

**Factors Affecting Wheat Production in Algeria
An Econometric Study for the Period 1990-2019****CHAABANE guessabi ^{1♦}, BENFLIS Lakhdar ²**¹ Sustainable Development in Highland and Desert Areas laboratory
Center Nour Bachir El Bayadh University, (Algeria) c.geussabi@cu-elbayadh.dz² Algeria 3University (Algeria), benflis.lakhdar@univ-alger3.dz**Received:** 09/03/2025**Accepted:** 17/04/2025**Published:** 25/05/2025**Abstract:**

This study aims to identify the factors affecting wheat production in Algeria during the period 1990-2019, through a quantitative study using the "EViews 10" software, in order to determine the most important factors influencing wheat production in Algeria, by identifying the main obstacles that have hindered the development of this sector, in addition to understanding the mechanisms available in this sector in order to activate them to achieve the desired results.

The study concluded that the agricultural sector in Algeria, especially wheat production, is unable to achieve food security, and that the most prominent factors affecting wheat production in Algeria, which have a positive relationship with wheat production, are the cultivated area, rainfall, and agricultural machinery, while the factors with a negative relationship are the labor force.

Key words: Bottom of Form The agricultural sector, agricultural production, wheat production, food security, self-sufficiency

JEL Classification: Q1, Q17, Q16, Q11, D58.

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1. Introduction:

Agriculture is the first activity that humans developed, as it serves as a means to meet basic human needs. Wheat production, in particular, receives increasing attention from most countries around the world, whether developed or developing, due to its important and vital role in achieving economic development goals. These goals include increasing the contribution of agricultural output to the gross domestic product (GDP) and raising per capita income, as well as providing jobs for various social groups, especially in rural areas. It also meets the food needs of the population, achieves food security, reduces the volume of imports, provides raw agricultural materials for industry, and represents a source of additional wealth for the country.

Algeria is striving hard to increase its wheat production in order to meet the local demand for both types of wheat, maintain the level of consumption it has reached for this widely consumed commodity, or reduce it by enhancing its wheat production or limiting the waste of this commodity due to its subsidized prices, in order to reach solutions that help increase wheat production. And in order to enrich this topic further, we need to raise the following issue:

What are the factors affecting wheat production in Algeria during the period 1990-2019?

- **Sub-questions:** To answer the previous issue, it was necessary to branch out into a set of sub-questions to comprehensively cover the topic, which are as follows:
 - ✓ What is the reality of wheat production in Algeria?
 - ✓ Does agricultural equipment affect wheat production in Algeria?
 - ✓ Is there a relationship between the influencing factors and wheat production in Algeria?
- **Study hypotheses:** The study is based on the following hypotheses:
 - ✓ Wheat production in Algeria is affected by the cultivated area and agricultural equipment.
 - ✓ Wheat production in Algeria achieves self-sufficiency.
 - ✓ Agricultural machinery is considered a fundamental factor in wheat production.
 - ✓ The factors identified in the study affect wheat production in Algeria.
- **Importance of the study:** The importance of this study lies in its contribution to enriching scientific knowledge in the field of agricultural economics through the results it reaches. It also highlights the components of wheat production by presenting the reality of this sector in Algeria.
- **Study Objectives:** This study aims to:
 - ✓ Understanding the reality of wheat production in Algeria.
 - ✓ Understanding the impact of agricultural equipment on wheat production in Algeria.
 - ✓ Knowing the factors affecting wheat production in Algeria.
- **The adopted methodology:** In this study, we relied on the descriptive and analytical methodologies to examine the factors affecting wheat production in Algeria. The descriptive methodology represents the theoretical aspect, which aims to describe the

phenomenon, identify the problem's features, and determine its causes. On the other hand, the analytical methodology involves analyzing the development of wheat production and conducting a standard study to identify the factors affecting its production.

2. Analysis of wheat production development in Algeria during the period 1990-2019:

Wheat is considered one of the most important agricultural crops in the world, and due to this significance, it has reached a strategic status, leading to its competition with many goods produced worldwide, whether agricultural or industrial. This importance also arises from its essential use on the human table, if not primarily in many countries around the world. Wheat is included in many basic food types for humans. Wheat production constitutes one-third of the world's grain production.

2.1. The quantity of wheat production in Algeria: Global wheat production in 2014 reached approximately 730 million tons, compared to 450 million tons in 1981, due to increased consumer demand resulting from population growth and technological advancement. We observe that global wheat production has been continuously increasing year after year, with the global quantity produced being around 591 million tons in 1991. The average global wheat production during the period (1991-2001) was approximately 572 million tons, and this global average for wheat production during the period (2002-2008) increased to around 614 million tons, due to population growth and technological advancement. This average "global wheat production" witnessed a continuous increase during the period (2009-2019), reaching nearly 690 million tons, due to the rising demand for wheat products.

Regarding national wheat production, it reached approximately 750,000 tons in 1990. It then increased to 2.65 million tons, which represents an increase of more than three times the quantities produced in 1990. The produced quantities peaked in 2012, reaching approximately 3.43 million tons. This increase in wheat production, both types, especially since 2003, is attributed to the gradual return of security in the country, coinciding with the recovery of the financial situation.

The public sector and the closure of the structural adjustment program. And the launch of an ambitious recovery program through the National Agricultural Development Plan (National Agricultural Development Plan 2000-2014 (**Ministry of Agriculture, 2012**)). As well as the policy of agricultural and rural renewal since 2008. Even though this year coincided with a severe drought period. Which caused local wheat production to drop to 1.11 million tons after being around 2.31 million tons in 2007.

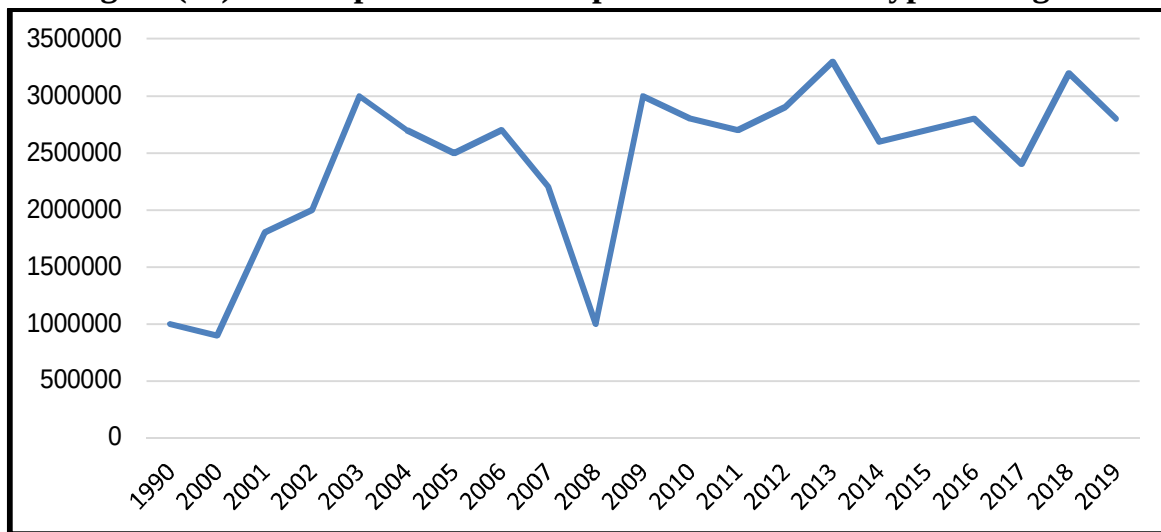
As for the recent period (2010-2019), which coincided with the implementation of the agricultural and rural renewal policy, it revolved around three integrated pillars: rural renewal, agricultural renewal, and the strengthening program.

