An econometric study to predict the nutritional gap of wheat in Egypt for the period (2025-2030)

Yehia M.M. Khalil
Khalid A.H. Abdelhamid

(*)**Yehia M.M. Khalil:** professor of Agricultural Economy, Department of Agricultural Economics of Agricultural and Biological Research of National Research Center, Cairo, Egypt.
E-mail: dryehia1951@yahoo.com
(**) **Khalid A.H. Abdelhamid:** Assistant prof. of economics, Higher Institute of computers Information Technology, EL-Shorouk academy, Cairo, Egypt.
Email: khalid_abdelhamid@yahoo.com

Abstract

The food problem has become one of the most important problems threatening economic and social development in Egypt because of its dangerous dimensions on the agricultural sector and the Egyptian economy in general. It suffers from a food gap in most strategic food commodities, the most important of which is wheat, and the study aims to predict the wheat gap using a standard model for the period (2025-2030) and using the system of simultaneous equations for a three-stage econometric model. The study expected that the wheat gap would be about 19.7 million tons in the tons normal case in 2030, and it decreases in the second case as production supports about ١8.8 million tons and continues to decline in the third case by about 15.9 million tons. As for the self-sufficiency rate of wheat, it will reach 31.3% in 2030 in the normal case, then rise to 42.2% in the second case, and then rise in the third case to reach about 46.9%. This requires the development of a strategy to reduce this gap through some policies and procedures based on horizontal expansion on old and new lands, rationalization of consumption, expansion in the construction of silos, and a balanced price policy for wheat**.**

Keywords: Food Gap; Wheat Gap; Production; Consumption; Self-Sufficiency.

دراسة اقتصادية قياسية للتنبؤ بالفجوة الغذائية للقمح في مصر للفترة (٢٠٢٥ – ٢٠٣٠)

الملخص

أصبحت مشكلة الغذاء من أهم المشكلات التي تهدد التنمية الاقتصادية والاجتماعية في مصر لما لها من أبعاد خطيرة على القطاع الزراعي والاقتصاد المصري بشكل عام. وتعاني من فجوة غذائية في معظم السلع الغذائية الاستراتيجية وأهمها القمح، وتهدف الدراسة إلى التنبؤ بفجوة القمح باستخدام النموذج القياسي للفترة (٢٠٢٥-٢٠٣٠) وباستخدام نظام المعادلات الآنية ل نموذج الاقتصاد القياسي ثلاثي المراحل. وتوقعت الدراسة أن تبلغ فجوة القمح نحو ١٩.٧ مليون طن في الحالة الطبيعية عام ٢٠٣٠، وتنخفض في الحالة الثانية حيث يدعم الإنتاج بنحو ٨ ملايين طن، ويستمر الانخفاض في الحالة الثالثة بنحو ١٥.٩ مليون طن. أما نسبة الاكتفاء الذاتي من القمح فستصل عام ٢٠٣٠ إلى ٣١.٣% في الحالة الطبيعية، ثم ترتفع إلى ٤٢.٢% في الحالة الثانية، ثم ترتفع في الحالة الثالثة لتصل إلى نحو ٤٦.٩%. وهذا يتطلب وضع استراتيجية لتقليص هذه الفجوة من خلال بعض السياسات والإجراءات المرتكزة على التوسع الأفقي على الأراضي القديمة والجديدة، وترشيد الاستهلاك، والتوسع في بناء الصوامع، وسياسة سعرية متوازنة للقمح.

Introduction

The wheat crop is considered a strategic crop and one of the most important grain crops in Egypt, as it represents the main food for citizens, so it is a key factor in achieving food security. Which means from economic logic the ability of society to provide the basic nutritional needs of all individuals, and to ensure the availability of the minimum of these needs regularly. This requires making all efforts from the various sectors of the economy in general, and the agricultural sector, which bears the achievement of food security, starting from the extent to which this sector is able to use agricultural resources with greater economic efficiency, and ends with achieving more self-sufficiency in various agricultural commodities and on Headed by the main strategic cereal crops, especially wheat. Egypt's large and continuous population has led to a continuous decline in the degree of self-sufficiency in wheat. This situation led to an increase in the quantities of wheat imported from abroad, and despite the increase in production, it did not meet the growing needs of consumers. The wheat crop is the main food for the population, in addition to the adoption of many food industries. Wheat production is about 8.9 million tons, which represents about 45.4% of the wheat available for consumption, and this production is not sufficient for the needs of individuals in Egypt. Egypt imports about 11.4 million tons, which means an increase in food imports' dependence on international markets. This negatively affects the agricultural trade balance and the Egyptian balance of payments, in addition to the political and economic risks that follow.

Research problem:

The food problem has become one of the most important problems threatening economic and social development in Egypt because of its dangerous dimensions on the agricultural sector in particular and the Egyptian economy in general. Despite the evidence indicating an increase in Egyptian agricultural production, Egypt still suffers from a food gap in most strategic food commodities, the most important of which is wheat, which threatens Egyptian food security.

Objectives of the study:

The study aims to identify and inventory the most important determinants of the Egyptian wheat gap by studying the most important variables such as production, consumption, self-sufficiency and, the imported quantity, then forecasting using a standard model for the period (2025-2030).and using the Simultaneous Equations System for a three-stage econometric model and defining the proposed policies and procedures to reduce that gap.

Data Sources:

The study depends on official data sources like the Central Agency for Public Mobilization and Statistics and bulletins issued by the Central Administration of Agricultural Economy at the Ministry of Agriculture and Land Reclamation.

Concepts:

Food security: It is the situation in which all people, at all times, have the physical, social and economic ability to obtain sufficient quantities of safe and nutritious food, and lead an active and healthy life, as defined by the Food and Agriculture Organization (FAO).

