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An analytical study of the factors affecting wheat production in Algeria during the period 1990-2024

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Abstract

This study aims to identify the most important factors affecting wheat production in Algeria, which are linked to a range of natural and economic factors. Wheat is considered one of the most important strategic crops, but its local production faces challenges mainly related to climate fluctuations, limited water resources, and the uneven use of agricultural technologies. The amount of rainfall during the year is one of the most important determinants of wheat production, especially since a large part of wheat cultivation in Algeria depends on rainfall. Irregular rainfall during the year, along with drought and high temperatures during the germination and growth stages, negatively affect the yield. The area allocated to wheat also affects the total production volume; increasing the cultivated area, with the availability of suitable conditions, can lead to an increase in production, while reducing the area or converting it to other crops leads to a decrease in the quantity produced. Agricultural machinery helps in carrying out the processes of plowing, sowing, and harvesting in a timely manner and reducing production losses, but the limited availability of equipment or the high costs of using it may pose an obstacle for some producers.

Keywords: Wheat production, cultivated area, rainfall, agricultural equipment

JEL Code Classification : Q10 , Q15, Q25 ,Q16

Introduction

Wheat occupies a pivotal position among strategic agricultural crops due to its role in food provision and its direct link to food security and the agricultural economy. The concept of wheat encompasses a range of cultivated species belonging to the genus *Triticum*, most notably durum wheat and soft wheat, which differ in their genetic characteristics, culinary uses, and adaptability to environmental conditions. Durum wheat (*Triticum turgidum* ssp. *durum*) is a crop of particular importance in Mediterranean and semi-arid regions, representing a significant source of food and agricultural income. Its grains are primarily used in the production of semolina, pasta, couscous, and other food products. Recent reviews indicate that the Mediterranean and North Africa are among the most important regions for durum wheat cultivation, and that Algeria is one of the countries with significant areas dedicated to this crop .(Grosse-Heilmann, Cristiano, Deidda, & Viola, 2024)

The importance of wheat extends beyond its role as a food crop; it also contributes to economic and social stability in rural areas. This role is even more crucial in countries where a significant portion of agricultural production depends on cereals. In Algeria, cereal production, particularly durum and soft wheat, is a significant agricultural activity. However, its yield is characterized by annual fluctuations largely dependent on changes in climatic conditions, especially rainfall and temperature. Studies on Algerian cereal farming indicate that a large part of cereal cultivation relies on rainfall, making productivity more sensitive to climatic variations than irrigated farming systems.(Benmehaia A, MERNIZ, & Oulmane, 2020)

Climate change has become an additional factor complicating wheat production challenges, as it affects several variables simultaneously, such as temperature, rainfall patterns, and the frequency of droughts. In Algeria, a recent study examined the impact of climate change on wheat production during the period 2014–2024, focusing on the semi-arid interior plains. It concluded that climate variability poses a challenge to rainfed agriculture and discussed the importance of improving irrigation scheduling and increasing water productivity as possible adaptation measures. (Ouzani, Hiouani, & Junaid Ahmad, 2025)

Wheat is one of the world's most important cereal crops and holds a strategic position in achieving food security due to its essential role in human nutrition and the reliance of many countries on it as a primary source of energy and protein. Global wheat production has witnessed remarkable development over the past decades, resulting from the expansion of cultivated areas, improved productivity, and advancements in agricultural technologies. International studies indicate that the increase in wheat production is largely linked to higher yields and improved farming practices, although significant variations in productivity persist between regions and countries due to differences in climatic and natural conditions and the level of agricultural technology used. (Zakharova &, (Zakharova & Zakharov , 2024)

In this context, this research paper aims to conduct an analytical study of the factors affecting wheat production in Algeria during the period from 1990-2024, focusing on the most important determinants that have the greatest impact on wheat production in Algeria. The study aims to analyze the relationship between wheat production and the variables of total area, agricultural equipment, and rainfall. Or are there other variables that have a greater impact on wheat production in Algeria? Accordingly, the study's problem revolves around the following main question:

What are the main factors that affect wheat production in Algeria?