Human capacities, technical assistance, and an incentive framework. The average production of wheat of both types reached approximately 2.84 million tons, which

It represents an increase of 24.64% compared to the average of the previous period. However, this increase in wheat production remains far from the desired goal, which is achieving self-sufficiency in wheat, as it is a strategic commodity for the Algerian citizen. Algeria still witnesses high imports of wheat, ranging from 7 million tons to 8 million tons per year, with financial values exceeding 2 billion dollars per year. The following figure will

illustrate the production of both types of wheat in Algeria (Taha, 2012).

Figure (01): Development of wheat production of both types in Algeria



Source: Prepared by the researchers based on data from the FAO website.

We observe from the above curve that the general trend of wheat production in Algeria is upward. However, there was a noticeable decline during the years 1997, 2000, and 2008, primarily due to the climatic conditions experienced in those years. These conditions remain a significant factor influencing the annual production of both types of wheat.

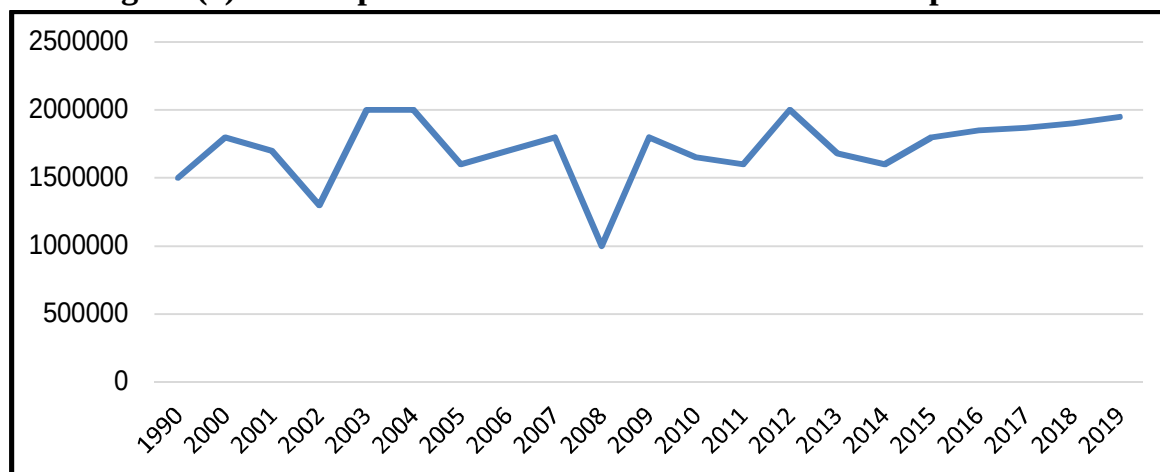
As for wheat productivity of both types in Algeria, it is characterized by fluctuations from time to time, remaining far from the global level. Wheat productivity in Algeria was estimated at 15.4 quintals/hectare in 2015, while soft wheat productivity was estimated at 12.7 quintals/hectare. It is noteworthy that wheat productivity in Algeria is considered among the low rates in the Arab region specifically. For example, if we compare it with some countries, we find that productivity in the Kingdom of Saudi Arabia reached 46.03 quintals/hectare in 1999, in the Arab Republic of Egypt it reached 63.50 quintals/hectare, and in Tunisia it reached 13.98 quintals/hectare. Meanwhile, it did not exceed 10.71 quintals/hectare in Algeria. Despite the improvement in wheat productivity in Algeria, its rates remain low compared to developed countries. (Gharbi, 2010)

2.2. Harvested Area: Globally, India has the largest area compared to other countries in wheat cultivation, with the cultivated area estimated at 13.5% of the world's wheat-producing area, followed by Russia at 11.24%, then China and the United States at 10.98% and 8.73% respectively. The total area cultivated with wheat in the world in 1981 was approximately 239 million hectares. This area decreased to approximately 219 million hectares in 1988. After thirty years, in 2011, the total area cultivated with wheat in the world reached approximately 221 million hectares, and this area remained relatively stable. It decreased to 219 million hectares in 2012, then to 218 million hectares in 2013, and increased to 220 million hectares in 2014. As for the national area cultivated with wheat, it was approximately 1.81 million hectares in 2014. While this area was approximately 1.75 million hectares in 2010. The following figure shows us the development of the area planted with wheat during the period 1999-2019. (Jafri, 2014)

The area harvested for wheat in Algeria has experienced significant fluctuations. In

2001, it reached 1,414,000 hectares for durum wheat and about 832,000 hectares for soft wheat. In the same context, an area of 1,503,698 hectares was harvested for durum wheat and 576,528 hectares for soft wheat. In 2009, the total area was 1,848,575 hectares, including 1,262,842 hectares of durum wheat and 585,733 hectares of soft wheat. We find that the area for durum wheat exceeded that of soft wheat throughout the entire period except for 1997. Thus, we can say that the harvested area for both durum and soft wheat was close in most years, in the graphs below.

Figure (2): Development of the harvested area for wheat production



Source: Prepared by the researchers based on data :Minister of Agriculture and Rural Development: DSASI MADR Report,2004

We notice from the figure the fluctuation in the area planted and harvested with wheat in Algeria. Its average during the period (1999-2000) was about 1.65 million hectares, then it witnessed an increase during the period (2001-2004) where the average area planted with wheat reached approximately 1.82 million hectares. Despite the decrease in the area planted in 2002, which was estimated at 1.3 million hectares. This increase, albeit by small percentages, is attributed to the implementation of the National Agricultural and Rural Development Plan, through which the state encouraged farmers to intensify production, increase land reclamation, and utilize it better. They were financially supported through price subsidies for seeds, fertilizers, and other agricultural production inputs. However, we notice that starting from 2005, the area planted with both types of wheat has declined. This area decreased from 2.01 million hectares in 2004 to 1.60 million hectares in 2006.