Food gap: there are two gaps (apparent gap), which express the adequacy of the quantity for a particular commodity or food commodities in general to meet the needs of the population. While the second expresses the adequacy of quantity and quality by increasing production and importing from abroad, and whenever this gap increases (quantity and value), this indicates a decline in food security conditions in a country. As for the (real gap), which is the difference between what an individual obtains in a country of food (quantitative and qualitatively) and the recommended scientific standards set by the organizations (Arab Organization for Agricultural Development, 1993).

***Self-sufficiency*:** the degree of the state's ability to satisfy its citizens from its national production **(FAO, 2009**), which is the ratio of the quantity of production to the quantity of consumption as a percentage, and it reflects the ability of production to meet consumption.

Strategic Food Commodities: The definition of a commodity as a strategic commodity may express the vital importance of this commodity, and hence the importance of securing local needs and striving to achieve this. However, the limited resources and production capacity of many societies and their inability to secure their needs of food commodities made an

arrangement for these commodities in the order of priorities. From the perspective of food needs, grain crops, especially wheat, came first in the priority list (Institute of National Planning, 2004).

Materials and Methods

The study is based on descriptive and quantitative analysis, and Time series analysis equations have been estimated to identify the trend of production, consumption, and imports of wheat during the period (2000-2019). (Kautsoyiannis A. (1981)), in addition to the use of simultaneous equations system for an econometric model with three stages using a Stata program, and accordingly, the best methods for estimation in this case, is the Three Stages Least Squares Method (3SLS). (Khalil, Y. M .2020)

Previous studies:

Some studies related to the nutritional gap of wheat dealt with a methodology based on some different statistical methods and reached different results in their details, but most of them agreed on the essence of the problem and based on the results, proposals for a solution were made, including the following:

A study (Shakra 2022) showed that the rate of increase in wheat production costs exceeded the rate of increase in net return for the period (2000-2022), which resulted in an increase in net return at a lower rate, in addition to a decrease in the ratio of net return to costs by about -3.1% annually. The cost of import is less than the cost of local production of wheat. The study recommended the development of a policy to subsidize bread to ensure that subsidies reach those who deserve it and limit the use of flour or bread as fodder for poultry and animals, with the establishment of storage silos to reduce the loss of wheat.

The study (OMER, S, 2022) showed that the wheat crop is one of the strategic crops in Egypt. This entails ensuring that minimum nutritional requirements are regularly met. The problem is represented by the phenomenon of a noticeable decline in the average wheat production in Egypt in general, when compared to its counterpart in other countries. Therefore, the expansion of the use of modern technological methods appropriate to the conditions of Egyptian agricultural production is considered the main input to increasing the output of the land unit. The study used the least squares method in Production and cost functions for a sample using laser technology using stepwise regression. The results

revealed the extent to which a positive return was achieved on the economic efficiency and productivity of the wheat crop when using laser leveling. The cost functions reflected an increase in the civil volume of costs, an increase in the maximum volume of profit, and improved flexibility at the level of the total study sample B, where It was found that the per-acre productivity of laser users amounted to about 20.30 acres of wheat, the total revenue per acre amounted to about 17,716 thousand pounds, the total costs per acre amounted to about 11,618 thousand pounds, the net revenue per acre amounted to about 5,798 pounds, and the unit cost of wheat amounted to about 586.40 pounds, and the profitability reached The pound was about 0.49 pounds, the revenue/cost ratio was about 1.49 pounds, and the net return per meter of irrigation water was about 3.31 pounds.

A study (Sayed, M. 2021) entitled an economic study of the wheat food gap in Egypt to confront some crises. The research aimed to estimate the size of the wheat gap in Egypt during the period (2000-2019), and to estimate the most important factors that affect it. The research was based on statistical analysis. On some descriptive and quantitative statistical methods. The results showed that both the area of wheat and the quantity produced of it increased during the study period at an annual growth rate of about 1.62% and 1.71% for each of them, respectively. It also showed that the amount of imports, the volume of consumption and the wheat gap increased at annual rates of about 3.4%, 5.2%. 5.3 of the average during the period (2000-2019). The food security factor declined from 0.35 on average for the period (2006-2012) to 0.28 on average for the period (2013-2019). This may be due to the decrease in the supply price and the failure of agricultural policy to keep pace with the level of population growth, and the rise in prices, which negatively affected food security. It has been shown that there is relative food security for the wheat crop in Egypt, but the increased dependence on imports still constitutes a burden on the agricultural trade balance, and that the most influential factors on the wheat gap are the population, the area cultivated with wheat, and the average per capita share of wheat, while more The factors affecting the food security factor are the size of the wheat stock and the percentage of self-sufficiency in it. Therefore, the research recommends the necessity of reconsidering the crop structure in order to achieve an increase in the area of wheat as a strategic crop by raising the supply price and state support for farmers.

Study (Al-Jundi, H 2020) The research aimed to study the development of productive and economic factors affecting wheat consumption in Egypt, and

a standard model was built to describe and analyze the impact of these factors on wheat consumption in Egypt during the period (2000 - 2018), as well as an attempt to predict production and consumption. And wheat imports until 2022. The simultaneous equations model was used, which was estimated using the three-stage least squares method (SLS3). The results of estimating the equations of the standard multi-equation model showed that the amount of local wheat production is increasing by amounts amounting to approximately 0.007, 2.66, and 2922.6. 0.077 thousand tons annually whenever the amount of wheat consumption, the area cultivated with wheat, the productivity of an acre of wheat, and the real agricultural price of a ton of wheat increase by a unit for each of them, respectively. And the amount of wheat consumption increases by amounts amounting to about 0.396, 177.2, 9.72, 9.271.4, 0.647 thousand tons annually, whenever the amount of local wheat production increases, the amount of wheat imports, the value of wheat support at real prices, the real national income, and the population of Egypt. And the amount of wheat imports increases. Wheat increases by amounts amounting to approximately 0.874, 0.572, and 320.2 thousand tons annually whenever the amount of local wheat production, the amount of wheat consumption, and the exchange rate increase by one unit for each of them, respectively. The research concluded with some recommendations that can be summarized. Here are the following: The necessity of working to increase local production of wheat by intensifying research and extension efforts, in addition to reviving the role of agricultural cooperatives. It is necessary to work to rationalize consumption of wheat by amending policies related to subsidizing bread and restricting it to those who deserve it, in order to reduce the amount of waste.

