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# Modern Desert Agriculture as an Effective Strategic Option for Achieving Food Security in Algeria

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**Abstract:**
Food security is one of the strategic issues whose importance has increased in light of global economic crises and accelerating climate change. Algeria faces real challenges in this field due to its reliance on importing a significant part of its food needs. In this context, desert agriculture has emerged as a promising strategic option based on the exploitation of vast areas and available groundwater resources.
This type of agriculture relies on modern techniques, such as drip irrigation and protected agriculture, in order to increase productivity and improve crop yields. It also contributes to expanding agricultural land and increasing national production, which strengthens the achievement of relative self-sufficiency and reduces food dependence on foreign markets.
Despite these positive aspects, this sector still faces several challenges, most notably the lack of infrastructure, high investment costs, and the scarcity of water resources. Nevertheless, desert agriculture remains a fundamental pillar for achieving food security and supporting the path of sustainable development in Algeria.
**Keywords:** Food Security; Desert Agriculture; Self-Sufficiency; Sustainable Development; Agricultural Technologies.

## INTRODUCTION

Food security is one of the strategic issues that has become increasingly important in light of global economic transformations and escalating climate challenges[1]. Ensuring the provision of sufficient and safe food for the population has become one of the most prominent priorities of public policies in various countries around the world. International economic crises, fluctuations in food prices, and climate change, which has directly affected agricultural

1- It should be noted that the concept of food security first appeared during the World Food Conference in 1974. At that time, attention focused on ensuring the availability of food supplies and the stability of their prices as two essential conditions for achieving food security at both the international and national levels. However, this concept later evolved and was no longer limited to merely providing food in sufficient quantities. It also came to include ensuring the continuous availability of healthy and safe food throughout the year for all individuals. For further details, see: Iis Maazouzi and Amina Ben Kheznadji, "The Role of the Agricultural Sector in Achieving Food Security in Algeria," Journal of Contemporary Economic Research, Vol. 6, No. 2, 2023, p. 193.

production, have highlighted the urgent need to strengthen countries' capacities to achieve a greater degree of food self-sufficiency and reduce their dependence on foreign markets.

In this context, Algeria faces real challenges in achieving food security, given its long-standing reliance on importing a significant part of its basic food needs, especially cereals and some agricultural products. This situation has led to an increase in the food import bill, making the strengthening of national food production an economic and strategic necessity to ensure economic and social stability.

Among the options that have emerged in recent years as one of the promising solutions for strengthening agricultural production in Algeria is desert agriculture, based on the fact that most of Algeria's territory is desert. This type of agriculture relies on exploiting vast areas of desert land and using groundwater resources and modern agricultural techniques in order to expand agricultural land and increase production. The Algerian desert, with its considerable natural potential, represents a promising area for developing agricultural activity and contributing to economic development and the strengthening of national food security.

The Algerian state has paid increasing attention to the development of desert agriculture through the adoption of various strategies and plans, most notably the Strategic Plan for the Development of Cereal Production (2023–2028) [2], supported by a set of incentives, particularly in the areas of financial support, the regularization of agricultural land, and the provision of agricultural electricity. These measures have contributed significantly to the development of desert agriculture and the achievement of self-sufficiency in a number of widely consumed products, while moving toward strengthening food security, especially with regard to cereals, which are of strategic importance.

**Research Problem**

Based on the above, the main research problem of the study can be formulated as follows:

**To what extent can desert agriculture in Algeria constitute an effective strategic option for achieving food security?**

Answering this research problem requires addressing the subject from a specific perspective. The study begins, in the first section, by defining the conceptual framework of food security and desert agriculture in Algeria. The second section then focuses on clarifying the current state and potential of desert agriculture and its role in strengthening food security in Algeria.

In order to study the subject of desert agriculture and its role in achieving food security in Algeria, the descriptive method was adopted to present the concepts related to food security and desert agriculture and to explain their characteristics. The analytical method was also adopted to analyze the current state of desert agriculture in Algeria and evaluate its role in strengthening food security by examining the available potential and the challenges facing this sector.