To answer the research problem, we can formulate the following main hypotheses:

- 1_The amount of rainfall during the year is the primary factor affecting wheat production in Algeria.
- 2_Technology and the use of agricultural machinery from the beginning of production until harvest are among the most influential factors.

1_Review of previous literature

A 2024 study in Agricultural Water Management (Aftab & Chao) investigated the determinants of wheat production stability in the Khyber Pakhtunkhwa region of Pakistan using the dynamic ARDL model. The study focused on the relationship between production and several environmental and agricultural factors, including land area, fertilizer use, moisture, and rainfall.

The results showed positive effects of land area, fertilizer, and moisture on wheat production in both the short and long term. Rainfall had a particularly positive effect in the short term. The study highlights the importance of combining climatic variables and agricultural inputs when interpreting changes in wheat production..(Aftab & Chao, 2024)

The study by Devkota et al. (2023) also addressed a particularly important topic: wheat in a rainy Mediterranean environment in Morocco, an agricultural and climatic environment similar to those of North Africa. The study investigated the effects of rainfall, temperature, planting date, variety, and supplemental irrigation on durum wheat production.

The results showed that total rainfall was the most significant factor explaining the variation in rainfed wheat production, followed by temperature during the flowering stage, early-season rainfall, and then variety. In supplemental irrigation systems, seasonal rainfall, planting date, temperature, irrigation amount, and variety emerged as important determinants of production. Furthermore, supplemental irrigation reduced the production gap compared to rainfed agriculture .(Devkota , Devkota , Karrou, & Nangia, 2023)

The study by Han et al. (2023) also examined the climatic determinants of wheat productivity variation in different regions of China, focusing on temperature, rainfall, and solar radiation. The researchers found that the impact of climatic factors on wheat productivity varies spatially, and that solar radiation and rainfall were among the most important drivers of yield variability. The study also found that the combined effect of climatic factors was greater than the effect of any single factor, suggesting that climate should not be studied as a set of completely independent variables . (Wanrui, Xiang, & Dong, 2023)

The study by Tita et al. (2025) also addressed wheat production gaps and sustainability challenges in the Mediterranean, Middle East, and North Africa (MENA) region. It examined the impact of climate change, supplemental irrigation, nitrogen fertilization, and planting date using the DSSAT model and simulating climate scenarios for sites in seven countries, including Morocco, Egypt, Turkey, and Iran. The results showed that agricultural management, particularly supplemental irrigation, nitrogen fertilization, and planting date, can significantly affect wheat yields and highlighted the importance of adapting to rising temperatures and changing water availability. (Davide, Karrar, Krishna Prasad, & Mina, 2025)

Previous studies have shown that wheat production is determined by a complex interplay of climatic, agricultural, and environmental factors. These studies have demonstrated that seasonal rainfall, its distribution, temperature, planting date, and irrigation are among the most significant determinants explaining variations in wheat yield. Furthermore, the amount of rainfall per year and temperature influence wheat productivity to varying degrees depending on the region. Climate change, supplemental irrigation, nitrogen fertilization, and planting date are crucial in explaining gaps in wheat production. Analysis also revealed that the impact of irrigation on wheat production interacts with soil characteristics, climatic conditions, and fertilization levels, confirming that the determinants of wheat production do not operate in isolation but rather through complex interactions between water, climate, soil, and agricultural practices.