The year 2008 witnessed the lowest area planted with wheat during the period (2000-2015), as it decreased to 1.00 million hectares due to climatic conditions and the state's focus on planning agricultural and rural renewal policies, as well as reorganizing agricultural land. This area planted with wheat began to increase again, reaching an average of approximately 1.77 million hectares during the period (2009-2019). From the general trend, it is clear that the area allocated for wheat cultivation in Algeria is on the rise, but at a very slow pace, as it did not exceed "2 million hectares except once or twice." This is despite the succession of policies and reforms initiated by the state since independence. This indicates a reliance on vertical expansion in intensifying production, which requires increasing the efficiency of using agricultural economic resources, instead of horizontal expansion in agriculture that depends on increasing the availability of land and water resources. And the obstacles faced

concerning these two resources (land and water).

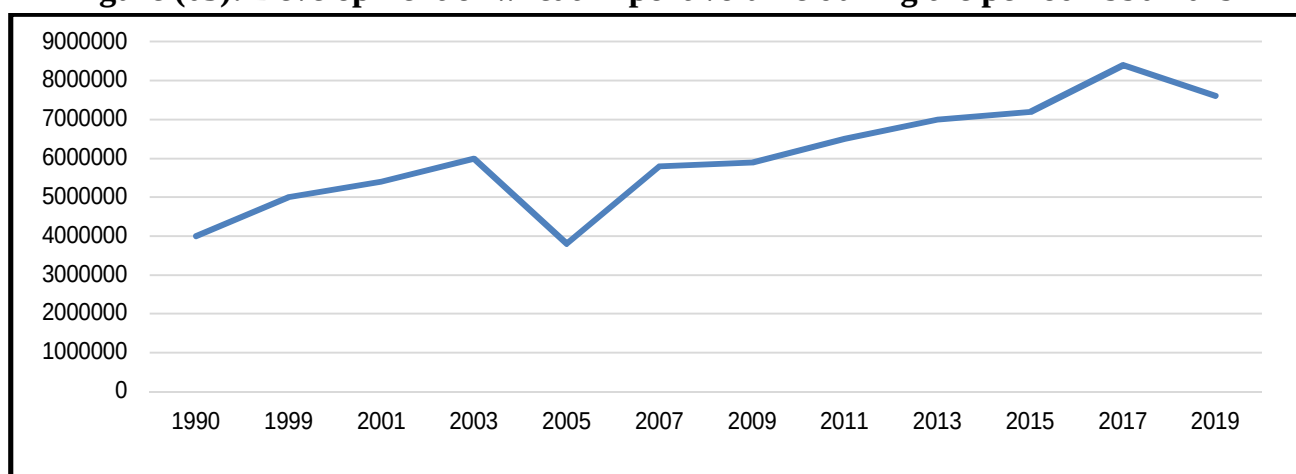
3. Analysis of wheat product imports and the cost of importing it from abroad :

Wheat imports and their cost for Algeria are vital to meet the food needs of the population, and this cost is affected by several factors such as the price of wheat in global markets, transportation and shipping costs, and customs duties. Securing wheat at reasonable prices requires well-considered government measures, and a thorough analysis must be conducted to assess the economic and social impacts of these policies.

3.1. Analysis of wheat product imports: Like other developing countries, Algeria suffers from excessive food dependency, which compels it to allocate a significant portion of its resources to purchasing food products in large quantities, primarily grains, especially wheat in both hard and soft varieties. Approximately 80% of grain consumption in Algeria is imported from abroad.

Algeria is among the ten largest wheat-importing countries in the world, due to insufficient local production and its limited capacity to meet the increasing domestic demand. Wheat accounts for 70% of Algeria's total grain imports, and wheat imports during the period from 1990 to 2019 were characterized by instability due to weak local production and growing domestic demand. The following figure illustrates the development of wheat imports during the period from 1990 to 2019:

Figure (03): Development of wheat import volume during the period 1990-2019



Source: Prepared by the researchers based on data from the FAO website.

Through the graph of the previous figure, it is clear that wheat imports are continuously increasing. During the period from 1990 to 1999, the imported quantities developed from 3.78 million tons in 1995 to 4.75 million tons in 1999, recording a growth of 25.66%. The decline recorded during this period is attributed to the cancellation of the requirement for importers of certain goods to adhere to professional and technical standards, such as (medications, milk, wheat, etc.). By the end of the period, the increase was due to the rise in local demand generated by demographic growth. (Samir, 2016)

However, during the year 2001, there was a decrease in the quantity of imports compared to the previous year due to the improvement in production during this year and the initiation of the national agricultural development plan; it returned to an increase in 2002 with a growth rate of approximately 26.68%, compared to 2001.

As for the period from 2004 to 2014, this period was characterized by the import of very

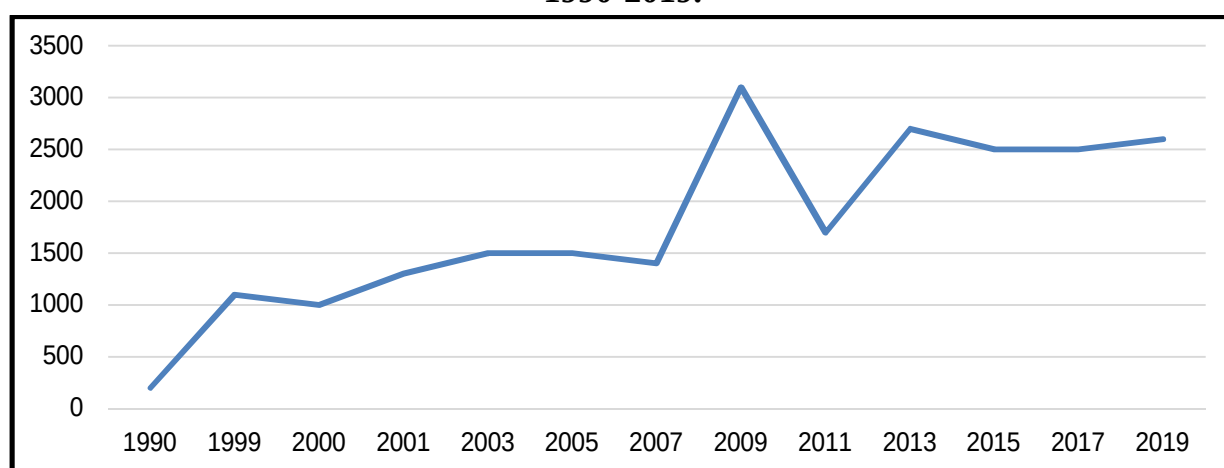
large quantities compared to previous periods. Algeria imported about 5.35 million tons in 2004, and the imported quantity reached about 6.35 million tons in 2008. Despite the relative improvement in wheat production quantities in recent years, the imported quantities of wheat continued to increase, peaking in 2019 at about 9 million tons.