2- Abdelrahim Turki and Mohamed El-Arabi Bebouche, "The Role of Desert Agriculture in Strengthening Food Security in Algeria: A Case Study of El Oued Province During the Period 2018–2023," Journal of Research and Studies, University of El Oued, No. 2, 2025, p. 165.

## 1. The Conceptual Framework of Food Security and Desert Agriculture in Algeria

Food security currently represents one of the most important strategic issues receiving increasing attention at both the international and national levels, especially in light of the economic and climatic changes taking place in the world and their direct effects on agricultural production and food supply chains. The growing global demand for food, along with climate fluctuations and rising food prices, has led many countries to reconsider their agricultural and food policies in order to strengthen their ability to achieve a greater degree of self-sufficiency and reduce dependence on foreign markets.

In this context, Algeria faces multiple challenges in achieving food security, particularly in light of increasing demographic growth and the rising domestic demand for basic food products. This situation has led the country to rely for a long time on importing a significant part of its food needs, which has been reflected in the increase in the food import bill and the exposure of the national economy to fluctuations in global markets.

Among the options that have emerged as one of the possible solutions to address these challenges is desert agriculture, which is based on exploiting vast areas of desert land and using available natural resources, especially groundwater, to develop agricultural activity. This type of agriculture is gaining increasing importance in Algeria, given the significant natural potential of desert regions, which can contribute to expanding agricultural land, increasing agricultural production, and strengthening national food security.

However, studying the role of desert agriculture in achieving food security initially requires defining the conceptual framework that regulates the various terms related to the research topic. This is done by clarifying the concept of food security and its different dimensions, explaining the concept of desert agriculture and its characteristics, and highlighting the relationship between these two concepts.

Based on this, this section will address, in the first subsection, the concept of food security, its basic dimensions, and its importance in achieving economic and social stability. The second subsection will then examine the concept of desert agriculture and its characteristics, while highlighting the most important agricultural techniques that allow the development of this type of agriculture in desert environments. As for the third subsection, it will analyze the relationship between desert agriculture and the achievement of food security by explaining the role that this type of agriculture can play in expanding agricultural production and reducing food dependence on foreign markets.

### 1.1 The Concept of Food Security and Its Dimensions

Food security is considered one of the fundamental concepts in modern economic and development studies, given its close connection to the ability of states to provide sufficient and safe food for their populations on a continuous and sustainable basis. This concept has evolved from a focus on the quantitative production of food to more comprehensive dimensions that include individuals' ability to access food, ensure its stability and continuity, and guarantee its safety and nutritional quality. Food security has acquired particular importance in light of contemporary challenges, such as climate change, population growth, rising food prices, economic crises, and geopolitical disturbances that affect global supply chains.

In light of these developments, achieving food security has become a fundamental objective of economic and agricultural policies, especially in developing countries that depend heavily on imports to meet their food needs. Hence, there is a need to strengthen local production capacities and reduce dependence on foreign sources in order to ensure economic and social stability. From this perspective, this subsection will be devoted to discussing the definition of food security and the different approaches that have addressed this concept in the first branch. It will then examine the multiple dimensions on which it is based in the second branch, and finally highlight its importance and role in achieving stability and sustainable development in the third branch.

**1.1.1 Definition of Food Security**

The concept of food security emerged in the 1970s and was mainly associated with the ability of states to provide sufficient food for their populations on a continuous basis. According to the Food and Agriculture Organization, food security is defined as the continuous provision of food to all members of society in sufficient quantity and quality in order to ensure a healthy and active life.

This concept has evolved from its traditional meaning, which was linked to self-sufficiency and domestic production, into a more comprehensive modern concept that takes into account the role of international trade. It is now associated with the ability of a state to meet its food needs through both domestic production and imports. Food security also reflects individuals' ability to obtain actual and stable access to food according to their economic means[3].

The Algerian Constitution, in several of its articles, affirms the citizen's right to a standard of living that guarantees health and a dignified life, which includes securing basic food needs[4]. Law No. 08-16 of August 3, 2008, relating to agricultural orientation[5], aims to define the general framework of the state's agricultural policy by organizing and developing the agricultural sector in a way that ensures improved production and strengthens food security. It also focuses on modernizing agricultural activity, encouraging investment, and improving the use of natural resources. In addition, it enshrines the principles of sustainable development in the agricultural field by supporting farmers and promoting national production.