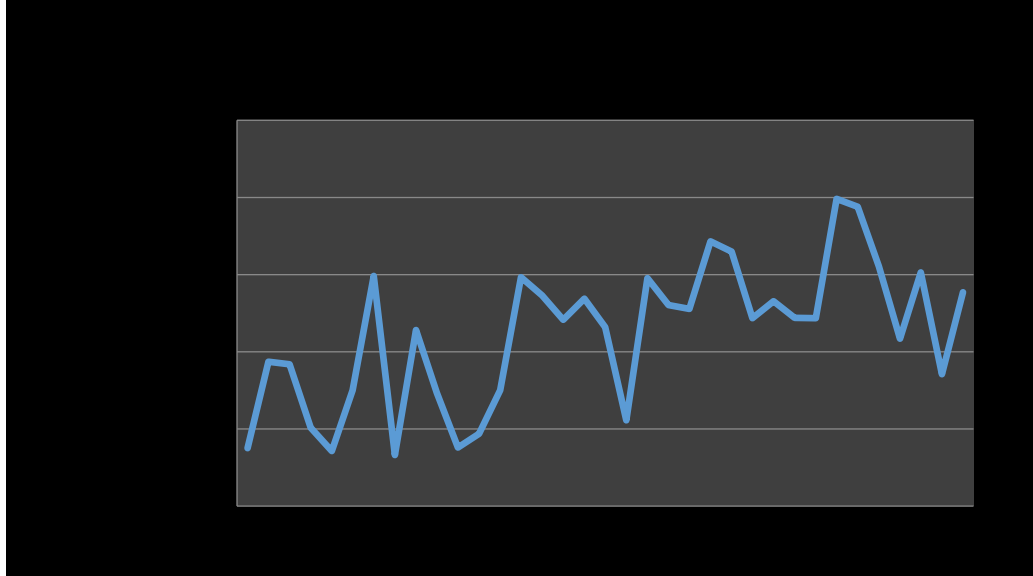
2_The reality of wheat production in Algeria

Algeria extends from east to west, occupying a strategic location and possessing natural and human resources, along with the diversity of its area and climate, which allows it to expand in the agricultural field, as wheat production is considered one of the most important foods for the people of Algerian society

2_1_Evolution of wheat production volume in Algeria during the period 1990-2024

Algeria is known for producing wheat of both durum and soft varieties, which is in high demand among the population. Therefore, the state has increased agricultural areas for its production within the framework of development plans in which the agricultural sector has received its share and opportunities from the development process, in light of the availability of financial resources that contribute to achieving this. The following figure illustrates this:

Figure (01): Represents the evolution of wheat production volume in Algeria during the period 1990-2024



Source: Prepared by the researchers using Excel outputs

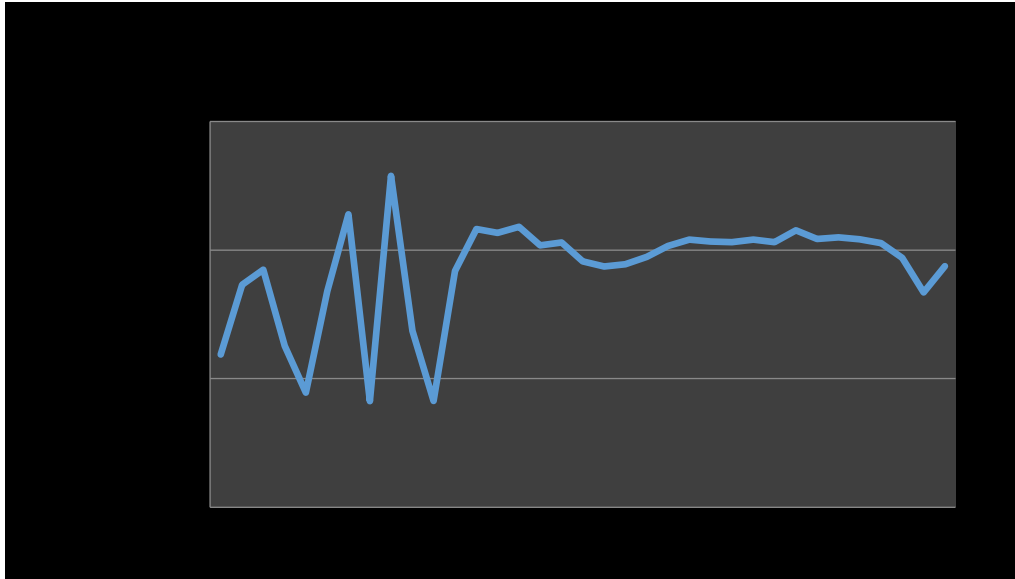
From the figure above, the following can be deduced:

The period from 1990 to 2024 was generally characterized by fluctuations in wheat production in Algeria. Algerian wheat production experienced two successive phases: the first from 1990 to 1999 and the second from 2000 to 2024. These phases saw fluctuations in production, influenced by the economic conditions since 1990, followed by several reforms and the adoption of various development programs and plans by the government from 2000 to the present. The lowest production value was recorded in 1997 at 6,615,140 quintals per hectare, while the highest value was recorded in 1996 at 29,826,038 quintals per hectare. The average production for the period from 1990 to 1999 was 15,080,724.8 quintals. The second phase, from 2000 to 2019, witnessed several reforms in the agricultural sector, along with the government's adoption of various programs and plans. Developmental, as the period from 2000-2004 witnessed an increase in wheat production, reaching its highest level in 2003 at 29,648,520 quintals. This is due to the National Agricultural Development Plan, and its lowest value was in 2000 at 7,603,610 quintals .

2_2The evolution of the total area dedicated to wheat production in Algeria during the period from 1990-2024

Algeria is known for its vast agricultural land, particularly the area dedicated to wheat production. This is due to increased consumer demand, as Algerians consume both durum and soft wheat. The following figure illustrates the evolution of the total area dedicated to wheat production in Algeria during the period 1990-2024.

Figure (02): Represents the development of the total area for wheat production in Algeria during the period from 1990-2024



Source: Prepared by the researchers using Excel outputs

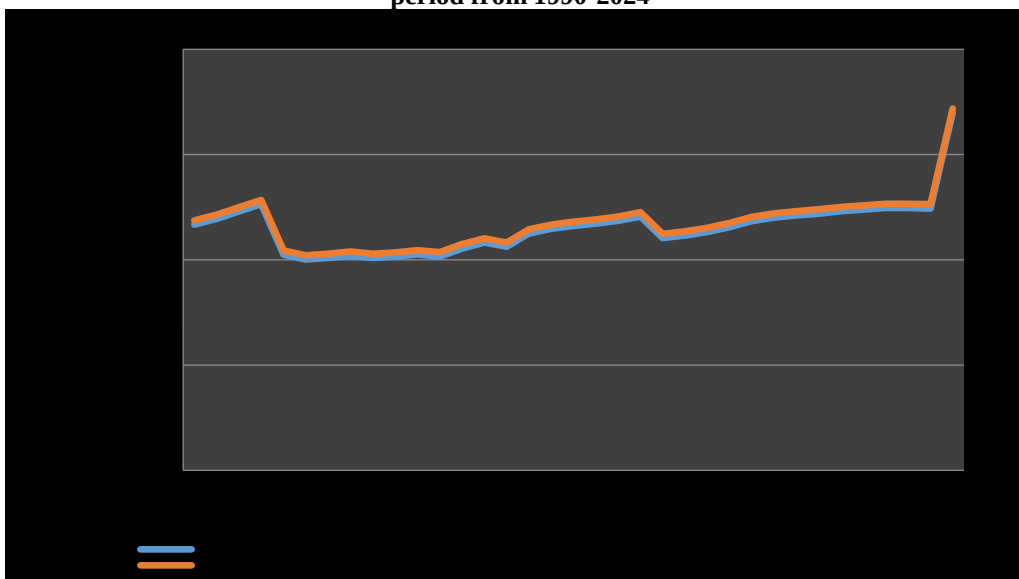
From the figure above, the following can be deduced:

The average area under wheat production in Algeria during the period 1990-1999 was 1.5 million hectares. However, the period from 2000 to 2010 saw a sharp decline in the total area under wheat production in 2000 due to the difficult security situation the country was experiencing. Following this year, the area saw a significant increase, coinciding with the agricultural sector reforms implemented since 2000. This led to an average increase in the total production area, reaching 1.89 million hectares, which corresponded to an increase in wheat production. As for the period from 2011 to 2024, we observe an increase in the area dedicated to wheat production in Algeria. This is due to a range of development programs and plans implemented as part of the reforms since 2000, in addition to government support in the form of seeds and fertilizers to boost production.

