raise the farm price of wheat and improve the productivity per unit of land thereby maximizing net return. The horizontal expansion in area limited in Egypt due to scarcity of agricultural land, any increase in wheat production will come through increasing the productivity.

The most important factors influence the wheat consumption are the number of population and domestic production of wheat. While, the domestic production, number of population, and per capita consumption are the factors influence the wheat gap. Forecasting results using ARIMA model predict that wheat production and consumption will increase over the next years, and the food gap of wheat would increase from 2015 to 2025. The forecast values could be used for formulating food policies especially for wheat by policy makers. Based on these results, several recommendations can be made for the future policy with respect to food gap of wheat in Egypt, as follows:

(1) Adopting an integrated strategy for wheat horizontal expansion in the new lands,
(2) Developing high yielding varieties of wheat crop,
(3) Supporting the wheat producers to improve the productivity through modern technology,
(4) Rationalizing per capita wheat consumption to develop awareness program, for the reducing the waste of wheat.

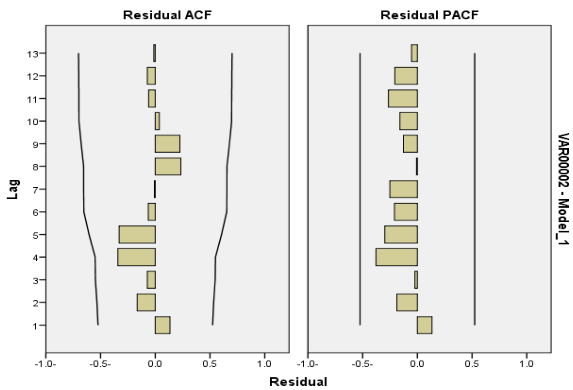

Figure 1. Residuals Autocorrelation Plot for Wheat Production of ARIMA(0,1,1)

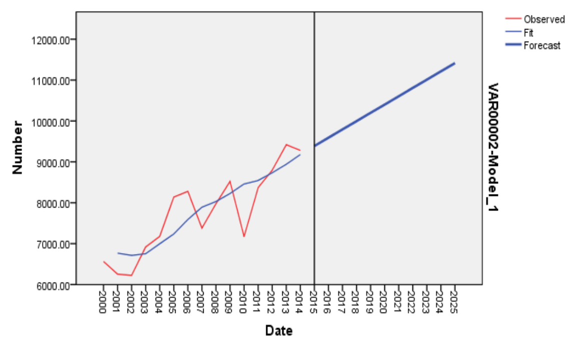

Figure 2. Forecasted Values for Wheat Production in Egypt, with 95% Confidence Interval

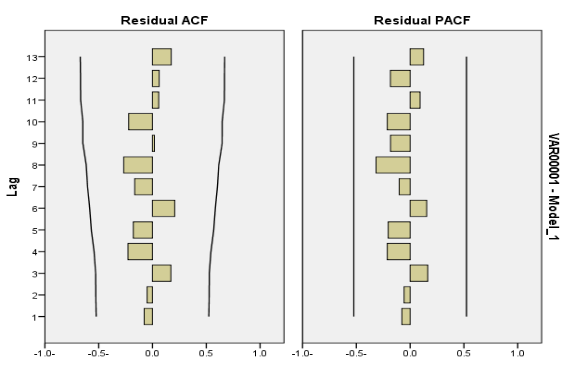

Figure 3. Residuals Autocorrelation Plot for Wheat Consumption of ARIMA(0,1,1)

Figure 4. Forecasted Values for Wheat Consumption in Egypt, with 95% Confidence Interval

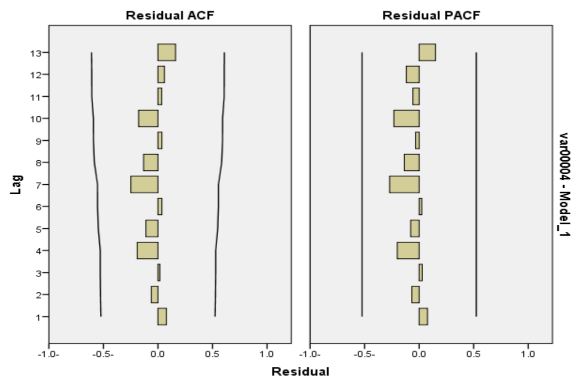

Figure 5. Residuals Autocorrelation Plot for Wheat gap of ARIMA(0,1,1)