Within this framework, there is also Law No. 10-03 of August 15, 2010[6], which sets out the conditions and procedures for the exploitation of agricultural lands belonging to the private property of the state. This law aims to regulate the use of these lands by establishing a clear

3- Wasila Waaer and Karmia Doufi, "An Analytical Study of the State of Arab Food Security in Light of Global Food Security Indicators During the Period 2009–2018," Journal of Economic Studies and Research in Renewable Energies, University of Batna, No. 2, 2021, p. 67.

4- There are several provisions in the Algerian Constitution of 2020, issued pursuant to Presidential Decree No. 20-442 of December 30, 2020, relating to the issuance of the constitutional amendment, Official Gazette No. 82, issued on December 30, 2020, as amended by Law No. 26-04 of March 26, 2026, containing the constitutional amendment, Official Gazette No. 22, issued on March 26, 2026. These provisions directly or indirectly affirm the citizen's right to a decent standard of living, including the provision of basic food needs. The most notable of these provisions are Article 62, Article 63, and Article 64.

5- Law No. 08-16 of August 3, 2008, relating to agricultural orientation, Official Gazette No. 46, issued on August 10, 2008.

6- Law No. 10-03 of August 15, 2010, determining the conditions and procedures for exploiting agricultural lands belonging to the private property of the state, Official Gazette No. 46, issued on August 18, 2010.

legal framework that ensures their rational and effective exploitation. It established the principle of granting the right of concession instead of transferring ownership, allowing the state to retain ownership of the land while enabling investors to exploit it under fixed-term contracts. It also regulates the conditions for benefiting from this right and defines the rights and obligations of beneficiaries, particularly the obligation to exploit the land effectively and continuously and to preserve its agricultural character. In addition, it organizes control mechanisms and allows for the withdrawal of the concession right in cases of failure to comply with obligations, with the aim of protecting agricultural land, strengthening food security, and supporting sustainable development.

This approach is integrated with national policies, particularly the National Plan for Agriculture and Rural Development, which reflects the state's effort to achieve self-sufficiency and reduce food dependence. The amendment to Investment Law No. 22-18 of 2022[7] also reinforced this dynamic by providing significant tax incentives and encouraging investment in the agricultural sector, especially desert agriculture, by classifying it among priority sectors and granting it tax advantages during both the implementation and exploitation phases, including exemptions from various duties and taxes. Desert regions have also benefited from a special system that grants additional advantages for longer periods, with the aim of encouraging investment in these areas. These measures have contributed to motivating farmers and strengthening the trend toward expanding agricultural investments in the desert.

Accordingly, food security in Algeria is not merely an economic concept, but rather a comprehensive framework that integrates productive, legal, and social dimensions. It aims to ensure the minimum food needs of the population on a permanent basis, thereby strengthening social and economic stability and limiting potential food crises.

**1.1.2 The Dimensions of Food Security**

Food security is based on four main dimensions that ensure the comprehensiveness of this concept and the integration of its policies. These are availability, access, stability, and utilization.

First, the dimension of availability refers to the existence of sufficient quantities of food to meet the needs of the population, whether through local production or imports[8]. This dimension depends on the state's ability to develop the agricultural sector, improve productivity, and store strategic food reserves to ensure the continuous fulfillment of demand. An example of this is Algeria, where the government encourages local production of wheat and barley to reduce dependence on imports, while maintaining strategic reserves sufficient for emergency periods, as stated in the National Food Security Plan.

Second, the dimension of access refers to individuals' ability to obtain food from an economic and social perspective. The mere availability of food is not sufficient; it must also be accessible to all segments of society at affordable prices. The food access indicator expresses the ability of individuals within society to meet their basic nutritional needs, and both food commodity

7- See Article 27 of Law No. 22-18 of July 24, 2022, containing the Investment Law, Official Gazette issued on July 28, 2022.
8- Abdelrahim Turki and Mohamed El-Arabi Bebouche, previously cited reference, p. 171.

prices and individual income levels are among the most important factors determining this ability. Food prices directly affect access to food, as the consumer price index is used to measure the cost of living and inflation levels, and thus to assess individuals' ability to obtain food[9].