2_3_Development of agricultural equipment and wheat production in Algeria during the period 1990-2024

Agricultural equipment is one of the most important elements of production in the agricultural sector, as it plays a vital role in increasing the efficiency of agricultural operations and improving the use of available resources. Agricultural equipment includes various machines and tools used in land preparation, plowing, sowing, fertilization, harvesting, and transporting agricultural products. Reliance on agricultural mechanization has become a fundamental requirement for developing agricultural production, especially given the need to complete agricultural operations within appropriate timeframes and reduce production costs.

Figure (03): Represents the development of agricultural equipment and wheat production in Algeria during the period from 1990-2024



Source: Prepared by the researchers using Excel outputs

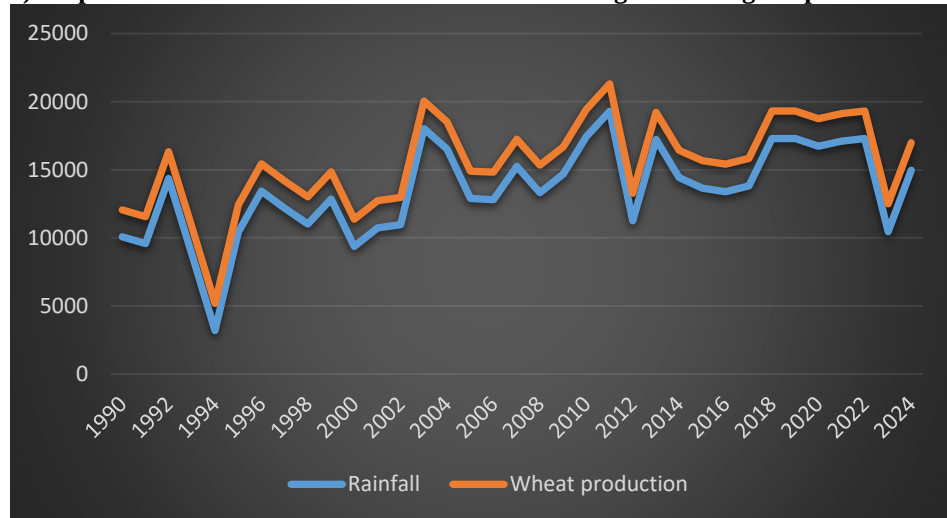
The curve shows a direct relationship between wheat production and agricultural equipment such as tractors and harvesters. The results indicate that during the period from 1990 to 1999, increased agricultural equipment led to increased

wheat production, while decreased equipment resulted in decreased wheat production. This demonstrates a direct correlation between wheat production and agricultural equipment, a crucial element in production. A decrease in equipment was observed in 1994, with the number of units estimated at 102,381, corresponding to a decrease in production of 104,375 quintals. However, the period from 2000 to 2010 witnessed a significant increase in wheat production. This was attributed to an increase in agricultural equipment, reaching its peak in 2010 at 120,602 units, corresponding to an increase in production of 122,612 hectares. A decrease in equipment in 2001, by 101,578 units, resulted in a decrease in production of 103,578 quintals. As for the period... From 2011 to 2024, we observe an increase in both agricultural equipment and wheat production. The number of units reached its highest value in 2012 at 169,866 units, while wheat production increased by 171,890.88 quintals, compared to 110,290 units in 2011, and wheat production by 112,301 quintals.

2_4_Evolution of rainfall amounts in Algeria during the period from 1990-2024

The agricultural sector in Algeria is dependent on natural conditions due to the fluctuation in rainfall throughout the year, as illustrated in the following figure:

Figure (04): Represents the evolution of rainfall amounts in Algeria during the period from 1990-2024