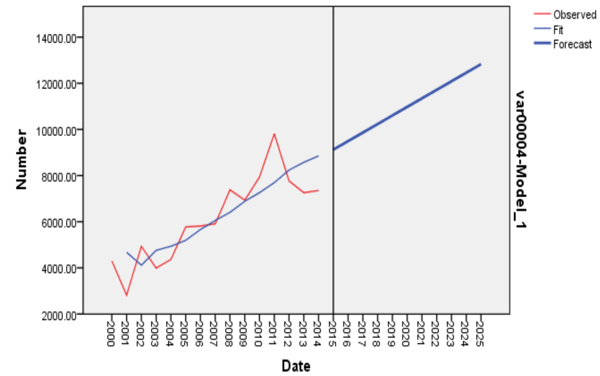

Figure 6. Forecasted Values for Wheat Gap in Egypt, with 95% Confidence Interval

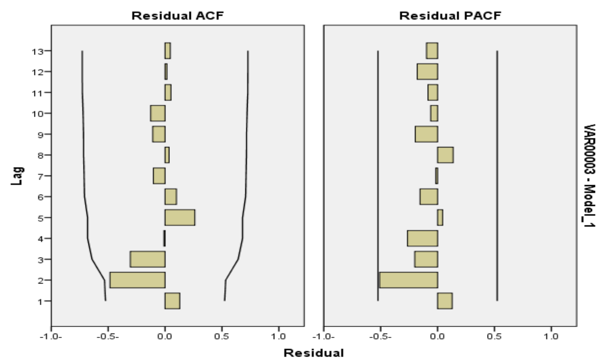

Figure 7. Residuals Autocorrelation Plot for Wheat Import of ARIMA(0,1,1)

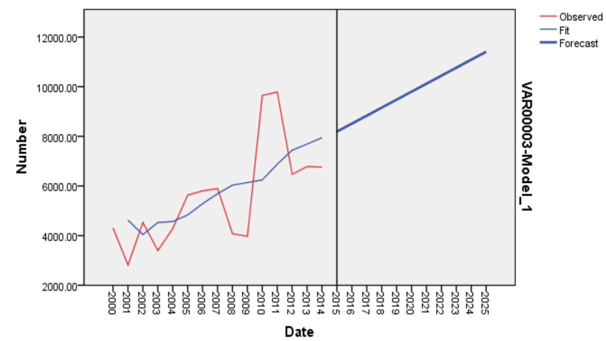

Figure 8. Forecasted Values for Wheat Import in Egypt, with 95% Confidence Interval

Appendix

Table A 1. Development of Economic Indicator's for Wheat Production and Consumption in Egypt During (2000-2014).

Year	Area (000Feddan)	Yield (ton/Feddan)	Production (000tons)	Consumption (000tons)	Imports (000tons)	Per Capita Consumption (Kg)	Wheat Gape	Self-sufficiency (%)
2000	2463	2.67	6564	10866	4302	170	-4302	60.41
2001	2342	2.67	6254	9073	2818	139	-2819	68.93
2002	2450	2.54	6225	11156	4531	164	-4931	55.80
2003	2536	2.73	6921	10910	3400	160	-3989	63.44
2004	2606	2.75	7178	11545	4286	167	-4367	62.17
2005	2985	2.73	8141	13914	5633	197	-5773	58.51
2006	3064	2.7	8278	14094	5805	193	-5816	58.73
2007	2716	2.73	7379	13290	5900	180	-5911	55.52
2008	2920	2.73	7977	15358	4078	204	-7381	51.94
2009	3147	2.71	8523	15456	3974	201	-6933	55.14
2010	3001	2.38	7169	15107	9647	192	-7938	47.45
2011	2049	2.75	8371	18182	9788	226	-9811	46.04
2012	3161	2.78	8795	16564	6471	204	-7769	53.10
2013	3378	2.81	9420	16678	6785	197	-7258	56.48
2014	3393	2.74	9280	16637	6759	199	-7357	55.78

Source: Ministry of Agriculture and Land Reclamation(MALR):Economic Affairs Sector, Central Administration Agricultural Economy, Various Issues. (one *Feddan* = 4200 M^2)

REFERENCES

[1] Box, G.E.P., Jenkins, G.M. and Reinsel, G.C. (2008) Time Series Analysis: Forecasting and Control, Fourth edition, John Wiley & Sons Inc., New York.

[2] Central Agency for Public Mobilization and Statistics (CAPMAS), Annual Bulletin for Consumption of Food Commodities, Various Issues, Cairo, Egypt.
[3] Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Various Issues, Cairo, Egypt.
[4] FAO. www.faoststat.org. FAOSTAT Database, Different Years.
[5] Gujarti, N.D. (1995) Basic Econometrics, McGraw-Hill Book Company, 2nd Edition, Singapore.
[6] Leaver, R. (2003) Measuring the Supply Response Function of Tobacco in Zimbabwe Aggreko, Vol 43,113-129.
[7] Ministry of Agriculture and Land Reclamation (MALR), Economic Affairs Sector, General Administration for Statistics, Agricultural Economic Bulletin, Egypt, Various Issues.
[8] Padhan, P., (2012) Application of ARIMA Model for Forecasting agricultural Productivity in India, journal of agriculture & Social Sciences, 8-2, 50-56.
[9] Shehata, G.A.B., Mohamed, M.E. (2015) Some Economic Aspects of wheat Crop in Egypt with Emphasis on Baladi Bread Manufacturing in Alexandria, International Journal of Social Science and Humanity, Vol. 5. No.6, 501-509.
[10] Suresh, K.K., and Priya, S.R.K. (2011) Forecasting Sugarcane Yield of Tamil Nadu Using ARIMA Models. Sugar Technology, Vol. 13, No.1, 23-26.
[11] Vincent, M. et al (2013) An Economic Approach to Ascertain Sorghum Supply Response in Zimbabwe, African Journal of Agricultural research, Vol.8, No. 47, PP.6034-6038.
[12] Wasim P.M. (2005) Milk Production Response in Pakistan. The Lahore Journal of Economics Vol.10, No.1, 105-121.