An example of this is the government subsidy program for basic food products in Algeria, which aims to ensure access to essential foodstuffs such as oil, sugar, and wheat for lower-income groups. This reflects the economic and social dimension of food security.

Third, the dimension of stability means ensuring the continuous availability of food and preventing it from being exposed to severe fluctuations as a result of economic crises, climate change, or geopolitical conflicts[10]. This dimension depends on long-term planning and risk management. In Algeria, for example, addressing annual drought waves requires the establishment of strategic storage facilities and the development of modern irrigation systems to preserve agricultural production, thereby ensuring the continuous availability of food for the population throughout the year.

Fourth, the dimension of utilization refers to the optimal use of food in a way that ensures proper and healthy nutrition for individuals. This dimension is related to food quality, storage methods, and cooking practices, while taking into account food safety and nutritional values. Practical examples of this include food awareness programs in Algerian schools and society, which encourage the balanced consumption of vegetables and fruits and warn against excessive consumption of processed foods, in addition to laws and regulations related to food safety that ensure the protection of consumer health[11].

**1.1.3 The Importance of Food Security in Achieving Economic and Social Stability**

Food security is a fundamental pillar of national security because it is directly linked to the state's ability to protect its population from food crises and ensure its economic and social stability. From the legal perspective in Algeria, the Constitution reflects the state's obligations toward citizens in this field, as it provides for every individual's right to a standard of living that guarantees health and a dignified life, which includes the right to sufficient and safe food[12]. The economic dimension of food security is reflected in laws and policies aimed at strengthening local production and reducing dependence on imports, thereby lowering the import bill and protecting the national economy from fluctuations in global markets[13]. From a

9- Wasila Waaer and Karmia Doufi, previously cited reference, p. 74.

10- Ben Zaza Mansouria, "An Analytical Study of the State of Food Security in the Arab World: Reality and Prospects," Finance and Markets Journal, Vol. 12, No. 2, 2025, p. 193.

11- See Law No. 09-03 of February 25, 2009, relating to consumer protection and the suppression of fraud, issued in Official Gazette No. 15 on March 8, 2009, as amended and supplemented by Law No. 18-09 of June 10, 2018, Official Gazette No. 35, issued on June 13, 2018.

12- Fatiha Khoumija and Fatna Senoussaoui, "Agricultural Farming as a Contributor to Achieving Food Security in Algeria," Fezzan University Scientific Journal, special issue of the Second International Scientific Conference for the Development of Administrative and Financial Sciences, 2025, p. 438.

13- It should be noted that the agricultural sector in Algeria contributed approximately 35 billion dollars to economic output in 2023, with significant production growth ranging between 12% and 14%. It also covers about 75% of the needs of the national market. Desert agriculture, especially in the provinces of Biskra, Oued Souf, and Aar, has become a major source of food thanks to abundant production and state support. Algeria has also achieved self-sufficiency in several agricultural products, while recording record yields in wheat production. Through the expansion of agricultural areas and the implementation of strategic programs, it seeks to achieve self-sufficiency

social perspective, food security contributes to strengthening social stability by ensuring the availability of food for all segments of society, in addition to creating job opportunities in the agricultural sector and related industries. This contributes to improving living standards and reducing poverty and hunger, as well as supporting national supply and ensuring its continuity[14]. These policies are integrated with government support programs for low-income families and with the monitoring of food quality and safety, thereby achieving comprehensive protection for citizens and ensuring social justice in access to food.

In brief, food security in Algeria represents an interconnection between the legal, economic, and social dimensions. It constitutes a strategic tool for achieving sustainable development, reducing dependence on foreign sources, and ensuring the stability of society and the state at the same time.

**1.2 The Concept of Desert Agriculture and Its Characteristics**

In light of the limited availability of fertile agricultural land in many countries, desert agriculture has emerged as a strategic option for expanding agricultural activity and exploiting unused or semi-arid lands. Desert agriculture is defined as all agricultural activities carried out in desert regions, with farming methods adapted to harsh climatic conditions such as water scarcity, high temperatures, the variation between day and night temperatures, and the scarcity of natural vegetation cover. This type of agriculture aims to strengthen national food security by benefiting from available natural resources and exploiting uncultivated lands in a sustainable manner, ensuring the production of crops suited to difficult environmental conditions (First Branch).