While The study (Qandil, S., & Mohammed, F., 2019) aimed to analyze the situation of production and food gap and the factors affecting on the food gap. Estimate the rate of self-sufficiency. Identify the price policy of wheat crop in Egypt and the geographical distribution of Egyptian imports of wheat. Identify the factors affecting on food gap of wheat in Egypt and ways to reduce the gap. The study depends on Secondary data from the Central Agency for Public Mobilization and Statistics (CAPMAS) And the Ministry of Agriculture and land reclamation. The study depends on descriptive and quantitative methods to analyze data. The results included that the average production, consumption, imports and food gap was about 7.99, 14.28, 6.61 and 6.62 million tons, respectively. The annual rate of

increase was statistically significant 2.48%, 4.22%, 5.44% and 5.43% respectively during the period (2000-2016). The average self-sufficiency rate was about 55.83% during the period (2000-2016). The geographical distribution of wheat imports showed that more than half of Egypt's wheat imports from Russia during the period (2016-2018). The study recommends increasing the area cultivated with wheat crop and developing varieties of high yield. And provide incentives price to farmers to ensure increased cultivated area. And rationalization of consumption and reduce losses of wheat crop.

Study by(Saleh, A and Ali, A 2018) An analytical economic study to reduce the wheat gap in Egypt. The study aimed to economically analyze the size of the nutritional gap for the wheat crop in Egypt during the period (2002-2016). The research used descriptive and quantitative analysis and some analysis methods. Statistics such as time series analysis, estimating general time trend equations, estimating arithmetic averages and percentages, and calculating some economic indicators for local production and consumption of the wheat crop. The research also used analysis of variance for varieties in two directions, and some scenarios (alternatives) for increasing wheat crop production. The results showed The expected challenge from increasing the cultivated area of wheat at the expense of other competing crops (whether export, import, or self-sufficiency crops) is not considered an actual challenge to increasing wheat production in Egypt. It has also become clear that by providing investments and water resources, there is the possibility of cultivating about one million acres of wheat in the new lands in the expansion areas east and west of the Delta, in Sinai, the New Valley, and east of Al-Uwaynat, in addition to the possibility of cultivating 200,000 acres of wheat on rainwater, as shown by a two-way variance analysis of per-acre productivity. For the most widespread wheat varieties in the governorates of Egypt during the period (2012-2016), there are statistically significant differences resulting from the difference in productivity of these varieties. This means that the averages of at least two varieties are not equal in the lands cultivated with wheat, and thus it is possible to substitute for high-productivity varieties at the expense of less productive varieties.

the study (Sadiq, 2017) showed that the supply of wheat was estimated by means of least squares, and the problems of estimation were addressed, such as double linearity and the residual correlation, and the (Mark Nirolf) farm model and net yield per acre were used. A general slowdown and municipal

costs, as a change of 10% due to variables in the short time leads to an increase in the wheat area by 1.29%, 1%, 1.6%, 1.3%, and 3.3%, respectively. production through a trade-off between its choice and expansion.

Research gap:

Through the reference review, it was found that most studies were based on measuring the wheat gap and the wheat self-sufficiency rate for previous periods and did not predict them for a future period, as stated in our study. It also became clear that most studies used traditional statistical methods and quantitative models, but in this study the study was adopted On descriptive and quantitative analysis, time series analysis equations were estimated to identify the trend of wheat production, consumption and imports during the period (2000-2022), in addition to using the simultaneous equations system of econometrics. A three-stage model using the Stata program chart, to predict the food gap and the wheat self-sufficiency rate for the period (2025-2030). Accordingly, the best estimation method in this case is the three-stage least squares method (3SLS), and this model is distinguished from other models. The precedent is as follows: Where the effect of the independent or explanatory variables (x_1, x_2, x_3,....) on the dependent variable (Y) is measured, then the effect of the dependent variable (Y) on the independent or explanatory variables (x_1, x_2, x_3,….) is measured. Then, it measures the mutual influence of each of them on the other, and this gives the analysis a realistic dimension since the variables have a mutual influence in both directions.

The development of production, consumption, the gap and the self-sufficiency rate of wheat in Egypt for the period (2000-2022):

As shown in table no.(1) that the produced quantity of wheat in Egypt increases annually at a statistically significant rate of about 0.138 million tons, representing about 1.6846% of the average production of about 8.2 million tons during the period (2000-2022), while the annual increase rate of wheat consumption is about 0.510million tons, representing about 3.02% of the average consumption of about 16.9 million tons, which means that there is a large gap between the produced and the consumed quantity of wheat , that shortage in the wheat quantities is filled by imports, whose annual increase rate is about 0.35 million tons, representing about 4.9% of the average wheat imports amounting to about 7.7 million tons for the average

study period (2000-2022). It was found that the amount of the wheat gap increases annually at a rate of about 0.367 million tons, representing about 5.8% of the average wheat gap for the study period, which amounted to about 8.6 million tons, while the self-sufficiency rate tended to decrease, reaching 0.916, representing about -1.7 of the average self-sufficiency rate for the study period, which amounted to about 52.2%.As for the amount of wastage of the wheat crop, it was found that it increases annually at a rate of124.3 thousand tons, representing about 6.04% of the average loss of wheat during the study period, which amounts to about 2058 thousand tons.

