

DETERMINANTS OF FOOD SECURITY IN ALGERIA: AN ECONOMETRIC AND ANALYTICAL STUDY OF SOCIOECONOMIC DIMENSIONS (2000 – 2022)

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ABSTRACT:

This study explores the state of food security in Algeria by analyzing the food security gap and identifying its main determinants. A multiple linear regression model was employed to examine the relationship between the food security gap and several explanatory variables, including total population, rural population, cultivated land area, agricultural labor force, and GDP per capita. The statistical analysis was conducted using the EViews 13 software. Relying on time series data from 2000 to 2022, the study highlights Algeria's growing dependence on food imports due to insufficient domestic agricultural production. The econometric results show that population growth and GDP per capita are the most significant factors affecting the food security gap, while the other variables did not demonstrate statistically significant effects.

Keywords : Food Security, Food Gap, Algerian Economy, Food Imports, Food Exports.

I. INTRODUCTION

Food security has become one of the most pressing global issues in recent decades, especially in light of population growth, climate change, and the increasing volatility of international markets. Ensuring food security means providing individuals with continuous access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for a healthy life. This issue is particularly important in developing countries, where food systems face numerous challenges related to production capacity, resource management, and economic stability. In Algeria, food security represents a major strategic challenge due to the country's increasing dependence on food imports to meet the needs of its growing population. Despite efforts to develop the agricultural sector, domestic production has often failed to keep pace with consumption levels. Although the government has implemented various programs and agricultural reforms aimed at boosting local production and reducing reliance on imports, the results have been mixed. These ongoing efforts raise an essential research question:

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What are the key economic and demographic factors that influence the food security gap in Algeria?

Objectives of the Study:

1. To analyze the evolution of the food security gap in Algeria over the past two decades.
2. To identify the most influential economic and demographic variables affecting food security, such as population growth, rural population, cultivated land area, agricultural labor force, and GDP per capita.
3. To construct an econometric model that explains the relationship between these variables and the food security gap in Algeria.
4. To contribute to a deeper understanding of food security dynamics by combining quantitative analysis with the Algerian economic reality.

Significance of the Study:

This study links quantitative analysis with the economic reality in the field of food security. The findings of the study offer an opportunity for a deeper understanding of the determinants of the food security gap and for proposing evidence-based interventions. It contributes to the economic literature on food security in developing countries, particularly within the Algerian context.

II. PRELIMINARY CONCEPTS:

II. 1. Definition of Food Security :

The Food and Agriculture Organization (FAO) and the World Food Programme (WFP) defined food security as: "Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life." (United Nations, 29/03/2025)

Similarly, the Arab Organization for Agricultural Development (AOAD) defined food security as: "The ability of a state or group of states to provide sufficient food for their populations, either through local production or imports from international markets, in a stable and sustainable manner without exposure to severe risks or fluctuations." (Arab Organization for Agricultural Development, 2023, p. 8). Meanwhile, the World Health Organization (WHO) defined food security as: "The situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. (World Health Organization, 2025)

Based on the above, food security can be generally defined as a continuous state of availability of sufficient, safe, and nutritious food for all individuals, at all times, ensuring their ability to meet their physical and functional needs within a sustainable food system that is resilient to economic or climatic crises, while preserving human dignity and promoting social and economic stability.

II. 2. Types of Food Security:

Food security is a multidimensional concept that can be classified into several types, each reflecting a different aspect of a country's ability to provide food for its population.

- **Absolute Food Security:** refers to a nation's complete self-sufficiency in producing all its food needs without relying on imports. This concept aims to achieve national independence from global food markets and to protect the country from external shocks. For example, China recently adopted legislation aimed at strengthening absolute food security as a core national strategy.
- **Relative Food Security :** occurs when a country produces a significant portion of its food needs but still depends on international markets for certain products that are more economically viable to import. According to the Food and Agriculture Organization (FAO), relative food security enables countries to optimize the use of their resources while maintaining strategic reserves of essential commodities.
- **Apparent or Superficial Food Security :** arises when food appears to be sufficiently available at the national level, yet problems such as poor food distribution, poverty, or malnutrition persist. According to the FAO, apparent abundance may conceal underlying inequalities in food access.
- **Sustainable Food Security :** focuses on ensuring that all individuals continuously have access to safe, sufficient, and nutritious food without compromising the ability of future generations to meet their own needs. This approach integrates environmental protection, economic viability, and social justice, closely aligning with the vision of the Food and Agriculture Organization (FAO).