Desert regions in Algeria are characterized by several features that affect the nature of agriculture in these areas, the most important of which are water scarcity, poor soil conditions, high temperatures, and strong winds that may cause soil erosion (Second Branch).

To overcome these challenges, modern techniques are used, such as drip irrigation to reduce water waste, greenhouses and climate-controlled nurseries to protect plants, and soil improvement through organic and chemical fertilizers, in addition to selecting drought-resistant crops such as dates and some cereals and desert vegetables. It is therefore clear that desert agriculture represents an integrated strategy that combines science, technology, and sustainable planning in order to achieve effective agricultural productivity despite difficult climatic conditions (Third Branch).

**1.2.1 Definition of Modern Desert Agriculture**

Modern desert agriculture in Algeria is defined as an advanced agricultural pattern practiced in desert regions. It is based on the exploitation of available natural resources, especially vast lands and groundwater, using modern techniques and methods aimed at achieving sustainable and effective agricultural production. It also means exploiting desert lands and transforming

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in cereals, especially durum wheat, by 2025. See: Fatiha Khoumija and Fatna Senoussaoui, previously cited reference, p. 446.

14- Sadek Noureddine Henna, "The Role of Desert Agriculture in Achieving Food Security in Algeria Within the Framework of Sustainable Development," doctoral thesis in political science and international relations, National Higher School of Political Science, academic year 2016–2017, p. 13.

them into productive areas through the use of agricultural methods adapted to the nature of the harsh environment[15].

This type of agriculture relies on the use of modern agricultural technology, such as drip irrigation and pivot irrigation systems, improved seeds, agricultural mechanization, and greenhouses, in addition to relying on renewable energies, particularly solar energy, to supply electricity[16]. This makes it possible to overcome climatic challenges such as drought and high temperatures.

Modern desert agriculture is considered a strategic option in Algeria because of its role in expanding agricultural land and increasing national production, especially in strategic crops such as wheat and vegetables. This strengthens food security and reduces dependence on imports.

In this context, this type of agriculture receives state support through policies and programs aimed at encouraging agricultural investment in desert regions by providing agricultural land, financial support, and infrastructure, thereby contributing to sustainable development and improving economic and social conditions.

**1.2.2 Characteristics of Desert Regions**

Desert regions in Algeria are characterized by several important features that affect the nature of agriculture in them, including the vast extent of desert areas, which constitute more than 80% of the country's total area, the availability of enormous groundwater reserves, the presence of large areas suitable for agricultural reclamation, and climatic conditions that allow the production of certain crops outside their normal season[17].

Among the important agricultural desert provinces are Biskra, El Oued, Ouargla, Ghardaia, and Adrar. To overcome the difficulties of the desert environment, agriculture in these regions relies on modern techniques such as pivot irrigation, drip irrigation, greenhouse farming, the use of modern agricultural mechanization, and the benefit of scientific research to improve seeds and crops.

The adoption of sustainable agricultural practices and modern techniques contributes to improving the productivity of agricultural land and the quality of crops, which increases the economic return for farmers. The use of modern irrigation systems, such as drip and sprinkler irrigation, also allows the rationalization of water consumption and the reduction of waste, especially in desert regions. These methods have had a positive impact on the development of agricultural production and the promotion of sustainable development, in line with government policies aimed at exploiting desert lands and supporting the agricultural sector as a fundamental pillar for achieving food security[18].

**1.2.3 Agricultural Techniques Used in the Desert Environment**

15- Sheikh Tihami Ibrahim, "The Adoption of Climate-Smart Agriculture as a Strategic Orientation for Achieving Desert Agricultural Development in Algeria: Reality and Requirements for Success," Journal of Economics and International Trade, No. 1, 2024, pp. 101–104.
16- Fatiha Khoumija and Fatna Senoussaoui, previously cited reference, p. 440.
17- Sadek Noureddine Henna, previously cited reference, p. 41.
18- Shekhalil Iman and Baghdadi Bilal, "Modern Irrigation Technology to Improve Water Consumption Efficiency in Agriculture and Promote Rural Development: The Experience of Applying Modern Irrigation Techniques on a Model Farm," Ibn Khaldun Journal of Creativity and Development, No. 1, 2024, p. 73.