Table1. Time series analysis equations of production, consumption and imports quantities of wheat Egypt during the period (2000-2022)

Indicators	Equation	R^2	Average	change rate%
production quantity (million tons)	$\hat{Y}_i$ =6.58 + ٠.138 x_i (7.3)**	٠.57	8.21	1.68
consumption quantity (million tons)	$\hat{Y}_i$ =10.8+ ٠.510 x_i (12.4)**	٠.88	16.9	3.3.03
wheat gap (million tons)	$\hat{Y}_i$ = 4.2 + ٠.367x_i (7.67)**	٠.73	8.6	4.3
self-sufficiency rate	$\hat{Y}_i$ =63.5.6-0.916x_i (3.8)**	٠.76	52.5	-1.7
Imports quantity (million tons)	$\hat{Y}_i$ =3.5.7 + ٠.347 x_i (7.5)**	٠.73	7.7	4.5
amount of wastage (thousand tons)	$\hat{Y}_i$ = 426.7 +124.3x_i (4)**	٠.43	2058	6.04

**Significant at 0.01

Where $\hat{Y}_i$ is the value of the Dependent variable.

X_i is the value of the time independent variable during the period (2000- 2019).

Where, i = (1, 2, 3… 20).

Source:

1/ The Central Agency for Public Mobilization and Statistics, the annual research of the movement of production and foreign trade, and the availability of consumption of agricultural commodities, in different numbers.

2/ Ministry of Agriculture and Land Reclamation, Central Administration of Agricultural Economy, Food Balance Bulletin, various issues.

[3/] Central Agency for Public Mobilization and Statistics, website: WWW.Capmas.gov.eg

A standard model for predicting the gap and the percentage of self-sufficiency for wheat in Egypt for the period (2020-2030)
***Description and rating of the model*:**

Estimating the multi-equation econometric model is relatively more difficult compared to those single-equation models, because it requires many stages and main steps, starting from the description of economic relations (according to economic logic) and then determining the most important variables that will be used according to the matrix of simple correlation coefficients, and then determining The best mathematical images that will be used in statistical analysis and after completing the preparation of the model parameter. The degree of definition of the model is determined, then the most appropriate methods of estimation are determined. In this regard, the study used the total form sometimes and the average form at other times, in addition to the logarithmic images for each of them. All these permutations and reconciliations between the variables of the model used under certain criteria were economic logic, statistical significance, and distance as possible from the problems of econometric measurement in order to ensure the accuracy of the obtained estimates as much as possible and so that they can be relied upon in forecasting later.

Description of an econometric model of the wheat market in Egypt:

The model consists of three structural equations in addition to a defining equation:

1-Local consumption Equation of the wheat: It is assumed that the most important factors affecting the consumed quantity of wheat are the produced quantity and the imported quantity of the wheat, and the number of populations.

2-Local production Equation The wheat: It is assumed that the most important factors affecting the wheat consumed quantity, were the imported quantity, the import price of wheat, and self-sufficiency rate.

3-Imports Equation of the wheat: It is assumed that the most important factors affecting the imported quantity of wheat were the consumed quantity, and the import price of.

4-Definition equation: in which the consumed quantity of the wheat = the locally produced quantity + the imported quantity.

The model consists of Structural-Form Equations that measure the direct effect of the explanatory variable on the dependent variable, while the reduction equations measure the direct and indirect total effect of the specified variables on the internal variables, which cannot be clarified in the structural formula of the model, and the following is the mathematical description of the behavioral and definition equations of the model

Consumption Equation

$\mathbf{QCO_t=}$ $\alpha + \beta_1 QPO_t + + \beta_{2RPCOt} + \beta_3 QIO_t$

Production Equation

$\mathbf{QPO_t =}$ $\alpha + \beta_1 Area_t - \beta_2 QIO_t + \beta_3 RPO_t$

Import Equation

$\mathbf{QIO_t=}$ $\alpha + \beta_1 QVO_t + \beta_2 IPOx_t + \beta_3 P_t$

As for the mathematical description of the definition equation, it is as follows:

Definitional Equation

$QCO_t = QPO_t + QIO_t$

Where :

QCO_t = Quantity of wheat consumed in million tons per year t
QPO_t = Quantity produced of wheat million tons per year t
QIO_t = Quantity of wheat imports in million tons per year t
$IPOX_t$ = Import price of wheat in dollars per ton per year t
RPO_t = real local price of wheat in pounds per ton per year t
P_t= Population in million people per year t
IN_t = real per capita income in pounds per year t
SUlf= self-sufficiency rate of wheat per year t
$Area_t$ = Wheat Cultivated Area (Thousand Fadden)
per year t

Results:

Consumed Quantity Equation

The function shows that the increase in the quantity consumed of wheat is due to the increase in quantity of wheat imports, meaning that there is a direct relationship between them, i.e., with an increase in the quantity of wheat imports by one unit, the quantity consumed of wheat increases by1.289 thousand tons. The coefficient of determination is estimated at about 0.626, meaning that 62% of the changes in the quantity consumed are due to the increase in quantity of wheat imports and the rest is due to unmeasured factors, and the calculated (F) value reached 81, which confirms the significance of the estimated model.

Produced Quantity Equation

It is clear from the function that there is a direct relationship between the produced quantity of wheat, the cultivated area, the consumed quantity, and the quantity of wheat imports. That is, by increasing each of them by one unit, the produced quantity of wheat increases by about 0.0022, 0.001, respectively, and the coefficient of determination is estimated at 095, meaning that95% of the changes in the produced quantity, it is due to the previous factors, and the rest is due to unmeasured factors. The calculated value of (F) reached 448.75, which confirms the significance of the estimated model.

Imported Quantity Equation

It was found from the function that there is a direct relationship between the imported quantity and the stock quantity, that is, by increasing the stock quantity of wheat increases the, the produced quantity of wheat increases by about 0.0022 thousand tons. and the population number increases one unit the imported quantity of wheat increases by about0.185 thousand tons The coefficient of determination is estimated at 0.74, meaning that 74% of the changes in the imported quantity are due to the quantity of stock and the population number is due to unmeasured factors and its value is (F) Calculated 78.95. Which confirms the significance of the estimated model?