II. 3. The Economic and Social Dimensions of Food Security:

Food security is a complex issue with closely intertwined economic and social dimensions, making its achievement a major challenge for countries, especially in light of rapid economic and demographic transformations. Economically, as the Food and Agriculture Organization (FAO) points out, "The economic dimension of food security includes maintaining the purchasing power of citizens, enhancing income generation through investment and employment, and implementing precautionary policies to mitigate the risks associated with the liberalization of agricultural product trade" (FAO, 2003).

Food security is a fundamental pillar of social stability in any nation. Its absence not only affects economic dynamics but also has profound social repercussions, often leading to increased tensions and potential internal unrest. According to the Food and Agriculture Organization (FAO, 2023), food insecurity contributes to societal stress and can exacerbate the risk of conflict, especially in contexts marked by chronic poverty or high unemployment. Ensuring access to adequate, nutritious, and affordable food is a core responsibility of the state, as food is recognized as a basic human right. This is reaffirmed by international legal instruments such as Article 25 of the Universal Declaration of Human Rights, which states that "everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food..." (United Nations, 1948). In Algeria, Law No. 18-11 explicitly emphasizes, in Article 1, the importance of protecting and preserving individual

health—an objective that cannot be achieved without guaranteeing food availability. Hence, any gap between the supply and demand of food leads to social instability, negatively influencing individuals' behaviors and weakening the effectiveness of development strategies. Thus, food security is not only a socioeconomic requirement but also a vital component of sustainable development and social justice.

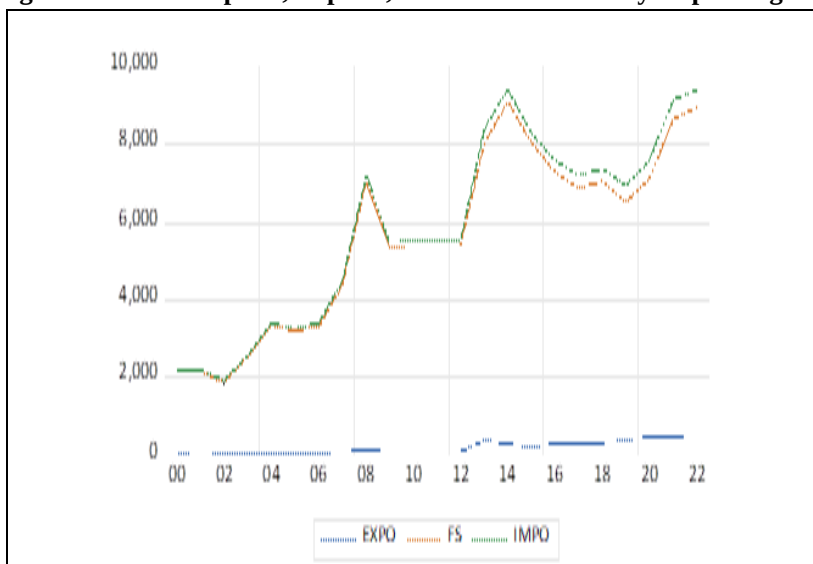
II. 4. Food Security Gap:

The food security gap refers to the difference between the amount of food actually available to individuals or households and the amount of food they need to maintain an active and healthy life. It is also considered one of the indicators of food security and can be expressed by the food trade balance. It is measured by the difference between the value of food imports and the value of food exports. If this balance is positive, it indicates the existence of a food security gap. On the other hand, if the food trade balance is negative, it indicates the absence of a food security gap. This indicator is calculated mathematically as follows:

$$\text{Food Security Gap} = \text{Food Imports} - \text{Food Exports}$$

III. ANALYSIS OF ECONOMIC AND DEMOGRAPHIC FACTORS INFLUENCING:

III. 1. The Food Security Gap Analysis of Food Imports and Exports and the Gap Between Them:

Figure 01 : Food Imports, Exports, and the Food Security Gap in Algeria.

Source: Prepared by the researcher based on the outputs of the EViews program.