The rapid increase in the quantities of imported wheat is attributed to the stability of the national production rate, the rise in overall consumption due to population growth, and the focus of consumers (especially low-income groups) on consuming grain derivatives, particularly wheat, since the early 1990s. This shift was driven by the rise in prices of animal products and fruits, the decline in purchasing power due to Algeria's adoption of economic reforms, especially the stabilization and structural adjustment programs, and the political and security crisis.

3.2 Cost of wheat import:

Import prices are considered one of the most important factors affecting the import process, and the following chart illustrates the price development of wheat imports during the period 1990-2019:

Figure (04): Development of wheat import prices in Algeria during the period 1990-2019.



Source: Prepared by the researchers based on the National Center for Automated Marking and Customs Statistics, Algeria.

Through the graph in the previous figure, it is clear that the prices of wheat imports are continuously increasing, as during the period 1990-1999, the prices were less than 500 DZD/ton due to the intense competition among Algeria's suppliers. As for the period from 1999 to 2003, we notice a continuous increase in wheat prices, reaching around 1500 DZD/ton, which coincided with the rise in global wheat prices during these years.

Starting from 2007, prices began to rise significantly, peaking in 2008 at a price of 3100 DZD/ton. This was due to several changes in the global market, particularly the increase in global demand. Beginning in 2009, prices fell from 3100 DZD/ton to 1700 DZD/ton in 2011 due to the decline in the global wheat price. Prices then rose again to approximately 2700 DZD/ton in 2013 and remained around this price from 2013 to 2019. They then increased slightly until 2019, reaching a price of 3000 DZD/ton.

4. Factors affecting wheat production in Algeria.

Among the most important factors affecting production, we find natural factors, economic factors, and technical factors, and we will address them as follows: (al., 1998)

4.1. Natural factors: Climate is one of the main factors, particularly rainfall, which remains the crucial factor directly affecting the grain production process. It is random and unevenly distributed in terms of space and time. To cope with these constraints, farmers have chosen a method to reduce their risks by controlling their production costs. In addition to the climate factor, there is the demographic growth factor, which in turn causes an increase in demand for goods and services. According to the statistics conducted, we find a high and continuous growth rate. For example, the population in 1970 was estimated at 13.3 million, rising to 33.5 million in 2006, not to mention the recent years when it exceeded 45 million. This is due to the improvement in the standard of living.

4.2. Economic factors: There are several economic factors that constitute constraints on increasing wheat production, including:

- ✓ The increase in fertilizer prices.
- ✓ The stability of wheat prices over a few years, which contributed to discouraging farmers, is due to Algeria having a centralized regulatory system. However, this regulatory approach has also caused several imbalances, as prevailing prices do not reflect the stability of purchasing power.

Increase in the prices of production factors, which are among the most important factors for production stability, including (raw materials, means of production, labor...).

- ✓ There is a record of support prices for agriculture in potato and wheat seeds, especially in 1994[1].
- ✓ The stability of the area allocated for grains is due to the restrictions on expanding agricultural lands in general and grain production areas in particular.

4.3. Technical factors: There are several technical factors that contributed to the weakness in the wheat harvesting process, including:

- ✓ Weak control and lack of adherence to technical methods by farmers, which is a result of the absence of the widespread adoption of modern technologies.
- ✓ The poor quality of the used seeds: About one-third of the used seeds come from unmonitored self-supply and do not meet the applicable agricultural standards.
- ✓ Shortage of fertilizers distributed by grain and dry grain cooperatives.
- ✓ The lack of continuous supervision over farmers, the weakness of irrigation methods, and the use of fertilizers.
- ✓ The lack of continuous supervision over the farmers.
- ✓ The difficulties in obtaining bank loans.
- ✓ Weakness of irrigation methods.

And here is the development in the use of irrigation methods, fertilizers, pesticides, in addition to mechanization:

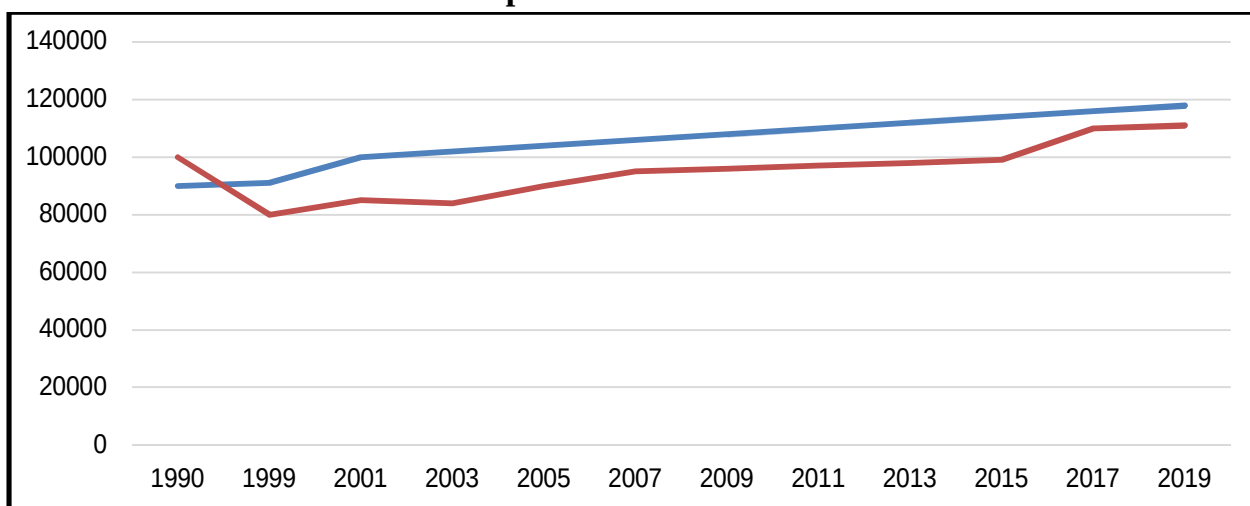
- **Irrigation:** Water is an essential element for plants, as it transports nutrients to the crops and has a significant impact on their growth and development. A deficiency in this vital element greatly affects agricultural crop production. Therefore, irrigation is considered an

effective means to cope with the fluctuations in rainfall. The latter is characterized in Algeria by its irregularity throughout the year and its significant variation from one region to another and from one year to another. Hence, the state has made great efforts to build dams and dig wells.