Table2: production, consumption and imports equations of wheat in the Egyptian market during the period (2000-2022)

Statement	Equation	R^2	F
Consumption	**QCOt =6.54 -0.004QPOt 0.+1.29 QIOt** **(2.34)** (-0.14) (5.1)****	0.93	193
Production	**QPOt =0.359+0.0022AREt + 0.015QIOt + 0.001RPOt** **(٠.٧٢) (٨.٦٩) ** (0.46) (2.72)****	0.91	199
Import	**QIOt =-9.68+ 0.509QVOt -0.004IPOt + 0.1856Pt** **(2.16)** (2.37)** (-1.17) (2.81)****	0.82	97

Source: Results of the red meat market model in Egypt in the appendix

Forecasting the wheat gap and wheat self-sufficiency for the year 2025,2030

Table.٣ and Chart no. 1 predictive values of the gap wheat in the case of normal conditions

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**12.7699**	**10.5497**	**14.99**
2021	**13.4658**	**10.816**	**16.1157**
2022	**14.1618**	**11.023**	**17.3006**
2023	**14.8577**	**11.1793**	**18.5361**
2024	**15.5537**	**11.2912**	**19.8162**
2025	**16.2496**	**11.3632**	**21.1361**
2026	**16.9456**	**11.3987**	**22.4925**
2027	**17.6416**	**11.4005**	**23.8826**
2028	**18.3375**	**11.3706**	**25.3044**
2029	**19.0335**	**11.3108**	**26.7561**
2030	**19.7294**	**11.2225**	**28.2363**

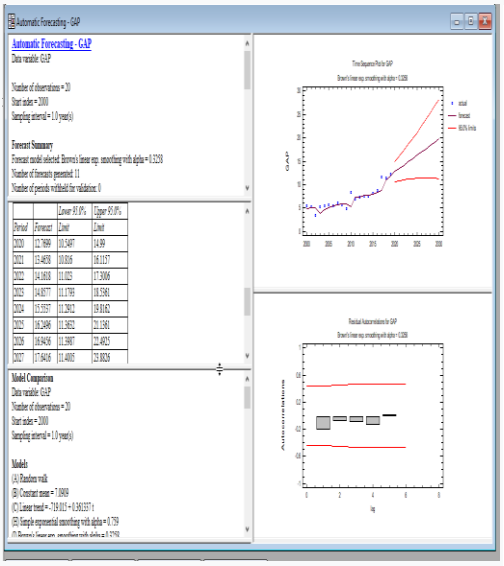


Table .4 and **Chart no. 2**of predictive values of the gap wheat in the event of an increase in the amount of production by 10%

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**11.7823**	**9.61249**	**13.952**
2021	**12.4847**	**9.88715**	**15.0823**
2022	**13.1872**	**10.1028**	**16.2716**
2023	**13.8897**	**10.268**	**17.5114**
2024	**14.5922**	**10.389**	**18.7954**
2025	**15.2947**	**10.4703**	**20.1191**
2026	**15.9972**	**10.5153**	**21.479**
2027	**16.6996**	**10.5266**	**22.8727**
2028	**17.4021**	**10.5065**	**24.2978**
2029	**18.1046**	**10.4565**	**25.7528**
2030	**18.8071**	**10.3781**	**27.2361**

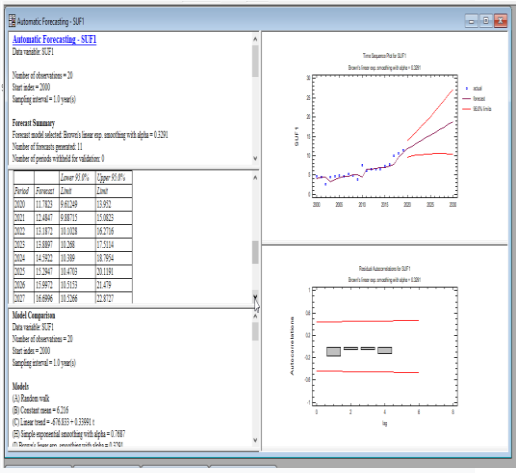


Table.5 and Chart no**. 3**of predictive values of the gap wheat in the event of an increase in the amount of production by 10% and a decrease in the amount of consumption by 10%

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**9.73775**	**7.58423**	**11.8913**
2021	**10.3569**	**7.81164**	**12.9022**
2022	**10.9761**	**7.98531**	**13.9668**
2023	**11.5952**	**8.11275**	**15.0777**
2024	**12.2144**	**8.19956**	**16.2291**
2025	**12.8335**	**8.24993**	**17.4171**
2026	**13.4527**	**8.26706**	**18.6382**
2027	**14.0718**	**8.2534**	**19.8902**
2028	**14.691**	**8.21094**	**21.171**
2029	**15.3101**	**8.14128**	**22.4789**
2030	**15.9293**	**8.04575**	**23.8128**

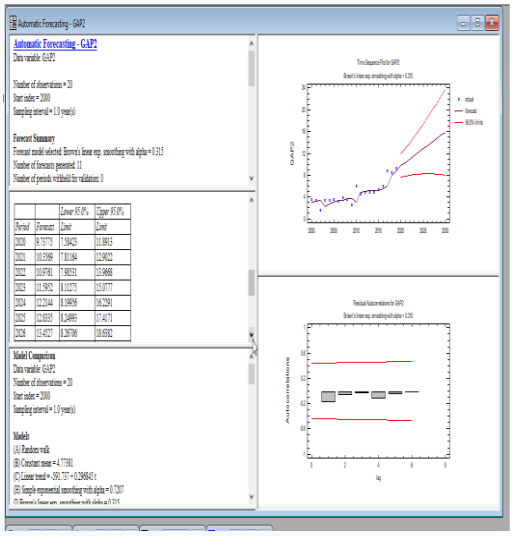


Table 6. Chart no. 4 and of predictive values of the self-sufficiency percentage of wheat in the case of normal conditions