Algeria has witnessed an increase in food imports due to its high reliance on food imports to meet basic food needs. Domestic production was not sufficient to cover the local market's needs, leading to an increase in the food security gap during the period from 2000 to 2008, rising from 2146 million dollars to 7066 million dollars. Later, the agricultural sector saw some improvement due to government policies that led to better local agricultural production, causing the food security gap to decrease to 5361 million dollars in 2009. The gap remained at this level until 2013. Starting in 2013, the food security gap began to rise again, as food imports exceeded exports, which impacted the food trade balance.

Fluctuations in global oil prices affected Algeria's ability to finance food imports, prompting the government to strengthen agricultural policies and invest in the agricultural sector. However, the food gap continued to widen due to increased local consumption driven by population growth. Algeria attempted to reduce its dependence on imports by encouraging local production, but it was not successful. The COVID-19 pandemic impacted global supply chains, leading to increased difficulties in securing food and rising food needs.

III.2. Analysis of Several Determinants of the Food Security Gap in Algeria:

Algeria has experienced a continuous population increase since the year 2000. The population rose from 30.9 million in 2000 to 35.7 million in 2010, reflecting a significant increase of around 5 million people. The number continued to grow, reaching 44.3 million in 2020, indicating ongoing population growth, although at a relatively slower pace compared to the first decade. Between 2020 and 2022, the population increased by 1.6 million, reaching 45 million, which shows a decline in the growth rate compared to previous periods. This continuous population growth indicates that Algeria has witnessed demographic

development with varying growth rates; the population grew faster earlier, while the growth rate began to slow down after 2010. This slowdown may be attributed to various factors such as declining birth rates or changes in migration patterns. Population growth significantly impacts the economy and society by increasing pressure on essential resources and services, such as education, healthcare, and food. (See Appendix 1, Table 1)

The rural population in Algeria witnessed a general decline over the period from 2000 to 2022, decreasing from approximately 12.85 million in 2000 to around 11.25 million in 2022. This decline indicates a trend toward urbanization and the migration of people from rural to urban areas, which may negatively impact domestic agricultural production due to the decreasing availability of labor in rural zones. The agricultural labor force, on the other hand, experienced notable growth during the first decade of the 2000s, rising from 1.288 million workers in 2000 to over 2.4 million by 2010. It continued to increase, reaching its peak in 2016 with approximately 4.959 million workers, before sharply declining again to 2.65 million workers in 2021 and 2022. This recent drop suggests a weakening of the agricultural sector or a shift of labor toward other economic sectors, which undermines Algeria's capacity to achieve food self-sufficiency. As for the cultivated land area, it remained relatively stable during the first decade, fluctuating between approximately 8.2 and 8.4 million hectares. It then saw a notable increase, surpassing 9 million hectares in 2012, followed by some fluctuations in the subsequent years, peaking in 2013 before stabilizing again at slightly below 8.6 million hectares. This development reflects efforts to expand agricultural land, although it did not necessarily translate into sufficient food production due to other factors such as low productivity or climate-related challenges. Regarding GDP per capita, it gradually and significantly increased, rising from around 1,757 dollars in 2000 to over 5,400 dollars in 2014, before continuing to fluctuate and settling at approximately 4,273 dollars in 2022. Despite this growth, its impact on food security remains limited unless accompanied by actual improvements in domestic food production capacity. Through this evolution, it is evident that most agricultural and demographic indicators influencing food security in Algeria showed relative improvement during the first decade, followed by a phase of stagnation or decline in the following years. This explains the persistence of the food security gap despite various agricultural policies, as the data indicate that agricultural production capacity has not kept pace with population growth and economic and social transformations. Consequently, addressing the food security gap requires enhancing land use efficiency, improving agricultural labor productivity, and encouraging rural population retention through comprehensive development policies. (See Appendix 1, Table 1)

III.3. Econometric Analysis of the Relationship Between Economic and Demographic Determinants of the Food Security Gap:

we aim to estimate the relationship between the food security gap and its dimensions based on data from a set of economic and demographic variables, in order to determine the nature of their relationship.