Therefore, to increase agricultural production in Algeria, especially wheat, in order to reduce food dependency on foreign sources and achieve self-sufficiency in this vital commodity, it is necessary to rely on full irrigation in non-rainy years or the supplementary irrigation method in rainy years to increase Productivity. The experience of the United States of America is the best example, as after preparing semi-desert areas where the rainfall rate does not exceed 70 mm per year, a system of irrigation was implemented, resulting in a productivity estimated at 80 quintals of grains per hectare. (Khira, 2015)

Mechanization: Agricultural mechanization is considered one of the most essential factors for the development and intensification of agricultural production. With plowing equipment, farmers can deeply turn and break the soil to make it ready for planting. This process helps in the rapid growth of crops by facilitating the absorption of water and nutrients present in the soil. As for harvesting equipment, it is used in the process of crop gathering, especially when it comes to grains, which require a long time and significant effort. The introduction of harvesting machines allows for the avoidance of a lot of wasted time and consequently prevents losses in the harvested crop, as delays in the harvesting process lead to significant production losses. The following figure illustrates the development of both the tractor and harvester fleets in Algeria during the period 1990-2019.

Figure (05): Development of the tractor and harvester fleet in Algeria during the period 1990-2019



Source: Prepared by the researchers based on data from the Ministry of Agriculture website.

The agricultural machinery fleet witnessed continuous development during the period from 1990 to 2019, recording an annual growth rate of 0.7% for the harvester fleet and 1.1% for the tractor fleet. In 1990, there were approximately 9,000 tractors and around 10,000 harvesters, compared to 10,000 tractors and 8,000 harvesters in 2003. The number of harvesters significantly decreased, only to rise again to around 12,000 tractors and harvesters by 2019. This period experienced many fluctuations in the number of harvesters and tractors.

And all of this is due to the sales of agricultural equipment, which experienced

fluctuations in prices from time to time, such that there was a relationship between agricultural equipment and its prices, meaning that whenever the agricultural equipment increased, its prices decreased, and vice versa.

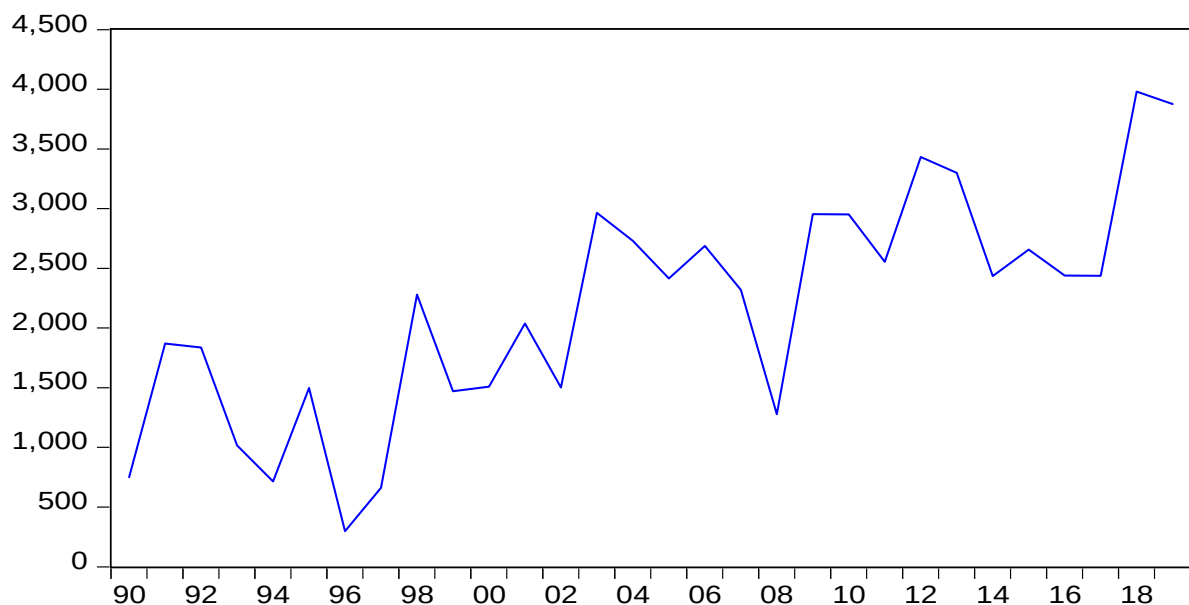
5. The standard study of the factors affecting wheat production in Algeria:

Econometric models play an important role in economic analysis by identifying the nature of economic variables and the extent of their interconnections, as well as understanding the impact of each on the others. Building an econometric model requires a deep understanding of the interrelated relationships between economic variables. This section addresses the applied aspect of the study, known as the econometric study. In this part, we will attempt to build an econometric model that illustrates the main determinants of wheat production in Algeria during the period 1990-2019.

5.1. Defining the variables:

5.1.1. The dependent variable is wheat production (Y): Wheat production refers to the process of cultivating and producing grains from the wheat plant. This includes all the stages necessary for growing wheat, soil preparation, planting, irrigation, crop care, and harvesting. Wheat is a vital crop widely used in the food industry to produce bread, pastries, and other food products. Wheat production is an essential part of agriculture in many countries and significantly contributes to food security and meeting the needs of local and global markets. We denote it by the symbol Y.

Figure (06): Development of wheat production in Algeria during the period 1990-2019



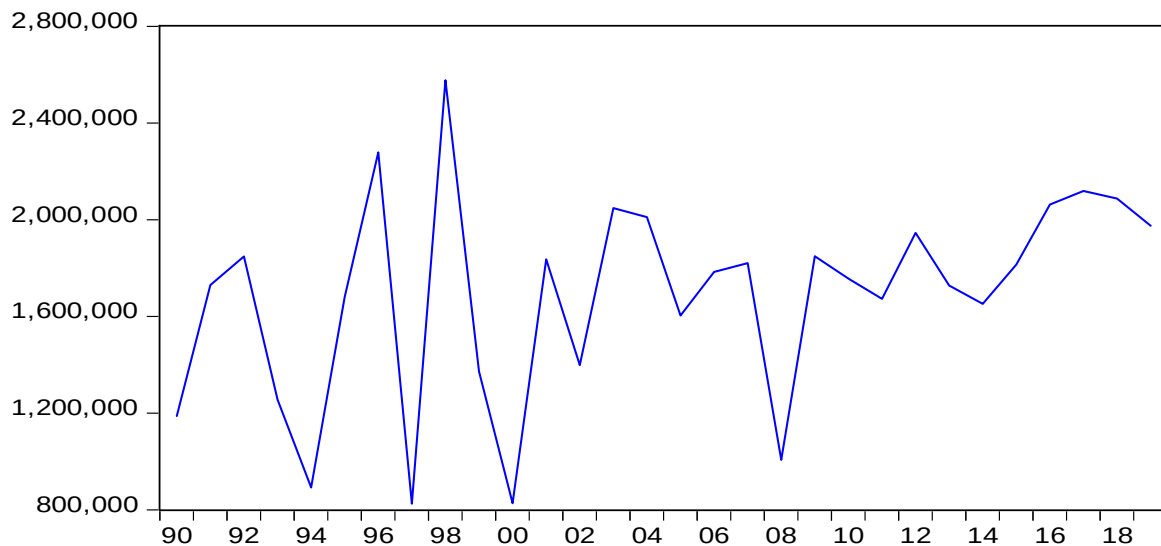
source: is prepared by the researchers based on the outputs of the eviews 10 program.