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**40.2105**	**29.538**	**50.883**
2021	**39.3211**	**24.2278**	**54.4143**
2022	**38.4316**	**19.9463**	**56.9169**
2023	**37.5421**	**16.1971**	**58.8871**
2024	**36.6526**	**12.7882**	**60.5171**
2025	**35.7632**	**9.62096**	**61.9054**
2026	**34.8737**	**6.63688**	**63.1105**
2027	**33.9842**	**3.7978**	**64.1706**
2028	**33.0947**	**1.07721**	**65.1123**
2029	**32.2053**	**-1.54417**	**65.9547**
2030	**31.3158**	**-4.08091**	**66.7125**

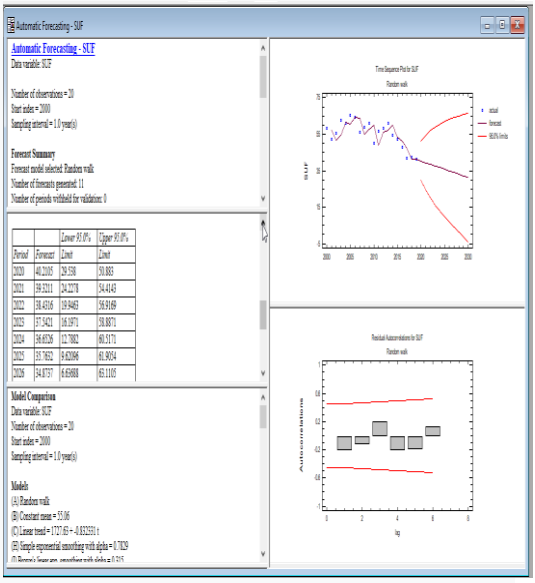


Table7. and Chart no5of predictive values of the self-sufficiency rate of wheat in the event of an increase in the amount of production by 10%

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**50.6769**	**37.4882**	**63.8657**
2021	**49.8312**	**36.4642**	**63.1982**
2022	**48.9854**	**35.4266**	**62.5442**
2023	**48.1396**	**34.3761**	**61.9032**
2024	**47.2939**	**33.3132**	**61.2745**
2025	**46.4481**	**32.2385**	**60.6577**
2026	**45.6023**	**31.1525**	**60.0522**
2027	**44.7566**	**30.0558**	**59.4573**
2028	**43.9108**	**28.9489**	**58.8727**
2029	**43.065**	**27.8324**	**58.2977**
2030	**42.2193**	**26.7067**	**57.7318**

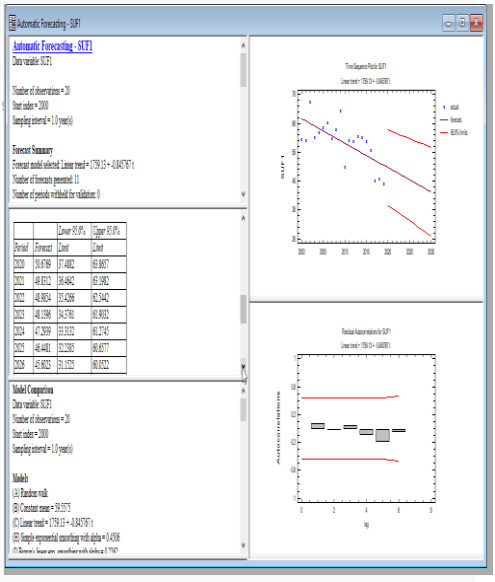
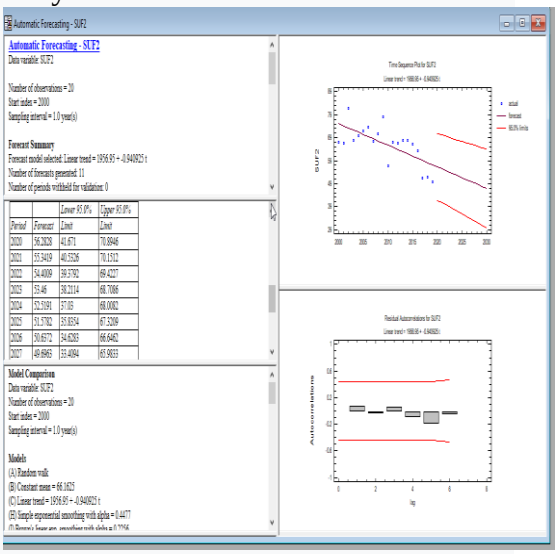


Table 8.and chart no6. of predictive values of the self-sufficiency rate of wheat in the event of an increase in the amount of production by 10% and a decrease in the amount of consumption by 10%

		Lower 95.0%	*Upper 95.0%*
Period	***Forecast***	***Limit***	***Limit***
2020	**56.2828**	**41.671**	**70.8946**
2021	**55.3419**	**40.5326**	**70.1512**
2022	**54.4009**	**39.3792**	**69.4227**
2023	**53.46**	**38.2114**	**68.7086**
2024	**52.5191**	**37.03**	**68.0082**
2025	**51.5782**	**35.8354**	**67.3209**
2026	**50.6372**	**34.6283**	**66.6462**
2027	**49.6963**	**33.4094**	**65.9833**
2028	**48.7554**	**32.1792**	**65.3316**
2029	**47.8145**	**30.9383**	**64.6907**
2030	**46.8735**	**29.6872**	**64.0598**



Discussion:

Some studies related to the nutritional gap of wheat dealt with a methodology based on some different statistical methods and reached different results in their details, but most of them agreed on the essence of the problem and based on the results, proposals for a solution were made, including the following:

the study (Sadiq, 2017) showed that the supply of wheat was estimated by means of least squares, and the problems of estimation were addressed, such as double linearity and the residual correlation, and the (Mark Nirolf) farm model and net yield per acre were used. A general slowdown and municipal costs, as a change of 10% due to variables in the short time leads to an increase in the wheat area by 1.29%, 1%, 1.6%, 1.3%, and 3.3%, respectively. production through a trade-off between its choice and expansion**.**