Desert agriculture in Algeria relies on a set of modern techniques aimed at overcoming the difficulties of the harsh desert environment, including water scarcity, high temperatures, and poor soil conditions. The most prominent of these techniques include:

- Pivot irrigation, which allows large areas of land to be irrigated in a balanced and efficient manner, ensuring that water reaches all parts of the field while reducing waste.
- Drip irrigation, which directs water directly to the roots of plants and is considered one of the most efficient methods of water consumption, especially in desert regions that suffer from water scarcity[19].
- Greenhouse farming, which provides a protected environment for plants, improves productivity, and enables the production of crops outside their natural season.
- The use of modern agricultural mechanization, which increases the speed of agricultural operations and improves the quality of production.
- Artificial intelligence analyzes climate and soil data through smart sensors in order to guide irrigation operations with extreme precision according to the actual needs of the crop. This technology contributes to maximizing productivity and improving crop quality while reducing water consumption and costs, thereby ensuring the sustainability of water resources[20].
- Reliance on scientific research to improve seeds and crops, making them more suitable for desert climatic conditions and increasing their resistance to drought and heat.

From a legal perspective, the Algerian state supports the use of these modern techniques, which aim to develop national agricultural production, improve the management of water resources, and encourage the reclamation of desert lands. National plans for food security and rural development also include programs to support agricultural projects in southern Algeria and to provide farmers with financing and modern technologies, thereby contributing to increased agricultural productivity and the achievement of food self-sufficiency.

Thanks to these techniques, Algeria has been able to exploit vast areas of desert land and increase the productivity of agricultural crops, which directly contributes to strengthening food security, achieving sustainable economic development, and reducing dependence on food imports from abroad.

**1.3 The Relationship Between Modern Desert Agriculture and the Achievement of Food Security: A Sustainable Development Approach**

Desert agriculture represents one of the strategic options for strengthening agricultural production and expanding the productive base of the agricultural sector, especially in countries that possess vast desert areas, such as Algeria. It allows unused lands to be exploited and transformed into productive areas, thereby contributing to increasing national food production and achieving a degree of self-sufficiency in the face of food security challenges. This expansion of agricultural activity is considered necessary to reduce dependence on imports and ensure the continuous and sustainable availability of food for the population.

19- Ibid., p. 73.
20- Ibid., p. 74.

From this perspective, this subsection aims to highlight the vital role of desert agriculture in supporting national food security in the first branch, by reviewing agricultural reclamation mechanisms and modern techniques used in desert regions, as well as the impact of this agriculture on economic development and job creation in southern regions. This link between desert agriculture and food security reflects the importance of national strategies that support the development of the agricultural sector, ensure the sustainable use of available resources, and reduce dependence on foreign sources in the second branch.

**1.3.1 The Role of Modern Desert Agriculture in Increasing Agricultural Production**

Modern desert agriculture plays a pivotal role in strengthening agricultural production by improving the efficiency of natural resource use, especially water, and enabling agricultural activity in environments that were traditionally considered unsuitable for production. Modern techniques have made it possible to overcome harsh climatic constraints, such as high temperatures and water scarcity, which has contributed to improving agricultural yields and ensuring the continuity of production under dry conditions[21].

This type of agriculture relies on a set of advanced techniques that increase production efficiency, most notably drip irrigation and precision irrigation, which help reduce water losses caused by evaporation and surface runoff and provide plants with their water needs accurately[22]. Soilless agriculture, or hydroponics, is also considered an effective solution, as it allows higher production per unit of water. Some research experiments have shown that tomato production can reach levels far exceeding those of traditional systems[23].

Studies also indicate that the adoption of agricultural technology in dry regions can lead to a significant increase in agricultural yields, ranging from 4.4% to 24.7%, depending on the type of technology and crop. Some applied models in desert environments have recorded positive results, represented by improved fertilizer use efficiency, reduced production costs, and considerable increases in yield that may reach approximately 30%[24].