We notice that wheat production y increased from 700 to about 1900 from 1990 to 1992, then decreased to around 700 in 1994, increased again to 1400 in 1995, rose to 2400 in 1998, then decreased again, and has since fluctuated between increases and decreases, reaching its highest value of about 4000 in 2018. Thus, we conclude that wheat productivity in Algeria is characterized by fluctuations between increases and decreases.

5.1.2. The independent variables are represented by:

- ✓ **Area planted with wheat (x_1):** The area planted with wheat refers to the agricultural region where the wheat plant is cultivated. It is usually measured in square metric units such as hectares or acres, and it varies according to the geographical area and agricultural practices, denoted by the symbol X_1 .

Figure (07): Development of the area planted with wheat during the period 1990-2019
 X_1

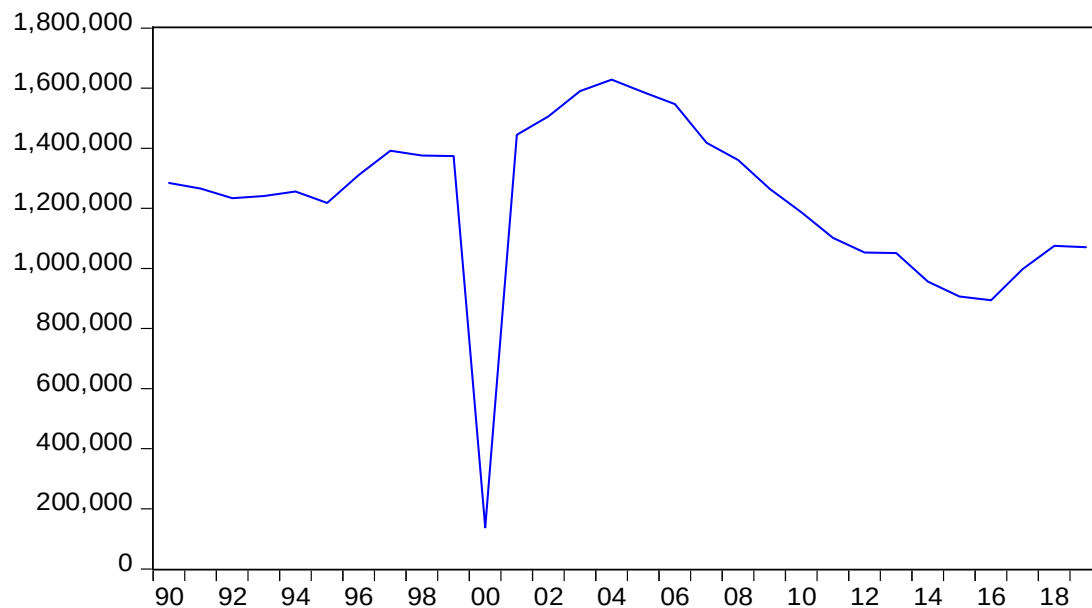


Source: prepared by the researchers based on the outputs of the eviews 10 program.

We observe from the curve that the area planted with wheat increased from 12,000.00 to around 1,800,000, then experienced a free fall and a significant decline to 800,000, remaining in a state of fluctuation between increase and decrease, reaching a maximum value of 2,500,000 in 1999 and a minimum value of less than 800,000 in 2000.

- ✓ **Agricultural labor (X_2):** refers to workers who are employed in the agricultural sector, whether they are engaged in crop cultivation, livestock care, harvesting, or any other activity related to agriculture. Agricultural labor includes various categories of workers, including farmers, seasonal workers, and migrant agricultural workers, and is denoted by the symbol X_2 .

Figure (08): Development of Agricultural Labor in Algeria during the period 1990-2019
X2

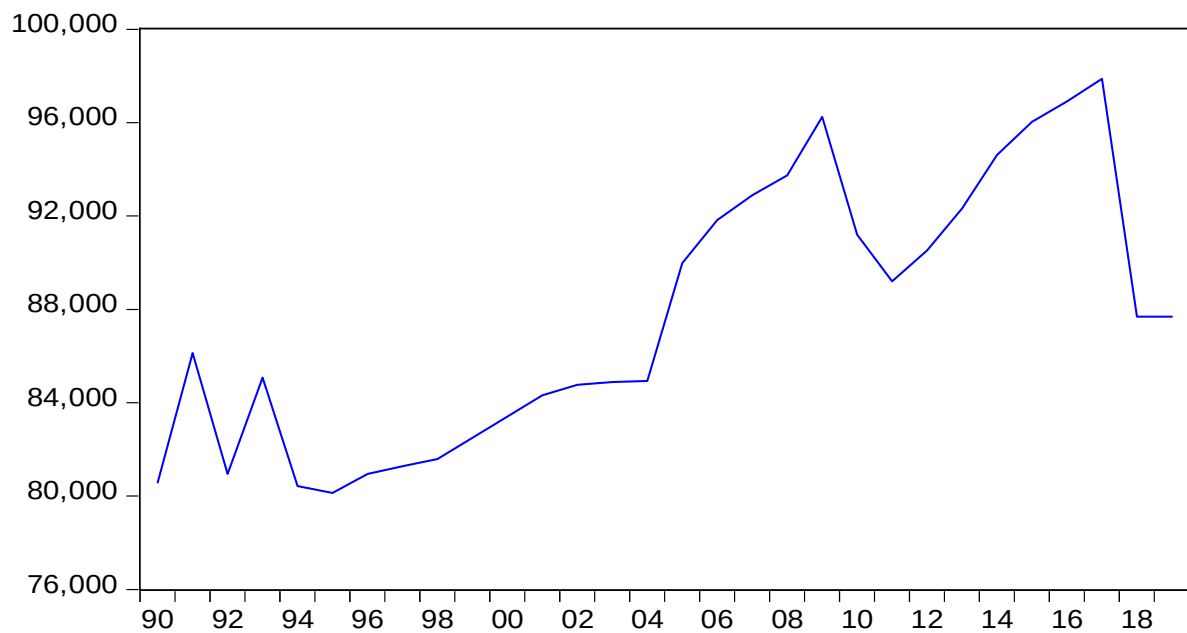


Source: prepared by the researchers based on the outputs of the Eviews 10 program.

We notice from the previous curve that the workforce experienced slight changes from 1990 to 2000, reaching between 1,300,000 and 1,400,000, then witnessing a significant decline in the same year to less than 200,000 workers. It then rose again to reach its peak in 2005 with a value exceeding 1,600,000, before declining once more until 2018 with a value of 1,000,000 workers.