While The study (Qandil, S., & Mohammed, F., 2019) aimed to analyze the situation of production and food gap and the factors affecting on the food gap. Estimate the rate of self-sufficiency. Identify the price policy of wheat crop in Egypt and the geographical distribution of Egyptian imports of wheat. Identify the factors affecting on food gap of wheat in Egypt and ways to reduce the gap. The study depends on Secondary data from the Central Agency for Public Mobilization and Statistics (CAPMAS) And the Ministry of Agriculture and land reclamation. The study depends on descriptive and quantitative methods to analyze data. The results included that the average production, consumption, imports and food gap was about 7.99, 14.28, 6.61 and 6.62 million tons, respectively. The annual rate of increase was statistically significant 2.48%, 4.22%, 5.44% and 5.43% respectively during the period (2000-2016). The average self-sufficiency rate was about 55.83% during the period (2000-2016). The geographical distribution of wheat imports showed that more than half of Egypt's wheat imports from Russia during the period (2016-2018). The study recommends increasing the area cultivated with wheat crop and developing varieties of high yield. And provide incentives price to farmers to ensure increased cultivated area. And rationalization of consumption and reduce losses of wheat crop.

A study (Shakra 2022) showed that the rate of increase in wheat production costs exceeded the rate of increase in net return for the period (2000-2022), which resulted in an increase in net return at a lower rate, in addition to a decrease in the ratio of net return to costs by about -3.1% annually. The cost of imports is less than the cost of local production of wheat. The study recommended the development of a policy to subsidize bread to ensure that subsidies reach those who deserve it and limit the use of flour or bread as fodder for poultry and animals, with the establishment of storage silos to reduce the loss of wheat.

As for our research, it was is based on descriptive and quantitative analysis, and Time series analysis equations have been estimated to identify the trend of production, consumption, and imports of wheat during the period (2000-2022).)),in addition to the use of simultaneous equations system for an econometric model with three stages using a Stata program, and

accordingly, the best methods for estimation in this case, is the Three Stages Least Squares Method (3SLS).

The results of the three scenarios show the following:
The normal situation (which will not change): the gap reached about 12.8 million tons in 2020, and it is estimated to reach about 16.2 million tons in 2025, and about 19.7 million tons in 2030, and the self-sufficiency ratio is about 40.2% in 2020 And it may reach about 35.8% in 2025, and 31.3% in 2030.

The second case (increasing wheat production by 10%)*:* the gap reached about 11.8 million tons in 2020 and is estimated to reach about 15.2 million tons in 2025, and about 18.8 million tons in 2030, and the self-sufficiency ratio may reach about 46.4% in the year 2025, and 42.2% in 2030.
The third case (increase in production and decrease in consumption by 10% together): the gap amounted to about 9.8 million tons, and it is estimated that the gap will reach about 12.8 million tons in 2025, and about 15.9 million tons in 2030, and the self-sufficiency ratio has been The model amounted to about 56.8%, and it is estimated that it will reach about 51.4% in 2025, and 46.2% in 2030.

A proposed strategy to reduce the nutritional gap of the wheat crop*:*

Based on the foregoing results of the model and the expectation that the wheat food gap will continue and increase, and the self-sufficiency rate will decrease, it was necessary to propose a strategy to reduce that expected gap, as the strategy is based on the following axes:

1- ***Vertical expansion of wheat crop****:* It means an increase in the productivity of the acre in the following ways:

• Working on the development of high-productivity varieties that are resistant to diseases and harsh environmental conditions of the wheat crop and the use of modern technological methods in the service of the land, agriculture, and harvest in order to ensure the optimal distribution of seeds, water and other production elements in order to increase the production of the wheat crop on the same area

• Cultivation of wheat with pure seeds by 100% instead of 30% and generalizing these seeds to all wheat growers. This is done by increasing spending on research and improving wheat strains in order to increase the productivity rate (Saleh et al., 2018).

*2 - **Horizontal expansion of the wheat crop***

A _ Horizontal expansion on ancient lands: By increasing the cultivated area of the wheat crop in the old lands at the expense of the alfalfa crop, where a study showed that the wheat and alfalfa crop are among the most important winter crops and there is intense competition between them for economic and agricultural capital resources, foremost of which is the area of agricultural land, provided that wheat cultivation is expanded at the expense of alfalfa in Regions and regions where wheat productivity is high and for which other fodder alternatives are available, as this leads to an increase in production of wheat straw, which can be technically treated and its nutritional value increases, and then it can compensate for a large part of the lack of alfalfa production.(Some studies have shown that the expected challenge of Increasing the cultivated area of the wheat crop at the expense of other competing crops (whether exported, importing, or self-sufficient crops), is not considered a real challenge to increasing wheat production in Egypt; This is due to the marginality of the areas that can be reduced from the areas of those crops, except for sustainable alfalfa in practice, if compared to the areas that need to be added to increase the local production of wheat in quantities that affect the reduction of the wheat gap. Likewise, the alfalfa crop, whose area represents about 22% of the area of winter crops as an average for the period (2014-2016), is not the only component in the animal nutrition system, and therefore it is not expected that the reduction of alfalfa areas will result in a decrease in meat and dairy production (Saleh et al. 2018).

A study has shown that reducing the areas planted with alfalfa in favor of wheat may not mean a decrease in the quantitative production of fodder, as the expansion of wheat cultivations is accompanied by an increase in the production of dry straws, which are mainly used to feed livestock, as this increase can compensate for a large part of the shortfall

in Alfalfa production (of which moisture - water constitutes a large proportion of its components), although this does not negate the fact that the nutritional value of the alfalfa crop is higher than that of wheat straw, which can be compensated by modifying the nutritional components in wheat straw by technical treatments and well-known industrial methods (Institute of National Planning , 2004).

B_ Horizontal expansion in new lands: Horizontal expansion means an increase in the cultivated area through the expansion of the area cultivated with wheat in the new lands outside the valley, and these areas have been determined by the state in the following areas (Central Agency for Public Mobilization and Statistics, 2012).

• 5 million acres in Sinai and depend on groundwater.

• 800 thousand feddans in the North Coast, and it depends on rainwater for its irrigation.

• 780 thousand acres in the south of the valley.