III.3.1. Methodology and Tools:

The data used in this study were collected from various issues of the Annual Yearbook of Agricultural Statistics published by the Arab Organization for Agricultural Development. To determine the relationship between the different independent variables and the food security gap, we conduct a statistical analytical study of the data in order to build a mathematical model. This is achieved by relying on a multiple linear regression model and the Ordinary Least Squares (OLS) method, using a set of statistical tools implemented through the EViews 13 software.

III.3.2. Overview of the Multiple Linear Regression Model

In this context, the relationship between food security and a number of independent economic and demographic variables can be studied by relying on an econometric model that establishes a relationship between the dependent variable  and several explanatory independent variables (X). This is known as the Multiple Linear Regression Model. The regression equation takes the following general form:

$$y = \beta X + \varepsilon$$

$$Y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \dots + \beta_K x_{Kt} + \varepsilon_t$$

$$(t = 1 \dots n)$$

The Multiple Linear Regression Model is used to explain the nature of the relationship between the dependent variable and several independent variables, to determine the direction and strength of this relationship, to predict the values of the dependent variable based on given values of the independent variables, to test statistical hypotheses regarding the effect of each independent variable on the dependent variable—whether individually or collectively—and to assess the importance of the independent variables in explaining changes in the dependent variable. This is based on the following indicators of model quality:

III.3.3. Indicators of the Quality of the Multiple Linear Regression Model:

Several statistical indicators and criteria are used to evaluate the quality and appropriateness of the multiple linear regression model, the most prominent of which are:

Student's t-test: This test is used to examine the significance of each coefficient in the regression model. It is based on two hypotheses: The null hypothesis (H_0) suggests that the coefficient is not statistically significant. The alternative hypothesis (H_1) suggests that the coefficient is statistically significant. The significance is assessed either by comparing the calculated t-value to the critical value or by evaluating the p-value.

Coefficient of Determination (R^2): This measures the proportion of the total variance in the dependent variable that can be explained by the independent variables. The closer the R^2 value is to one, the higher the explanatory power of the model.

F-test: This test examines the overall significance of the model, meaning whether the independent variables collectively contribute significantly to explaining the variance in the dependent variable. The test is based on two hypotheses:

$$\begin{cases} H_0: \text{Independent variables} \\ H_1: \text{correlated variables} \end{cases}$$

Where we compare the calculated Fisher value to its tabulated value.

Durbin-Watson Test: This test is used to detect the problem of autocorrelation among residuals (errors). A test value close to 2 indicates the absence of autocorrelation, while values significantly different from 2 suggest the possibility of its presence.

Goldfeld-Quandt Test: This test is used to detect the presence of heteroscedasticity in the residuals, which is a problem that can weaken the efficiency of estimators and invalidate the results of statistical tests.

III.3.4. The Econometric Model

❖ Presentation of Variables :

To study the food security gap and the factors influencing it, we relied on an econometric model that includes the selected study variables, which are as follows: the food gap (FS), total population (POP), rural population (PORAL), labor force in the agricultural sector (FOR), cultivated areas (AREA), and the average per capita GDP. Accordingly, a multiple linear regression model was constructed to analyze the relationship between the food security gap and the influencing factors in our current study as follows:

$$FS_t = \beta_0 + \beta_1 POP_t + \beta_2 PORAL_t + \beta_3 FOR_t + \beta_4 AREA_t + \beta_5 GDP_t + \varepsilon_t$$

For the purpose of eliminating heterogeneity that may exist among the different variables due to differences in measurement units, we adopt the logarithmic form, which is written as follows:

$$\log(FS_t) = \beta_0 + \beta_1 \log(POP_t) + \beta_2 \log(PORAL_t) + \beta_3 \log(FOR_t) + \beta_4 \log(AREA_t) + \beta_5 \log(GDP_t) + \varepsilon_t$$

❖ Model Estimation

Based on the data of the five variables over the period from the year 2000 to 2022, and using the EViews 13 software, after applying the logarithmic transformation to the five variables, we estimated the previously mentioned model. The estimation results have been summarized as follows:

Table 1: Estimation of the Econometric Model.