- ✓ **Agricultural equipment (X_3):** It includes all the tools and machinery used in agricultural operations. This equipment includes agricultural machines such as tractors, plows, seeders, harvesters, and others, as well as hand tools like sickles, rakes, hoes, and shovels. The types of agricultural equipment vary depending on the types of agriculture, geographical areas, and the level of investment in agriculture. Agricultural equipment plays a vital role in increasing work efficiency in the fields, improving productivity, and reducing agricultural costs, and we denote it by the symbol X_3 .

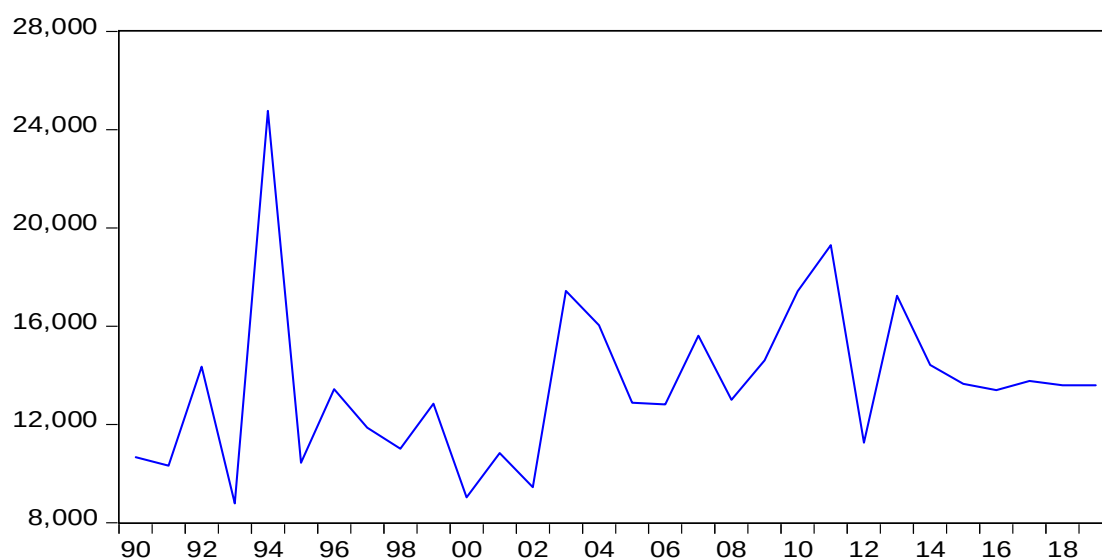
Figure (09): Development of agricultural equipment in Algeria during :1990-2019
X3



Source: prepared by the researchers based on the outputs of the Eviews 10 program.

We notice from the curve that agricultural equipment in Algeria is in continuous changes, having reached its lowest number in 1990 with a value of 80,000, then increasing to its highest value in 2017 with 97,000, with some fluctuations during the years 1992 to 2016, before decreasing again to 88,000 and stabilizing there in 2018.

- ✓ **Rainfall Amount X_4 :** It represents the amount of rain that falls in a specific area over a defined period, usually measured in metric units such as millimeters or inches. The average annual rainfall amount is used to estimate the precipitation pattern in a specific area, which is an important indicator for assessing the availability of water needed for plants, animals, and human use. The amount of rainfall varies significantly according to geographical regions, seasons, and weather conditions, and it is denoted by the symbol X_4 .

Figure (10): Rainfall amounts in Algeria during the period 1990-2019
X4

Source: prepared by the researchers based on the outputs of the Eviews 10 program.

We notice from the previous curve that the amount of rainfall is subject to significant fluctuations, with periods of increase and decrease, reaching its lowest value in the year 1990 at less than 10,000. It remains close to these values until it reaches its highest value in 1994 at more than 24,000.

5.2. model estimation: We attempt to present a standard study using the least squares method.

Table (1): Model Estimation the Eviews 10 program

Dependent Variable: Y				
Method: Least Squares				
Date: 05/06/24 Time: 09:50				
Sample: 1990 2019				
Included observations: 30				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5398.497	2281.911	-2.365779	0.0261
X1	0.001083	0.000324	3.345157	0.0026
X2	-0.000396	0.000481	-0.823290	0.4181
X3	0.065140	0.025159	2.589145	0.0158
X4	0.037256	0.039843	0.935089	0.3587
R-squared	0.527963	Mean dependent var		2162.012
Adjusted R-squared	0.452437	S.D. dependent var		951.9165
S.E. of regression	704.3946	Akaike info criterion		16.10357
Sum squared resid	12404294	Schwarz criterion		16.33710
Log likelihood	-236.5535	Hannan-Quinn criter.		16.17828
F-statistic	6.990477	Durbin-Watson stat		1.334502
Prob(F-statistic)	0.000639			

Source: prepared by the researchers based on the outputs of the Eviews 10 program

Through estimating the model for the factors affecting wheat production in Algeria, and using the ordinary least squares method, we obtained the following mathematical model.

$$Y = -5398,49 + 0,001*X_1 - 0,00039*X_2 + 0,06*X_3 + 0,03*X_4 + e_i$$

5.3. Studying the validity of the estimated model

5.3.1. The economic aspect: At this stage, we delve into the economic interpretation of the study variables by addressing the variables as follows:

- ✓ Regarding the parameter of the cultivated area, we have prob x1 equal to 0.0026, which is less than 0.05, meaning that for every one-unit increase in the cultivated area of wheat, the wheat production increases by 0.001.
- ✓ Regarding the parameter of agricultural labor, the sign is negative, meaning there is an inverse relationship between agricultural labor and the quantity of wheat production. This means that for every additional unit of agricultural labor, the quantity of wheat production decreases by 0.0003.
- ✓ Regarding the agricultural equipment parameter, we have prob x3 equal to 0.0158, which is less than 0.05, meaning that for each additional unit of agricultural equipment, wheat production will increase by 0.6.
- ✓ As for the parameter of rainfall amount, we have prob x3 equal to 0.58, which is greater than 0.05. This means that there is an inverse relationship between wheat and rainfall, meaning that as rainfall increases, wheat production decreases.

5.3.2. From a statistical perspective: We will address three tests as follows:

- **Student's t-test:** Study of parameter significance. The study of parameter significance using the Student's t-test can determine whether the model we constructed is correct or incorrect, and we prove its correctness through testing the following hypotheses:

Hypothesis of Nothingness:

- **H₀:** does not have statistical significance. $H_0: B_1=0, B_2=0, B_3=0, B_4=0$
- **H₁:** The parameter has statistical significance. $H_1: B_1 \neq 0, B_2 \neq 0, B_3 \neq 0, B_4 \neq 0$

- ✓ Since the T STATISTICS equals 3.34 (calculated) which is greater than the tabulated T (1.706), we reject H₀ and accept H₁. This indicates that X₁, the area planted with wheat, has statistical significance.
- ✓ Since the T STATISTIQUE equals -0.84, which is smaller than the tabulated T (1.706), we reject H₁ and accept H₀. This indicates that X₂, the agricultural labor force, does not have statistical significance.
- ✓ Since the T STATISTICS equals 2.58, which is greater than the T table value (1.706), we accept H₁ and reject H₀. This indicates that X₃, agricultural equipment, has statistical significance.
- ✓ Since the T STATISTICS equals 0.93, which is less than the tabulated T (1.706), we reject H₁ and accept H₀. This indicates that X₄, the amount of rainfall, does not have statistical significance.