The impact of modern desert agriculture is not limited to increasing production alone; it also extends to strengthening food security by expanding agriculturally exploitable areas in dry regions and reducing pressure on fertile lands and traditional water resources. This type of agriculture also contributes to supporting local self-sufficiency, reducing food dependence, creating job opportunities, and developing inland regions, thereby promoting sustainable development.

**1.3.2 Modern Desert Agriculture Reduces Food Dependence on Foreign Sources**

Modern desert agriculture is one of the most important mechanisms that contribute to reducing food dependence on foreign sources by increasing local agricultural production and strengthening the capacities for relative self-sufficiency, especially in countries with dry climates such as Algeria. Some studies have shown that developing this agricultural pattern

21- https://icarda.org/media/blog/inside-icardas-integrated-desert-farming-systems, consulted on March 20, 2026.
22- https://www.earthsblueaura.com/desert-agriculture/, consulted on March 12, 2026.
23- https://icarda.org/media/blog/inside-icardas-integrated-desert-farming-systems, consulted on March 24, 2026.
24- Sahaja Deva and others, "Improved yland Technologies for Sustainable Crop Productivity in Rainfed Situation in Anantapuramu District," Mysore Journal of Agricultural Sciences, 59(1), p. 341.

contributes to reducing reliance on food imports and diversifying sources of national production[25].

The contribution of this type of agriculture to reducing food dependence is mainly reflected in increasing the production of cereals, vegetables, fodder, and dates in desert regions, which reduces the volume of imports and strengthens local supply. This agricultural expansion also makes it possible to exploit lands and water resources that were previously unused or poorly productive, thereby broadening the national production base[26].

Modern desert agriculture also relies on advanced techniques such as precision irrigation, protected agriculture, and hydroponics. These techniques contribute to increasing agricultural productivity and reducing water waste. This helps make local production more stable and continuous, even under harsh climatic conditions and resource scarcity.

In contexts that depend heavily on food imports, this type of agriculture is a strategic means of reducing exposure to global price fluctuations and supply chain disruptions. Therefore, it represents an effective development option for strengthening food security and achieving a greater degree of food sovereignty.

## 2. Desert Agriculture in Algeria Between the Current Reality, Development Prospects, and Its Role in Supporting Food Security

Desert agriculture is one of the strategic pillars for developing the agricultural sector in Algeria, especially in light of the limited availability of fertile agricultural land in the north and the heavy reliance on imports to meet food needs. The vast desert lands, which constitute more than 80% of the country's total area, represent an important opportunity to expand agricultural activity and exploit available natural resources in a sustainable manner. The availability of large groundwater reserves and a climate suitable for certain crops also gives desert agriculture a competitive advantage in local and international markets, making it an important element in strengthening national food security.

From this perspective, this section seeks to study the reality and potential of desert agriculture and its role in strengthening food security in Algeria through three main subsections. The first subsection focuses on the natural and human potential of desert agriculture, including desert areas, water resources, and climatic conditions suitable for certain crops. The second subsection reviews the current state of desert agriculture in Algeria and identifies the most important agricultural regions and crops produced, in addition to the modern agricultural techniques and innovations on which the state relies to enhance productivity.

The third subsection reviews the role of desert agriculture in strengthening food security by increasing local production, reducing food dependence on foreign sources, stimulating economic development, and supporting government policies, while also addressing the challenges and development prospects of this vital sector.

25- . Maaskri Samra and . Moghrabi Miloud, "Desert Agriculture Is the Food Basket in Algeria," Finance and Markets Journal, No. 01, University of Mostaganem, 2025, p. 29.

26- Hergoun Tefaha, "Desert Agriculture in Algeria: Reality and Challenges: Aar Province as a Model," Journal of Economics and International Trade, No. 1, 2024, pp. 30–33.

### 2.1 The Natural and Human Potential of Desert Agriculture in Algeria

Natural potential is one of the basic pillars on which desert agriculture in Algeria is based, as desert regions possess diverse natural assets despite the harsh climatic conditions. The most prominent of these resources are the abundance of groundwater, especially in deep aquifers such as the Northern Sahara Aquifer System, in addition to vast areas of land suitable for reclamation. Climatic characteristics, despite high temperatures and low rainfall, also make it possible to produce agricultural crops adapted to dry environments when modern irrigation techniques and water-saving methods are adopted (First Branch).