Dependent Variable: FS				
Method: Least Squares				
Date: 03/25/25 Time: 19:56				
Sample: 2000 2022				
Included observations: 23				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.029246	8.927165	-0.563364	0.5805
POP	1.244008	0.388640	3.200926	0.0052
PORAL	-0.634208	0.428391	-1.480441	0.1571
FOR	0.094877	0.181106	0.523877	0.6071
AREA	-0.184313	0.836972	-0.220215	0.8283
GDP	0.902696	0.165161	5.465542	0.0000
R-squared	0.866516	Mean dependent var	8.528696	
Adjusted R-squared	0.827256	S.D. dependent var	0.500466	
S.E. of regression	0.208006	Akaike info criterion	-0.083040	
Sum squared resid	0.735531	Schwarz criterion	0.213176	
Log likelihood	6.954959	Hannan-Quinn criter.	-0.008542	
F-statistic	22.07122	Durbin-Watson stat	1.541570	
Prob(F-statistic)	0.000001			

Source: Prepared by the researcher based on the outputs of the EViews program.

The estimated model is written as follows:

$$\log(FS_t) = 1.24 \log(POP_t) + 0.9 \log(GDP_t) + \varepsilon_t$$

$$R^2 = 0.86$$

$$N = 23$$

$$F = 22.07$$

$$DW = 1.54$$

IV. RESULTS AND DISCUSSION:

In this study, we evaluate the estimated model both economically and econometrically as follows.

IV.1. Econometric Evaluation of the Estimated Model:

The model is evaluated by testing the significance of the regression parameters, in addition to testing the overall significance of the model.

- **The coefficient of the constant variable (C):** Since the calculated Student's t-value is lower than its tabulated value and the Sig value is greater than 5%, the coefficient β_0 is not statistically significant. Therefore, the model does not accept the constant.

- **The coefficient of the variable POP:** Since the calculated Student's t-value is greater than its tabulated value and the Sig value is clearly less than 5%, we reject the null hypothesis and accept the alternative hypothesis, meaning that β_1 is statistically significant. Thus, the explanatory variable "population" has a significant effect on the dependent variable, the food security gap.
- **The coefficients of the variables AREA, FOR, and PORAL:** We observe that the calculated Student's t-values are lower than their tabulated values, and the Sig values are clearly greater than 5%. Accordingly, the three variables are not statistically significant, and therefore have no significant effect on the dependent variable, the food security gap.
- **The coefficient of the variable GDP:** We observe that the calculated Student's t-value is greater than its tabulated value and the Sig value is clearly less than 5%. Thus, the variable "GDP per capita" is statistically significant and therefore has a significant effect on the dependent variable, the food security gap.
- **The coefficient of determination (R^2):** The R^2 value is 0.86, which is very close to one. This indicates that approximately 86% of the variations in the food security gap can be explained by changes in both the population and the GDP per capita. This result reflects a high explanatory power of the model, meaning that the selected independent variables explain a large portion of the behavior of the dependent variable. Moreover, the proximity of the R^2 value to one indicates that the model provides an excellent fit to the data.
- **Fisher Test (F):** The calculated Fisher value is greater than its tabulated value, $F_c = 22.07 > F_t = 2.64$. Also, $\text{Proba } F_c = 0.000001 < 0.05$. Thus, we accept the hypothesis that there is a relationship between the explanatory variables and the dependent variable, meaning that the model is statistically significant.
- Furthermore, the value of **the Durbin-Watson** statistic indicates the absence of autocorrelation in the errors.
- The results shown in Table N° (2) confirm that the model is free from the problem of serial correlation of errors, as the probability value of the Fisher test is 0,2955 which is clearly greater than 0.05, thus confirming the absence of serial correlation.

Table 2: Results of the Autocorrelation Test of the Residuals.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	1.169570	Prob. F(1,16)	0.2955
Obs*R-squared	1.566732	Prob. Chi-Square(1)	0.2107

Source: Prepared by the researcher based on the outputs of the EViews program.