- **Fisher's Test:** (Model Significance Study): A study of the model's significance using Fisher's F test, which is divided into two hypotheses: Since Prob (F-statistic) 0.000639 is less than 0.05, we accept H₁ and reject H₀, indicating that the model has statistical significance.

- **Model Quality:** Since the coefficient of determination is 52%, $R=0$, then $R^2=52\%$. This indicates that 52% of the changes in wheat production are caused by changes in the

cultivated area, agricultural equipment, and the amount of rainfall. The remaining 48% represent the random variable or random error, indicating either quantitative variables that were not included in the model or qualitative variables due to measurement difficulties or data errors.

5.3.3. From a standard perspective: we will address three basic tests, which are as follows:

- **The absence of autocorrelation among the residuals LM TEST:** The study is conducted using the LM TEST :

Table (2): Results of the Autocorrelation Test for Residuals

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.278855	Prob. F(2*23)	0.2974
Obs*R-squared	3.002276	Prob. Chi-Square(2)	0.2229

Source: prepared by the researchers based on the outputs of the Eviews 10 program

Since the calculated Prob F is 0.29, which is greater than 0.05, we reject H1 and accept H0. This is evidence of no autocorrelation between the residuals.

- **The absence of the heteroscedasticity problem: White test:**

Table (3): Results of the Residual Variance Homoscedasticity Test

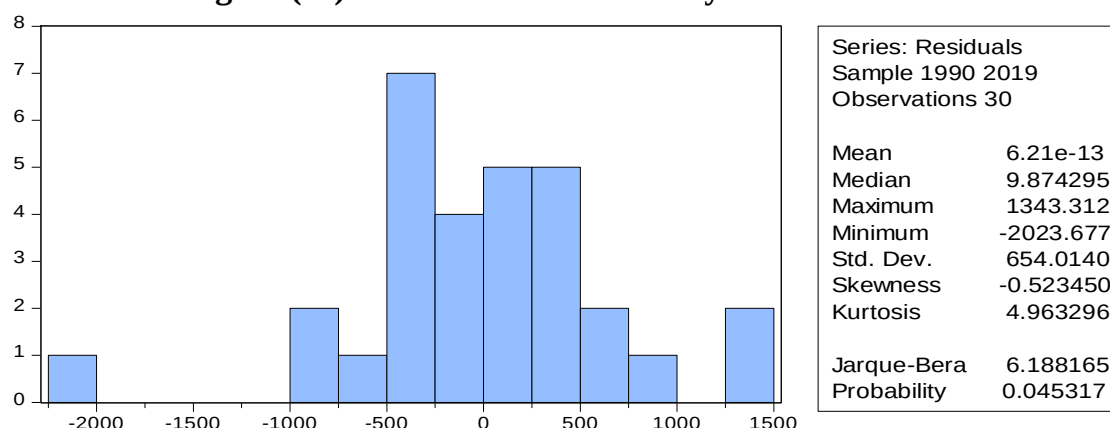
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.060797	Prob. F(4*25)	0.1163
Obs*R-squared	7.438987	Prob. Chi-Square(4)	0.1144
Scaled explained SS	10.23712	Prob. Chi-Square(4)	0.0366

Source: prepared by the researchers based on the outputs of the Eviews 10 program

Since prob f(4,25) is 0.1163, which is greater than 0.05, we reject H1 and accept H0. This indicates that there is no problem with the homoscedasticity of the residuals.

- **The normal distribution of the residuals:**

Figure (11): Results of the normality test for the residuals



Source: is prepared by the researchers based on the outputs of the Eviews 10 program

We observe from the figure the normality test of the estimated model residuals, Jarque-Bera, that the p-value of the Jarque-Bera statistic (Prob = 0.045317) is greater than 0.05 (5%). Therefore, the residuals follow a normal distribution.

6. Results analysis:

- ✓ Through this study, we confirm the validity of the main hypothesis: that the factors affecting wheat production lie in the cultivated area and agricultural equipment, as evidenced by our findings in Chapter Three.
- ✓ The first secondary hypothesis "Wheat production in Algeria achieves self-sufficiency" and through the analysis, we concluded that wheat production in Algeria is weak and does not achieve self-sufficiency, thus we deny the validity of the first secondary hypothesis.
- ✓ The second secondary hypothesis "equipment is a key factor in wheat production" through analysis, we concluded that equipment is a key factor in wheat production, and thus the second secondary hypothesis is correct.
- ✓ The third secondary hypothesis "The factors identified in the study affect wheat production" Through the analysis, we concluded that the factors identified in the study do not all affect wheat production, as we find that labor does not significantly impact wheat production, thus we reject the validity of the third hypothesis.

7. Conclusion: Through our study of the factors affecting wheat production in Algeria during the period from 1990 to 2019, we reached the following results:

- The agricultural sector represents one of the pillars of economic development due to its importance in providing food production, increasing national income, continuously raising the per capita share of agricultural output, and achieving economic and social stability.
- This is realized through the use of agricultural development components, represented by natural and human resources, and the accumulation of their use based on a set of basic criteria represented by the rate of capital and technology, agricultural investment, the combination of production elements, the process of selecting agricultural programs and projects, and agricultural price policies that affect the supply and demand for agricultural products, resulting in achieving the maximum agricultural output at the lowest marginal cost.
- This text couldn't be translated. Moreover, all the numbers and statistics indicate that all the basic agricultural production factors are sufficiently available, but they do not achieve the desired production, especially in terms of wheat production.
- Through the practical aspect of our study, which was a standard study, we concluded that:
 - ✓ The area planted with wheat and agricultural equipment have a direct relationship with the quantity of wheat production.
 - ✓ The amount of rainfall and labor have an inverse relationship with the quantity of wheat production.
- **Accordingly, we present the most important recommendations and suggestions as follows:**
 - ✓ Increasing the number of agricultural equipment and developing it in order to increase wheat production in Algeria.
 - ✓ Expanding foreign investments to include the agricultural sector in general and wheat production in particular.
 - ✓ Increasing production rates to achieve self-sufficiency in wheat consumption.

- ✓ Exploiting arable land to produce wheat.
- ✓ Focusing on the technical and technological workers to increase production.
- ✓ Increasing periodic monitoring of this sector because all the results indicate negligence in monitoring it.
- ✓ Increasing and expanding irrigation and focusing on finding solutions to mitigate the phenomenon of drought.

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