Source: Prepared by the researchers using Excel outputs

The graph above illustrates the relationship between rainfall and wheat production in Algeria during the period 1990-2024. Wheat production is directly dependent on the amount of rainfall during the year. Higher rainfall leads to increased wheat production, and vice versa; there is a direct relationship between rainfall and wheat production. The average rainfall during the period 1990-1999 was 10,586.3 mm, equivalent to 105.86% of the annual average. As for production during the same period, the average was 125,808 quintals. The lowest rainfall was recorded in 1994 at 3,196 mm, while wheat production saw a sharp decline, reaching only 5,190 quintals that year. For the period 2000-2010, the average rainfall was 13,817.5 mm. This represents a 138.11% increase compared to the previous period, a rise of 32.31%. As for production quantity, the average for the period was 15,822.5 quintals, representing a 158.22% increase, or 32.41%. This period was characterized by fluctuations in rainfall throughout the year; that is, higher rainfall corresponds to higher wheat production, and lower rainfall corresponds to lower wheat production. The period from 2011 to 2024 saw slight fluctuations in rainfall. The highest rainfall was recorded in 2011 at 19,298.6 mm, resulting in an increase in wheat production of 21,309.6 quintals. The lowest rainfall was recorded in 2023 at 10,464.3 mm, while production reached 12,487.3 quintals. In conclusion, wheat production in Algeria is dependent on annual rainfall, as most Farmers depend on rainfall amounts, except for a few who rely on irrigation

3_Study Results

Despite the increase in the area dedicated to wheat production in Algeria, it is not fully utilized due to climatic conditions and the lack of timely rainfall throughout the year.

The study results showed that wheat production in Algeria during the period 1990-2024 is influenced by a range of agricultural and climatic factors. The cultivated area, annual rainfall, and agricultural machinery all significantly impacted wheat production. The study also revealed fluctuations in production that are more closely linked to climatic conditions, specifically annual rainfall. Furthermore, the results indicated that wheat production can be divided into two phases: the first phase, preceding the economic reforms, spanned the period from 1990-1999, while the second phase, following the economic reforms and subsequent financial boom, covered the period from 2000-2024. The study showed a significant increase in wheat production during the period 2000-2024 compared to the period 1990-1999. The average production for the period 1990-1999 was 15,080,724.8 quintals, while the average for the period 2000-2024 was approximately 25,154,940.6 quintals. The percentage increase in wheat production is approximately 0.032%, reflecting the reforms

implemented by Algeria during this period, which included a series of development plans and programs that significantly boosted wheat production.

The average total area cultivated with wheat during the period 1990-1999 was 1.5 million hectares, representing 0.024% of the total area. This compares to 1.9 million hectares (0.030%) for the period 2000-2024.

Regarding agricultural equipment, the period 1990-1999 showed a direct correlation between increased equipment and decreased wheat production. This indicates a strong balance between wheat production and agricultural equipment, which is a crucial element in production. However, the period 2000-2024 witnessed a notable increase in wheat production. This is attributed to the increased use of agricultural equipment up to 2010, which in turn led to higher production levels, and vice versa. As for rainfall, wheat production depends on the amount of rain that falls during the year; that is, the greater the rainfall, the greater the wheat production, and vice versa—a direct relationship between the amount of rainfall and wheat production.

4_ Conclusion

In light of the foregoing, it is clear that wheat production in Algeria is a fundamental element in achieving food security, given wheat's prominent place in the population's diet and its direct link to providing basic foodstuffs and reducing dependence on imports. However, Algeria's ability to achieve sustainable wheat production stability is affected by a complex interplay of natural, economic, technical, and institutional factors. Among these are climatic factors, particularly the amount and distribution of rainfall and the frequency of droughts, which are among the most important determinants of wheat production, especially in rainfed agricultural areas. Furthermore, water scarcity makes the development of supplemental irrigation and improved water use efficiency crucial for mitigating production fluctuations. In addition, the area of cultivated land, soil fertility, agricultural mechanization, and planting and harvesting methods all influence productivity and yield, as does improving the efficiency of available resources. Therefore, enhancing food security in Algeria requires adopting an integrated wheat production policy that combines improved water resource management, the development of drought-resistant varieties adapted to local conditions, the expansion of modern agricultural technologies, the improvement of farming practices, and support for scientific research and agricultural extension services. Furthermore, studying the interaction between different factors, such as rainfall and irrigation, fertilizers and water, or technology and natural resources, can provide a deeper understanding of the determinants of wheat production, in order to enhance the ability to meet domestic wheat demand sustainably.

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