IV.2. Economic Evaluation of the Estimated Model:

The econometric results of the multiple linear regression model analyzing the food security gap in relation to several explanatory variables offer important economic insights. Most notably, the variables total population (POP) and GDP per capita (GDP) were found to have a statistically significant effect on the food security gap. The significance of the population variable suggests that population growth increases pressure on food resources, which can contribute to the widening of the food security gap. As the number of people increases—especially if agricultural production does not grow at the same pace—dependency on food imports tends to rise, intensifying food insecurity. For example, a rapidly growing population may lead to increased domestic food demand that cannot be met by local supply, resulting in a surge in imports and a larger food gap. Regarding GDP per capita, the results revealed a surprising and counterintuitive finding: as GDP per capita increases, the food security gap also tends to widen. This suggests a positive relationship between income and the food gap, which may be attributed to increased consumption patterns and a higher reliance on imported food. In other words, instead of fostering local agricultural development, rising income levels may encourage greater importation of food products, which deepens food dependency and expands the food security gap. This finding highlights the need for policies that balance income growth with domestic agricultural support. On the other hand, the variables cultivated area (AREA), rural population (FOR), and agricultural labor force (PORAL) were found to be statistically insignificant. This suggests that, in their current state, structural agricultural factors are not having a meaningful impact on the food security gap. Possible explanations include low productivity, inefficient land use, or a mismatch between labor availability and agricultural output. For instance, a large rural population or agricultural workforce does not necessarily translate into higher production if modern techniques, investment, and infrastructure are lacking.

V. CONCLUSION:

Food security remains one of the most pressing challenges for Algeria, particularly given its increasing reliance on food imports and the limited capacity of domestic agricultural production to meet national needs. The evolution of the food security gap over the past two decades highlights the complex interaction between demographic, economic, and agricultural factors. The econometric analysis conducted in this study revealed that population growth is a significant determinant of the food security gap. As the population increases, the demand for food rises, exerting more pressure on imports and widening the food gap. Similarly, GDP per capita was found to have a statistically significant but counterintuitive effect: rather than reducing the food gap, higher income levels were associated with a greater reliance on food imports, further exacerbating food insecurity. This finding suggests that income growth alone is not sufficient to improve food security unless it is accompanied by strong domestic agricultural development. In contrast, variables such as cultivated land area, rural population, and agricultural labor force were not statistically significant in the model. This indicates that,

despite policy efforts and moderate improvements in some agricultural indicators, these factors have not translated into meaningful progress in reducing the food gap. Declines in rural population and agricultural employment further underscore the need to reinvigorate the sector and retain labor in rural areas. Overall, the study demonstrates that addressing Algeria's food security gap requires more than isolated policy interventions. It calls for an integrated strategy that links economic development with sustainable agricultural production, demographic stability, and rural revitalization. Only through a comprehensive and coordinated approach can Algeria achieve meaningful progress toward food self-sufficiency and long-term food security.

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Appendix 1

Table 1: Total Population – Rural Population – Agricultural Labor Force – Cultivated Land Area– GDP per Capita in Algeria (2000 - 2022).

Year	Total Populat ion (in thousan ds)	Rural Populat ion (in thousan ds) –)	Agricul tural Labor Force (in thousa nds)	Cultiva ted Land Area (in thousan d hectare s)	GDP per Capita (USD
2000	30824,5	12852	1288	8226	1757,63
2001	30836	12859	1326	8169,23	1772,21
2002	31046,8	12224,04	2660	8205,05	1800,96
2003	31600	13000	2729	8458,68	2630,69
2004	32312	13825,22	1617	8196,82	3091,45
2005	33156	13158,92	1381	8389,64	3100,49
2006	33722,97	13320,77	1609,63	8403,57	3457,58
2007	34400	13684	2220,12	8414,67	3706,31
2008	34800	13843	2244,06	8424,76	3899,51
2009	35100	13970	2358,34	8423,34	3974,2
2010	35661,31	13970	2420,17	8430,3	4535,29
2011	36414,29	13970	2442,6	8445,49	5458,55
2012	37183,18	13970	2476,5	9032,7	5345,67
2013	38297	9926	2528,9	8461,87	5468,2
2014	39500	9792	2550,6	8465,04	5401,09
2015	39963	10357,8	4959,8	8488,03	4176,21
2016	40836	13910,17	2545,19	8448,48	3920,33
2017	41721	14211,63	2608,77	8534,6	4016,56
2018	42600	11498,04	12400	5522,41	4801,01
2019	43000	11542,57	12700	5724,78	3980,42
2020	44250	11382	2650	8509,57	3337,6
2021	44178	11217	2650	8509,57	3700,32
2022	44903	11248	2650	8503,62	4273,92

Source: Prepared by the researcher based on the Various editions of the Arab Agricultural Statistics Yearbook.