• East "Owainat" and "Toshka" area, which has an area of more than 1.5 million feddans.

Which helps to fill a large part of the expected wheat gap in the three cases previously mentioned by the results of the model.

3_ Rationalizing the local consumption of wheat:

By limiting the use of subsidized loaf of bread in feeding poultry and birds, by making use of the remaining bread points per month in purchasing food supplies, as the average per capita share of wheat reached about 155,63 kilograms per year as an average for the period (2000-2016) at a minimum. It reached about 126,5 kilograms per year, and a maximum of about 182,7 kilograms per year (Kandil et al., 2019).

4- Reducing the wastage of the wheat crop:

Wheat is exposed to a large quantity of losses during the stages of harvest, transportation and storage, where the average loss of the wheat

crop reached about 1939.4 thousand tons during the period (2000-2019), equivalent to 24% of the average production of the wheat crop during the same period, which amounted to about 8.1 million tons. Thus, a specific strategy must be followed to reduce waste, cover the greatest amount of consumption, and reduce the nutritional gap of wheat. According to one study, saving 6 kilograms of annual consumption per capita each year contributes to providing 420,000 tons of national wheat consumption without decreasing the level of wheat saturation for the Egyptian consumer (Al-Kilani,2011). Expanding the construction of modern metal and concrete silos to accommodate the quantities of wheat that are imported locally or imported from abroad and considering raising the cost categories of wheat storage and transportation, encouraging investors to establish modern silos to accommodate wheat, and developing and improving wheat storage capacities in proportion to the hoped-for increase from Quantity of Voluntary Supply (Saleh et al. 2018).

***5- Encouraging local farmers to grow and supply wheat*:** This is done through the application of a balanced price policy for wheat that takes into account the cost of production inputs in addition to an appropriate profit that encourages the farmer to expand wheat cultivation, as well as an early announcement of the wheat supply price before starting to plant it. Price is the main factor on which the farmer bases his decisions in choosing the type of crops to grow (Al-Rasoul, 2004). With the necessity of not linking the local price of the wheat crop to international prices in the event of a decline. To support the farmer to motivate him to continue farming without worrying about the impact of external conditions.

summary

The food problem has become one of the most important problems that threaten Egypt's economic and social development because of its serious dimensions on the agricultural sector in particular and the Egyptian economy in general. Although there is evidence of increased Egyptian agricultural production, Egypt still suffers from a food gap in most strategic food commodities, the most important of which is wheat, threatening Egyptian food security. The equation of the amount

consumed shows that the increase in the amount consumed of wheat is due to the increase in the population, i.e., there is a direct relationship between them, i.e., an increase in the population by one million people, the amount consumed of wheat increases by 0.238 thousand tons. A model that produced the quantity equation shows from the function that there is a direct relationship between the quantity produced from wheat, the area cultivated, the amount consumed and the rate of self-sufficiency. That is, by increasing each by one unit, the amount produced from wheat increases by about 0.0014, 0.286 and 0.072, respectively, equivalent to the imported quantity and the function shows that there is a direct relationship between the imported quantity and the quantity consumed, i.e., by increasing the amount consumed, the imported quantity of wheat increases by about 0.877 thousand tons. For forecasts for 2030, the wheat gap is normally about 19.7 million tons in 2030 and then declines in the second case, with production supporting about 8 million and continuing to decline in the third case as production increases. Consumption is down 10% by about 15.9 million tons. The self-sufficiency of wheat will reach 31.3% in 2030 as usual, then rise to 42.2% if production increases by 10%, and then rises in the third case to about 46.9%. In the case of increased production and a 10% decrease in consumption. This requires a strategy to reduce that gap through some proposed policies and measures based on a horizontal expansion of old land at the expense of clover crops in areas and regions with high wheat productivity and other feed alternatives, and horizontal expansion of new land with a total area of more than 2.5 million feddan, which means the production of about 9.2 million tons of wheat that contributes to closing a large part of the gap. For the expected wheat in the three cases mentioned above the results of the model, and rationalizing the local consumption of wheat by reducing the use of supported loaf of bread in poultry nutrition by benefiting consumers from the remaining bread points per month in the purchase of food commodities, reducing the loss of wheat crop during the harvest, transportation and storage, where the average loss of a crop equivalent to 24% of the average production of wheat crop during the study period, and expanding the construction of

metal and concrete silos modern to accommodate Quantities of wheat that are supplied locally or imported from abroad, and work to encourage local farmers to grow and supply wheat through the application of a balanced price policy for wheat that takes into account the cost of production inputs in addition to an appropriate profit that encourages farmers to expand wheat cultivation.

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Three-stage least-squares regression

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
QCO	23	3	2.230987	0.6164	80.98	0.0000
QPO	23	3	.2473598	0.9481	448.75	0.0000
QIO	23	3	1.375383	0.7387	78.95	0.0000

Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
QCO					
QPO	-.0603117	.4164948	-0.14	0.885	-.8766265	.7560031
RPCO	.0003814	.00053	0.72	0.472	-.0006574	.0014202
QIO	1.289992	.2551371	5.06	0.000	.7899324	1.790052
_cons	6.542518	2.792684	2.34	0.019	1.068957	12.01608
PO						
ARE	.0022058	.0002537	8.69	0.000	.0017085	.0027031
QIO	.0152199	.0329563	0.46	0.644	-.0493732	.0798131
RPO	.001001	.0003681	2.72	0.007	.0002795	.0017226
_cons	.3587164	.4960518	0.72	0.470	-.6135273	1.33096
QIO						
QVO	.5091562	.2147104	2.37	0.018	.0883315	.9299809
IPONEW	-.0004223	.0003614	-1.17	0.243	-.0011307	.0002861
Pt	.185081	.065932	2.81	0.005	.0558566	.3143053
_cons	-9.678082	4.488986	-2.16	0.031	-18.47633	-.8798312

Endogenous variables: QCO QPO QIO

Exogenous variables: RPCO ARE RPO QVO IPONEW Pt