As for human potential, Algeria has relatively qualified human resources in the agricultural field, especially with the state's growing orientation toward training farmers and supporting investment in the desert agricultural sector. Vocational and university training policies have also contributed to providing skills capable of introducing modern techniques into agriculture, such as protected agriculture and drip irrigation. In addition, the experience of local farmers in adapting to the desert environment constitutes an important asset that can be developed through extension programs and technical support (Second Branch).

The strategic importance of these potentials is reflected in their ability to support the construction of a sustainable desert agricultural model based on the rational use of natural resources and the enhancement of human resources. Integrating these potentials into effective public policies also contributes to strengthening agricultural production, reducing food dependence, and supporting the path toward achieving food security in Algeria. However, investing in these capacities remains conditional on the availability of good governance and sound scientific planning to ensure the sustainability of resources for future generations.

#### 2.1.1 The Natural Potential of Desert Agriculture in Algeria

The natural potential of desert agriculture in Algeria consists of a set of assets that make this agricultural pattern promising in terms of expansion and production. The Algerian desert area extends over vast territories exceeding 80% of the country's total area, which provides a large land reserve that can be invested in various agricultural projects if it is properly used and managed[27].

Algeria also possesses important groundwater resources, especially in the deep layers of the south, which are among the most prominent elements supporting the establishment of relatively stable desert agriculture. Although the use of this water must be rationalized, it constitutes a fundamental basis for supplying oases and new agricultural perimeters and enabling them to continue producing throughout the year.

In addition, the desert climate itself can be a positive factor in some cases, as high temperatures and abundant solar radiation help cultivate certain crops outside their natural season in the north. This gives desert agriculture a competitive advantage in terms of early agricultural produce and off-season production, especially vegetables and some horticultural varieties.

Accordingly, the natural potential of desert agriculture in Algeria is not limited only to the abundance of land and water, but also includes climatic characteristics that allow production diversification and higher returns. However, investing in this potential remains linked to sound

27- Fatiha Khoumija and Fatna Senoussaoui, previously cited reference, p. 439.

management, the adoption of modern techniques, and the protection of natural resources from depletion in order to ensure the sustainability of this agricultural orientation.

**2.1.2 Human Potential**

The human dimension constitutes one of the most important pillars of the success of desert agriculture, because the availability of land and water alone is not sufficient unless it is accompanied by human resources capable of planning, implementation, and follow-up. Human potential here refers to the set of local experiences, technical skills, and qualified labor that can transform natural potential into actual and sustainable production.

Algeria benefits from accumulated local experience in desert regions, especially among farmers who have developed practical knowledge of soil characteristics, irrigation patterns, and methods of adapting to the dry climate. These traditional experiences, despite sometimes being simple, remain of great value when integrated with modern scientific methods[28].

In addition, there are qualified agricultural and technical personnel in the fields of agricultural extension, agricultural engineering, and agricultural project management. These personnel are necessary for supervising investors and farmers, guiding them toward selecting suitable crops, adjusting agricultural programs, and using resources with high efficiency.

The importance of human potential also appears in the ability to absorb modern techniques and apply them in the field, such as drip irrigation, which ensures the rationalization of water consumption; pivot irrigation, which allows large areas to be covered; and agricultural mechanization, which increases productivity and reduces dependence on manual labor. These techniques cannot yield results unless there are workers and technicians trained to operate and maintain them.

Training and qualification are of particular importance in this field, because modern desert agriculture relies on precise knowledge more than on physical effort alone. Therefore, investing in human resources through vocational and university training and continuous training represents an essential condition for the success and development of this agricultural pattern.

Accordingly, human potential in desert agriculture is not limited to the availability of labor, but also includes experience, skill, and the ability to deal with modern agricultural technology. Therefore, strengthening this potential is a key entry point for increasing production, improving quality, and ensuring the sustainability of agricultural development in desert regions.

**2.2 The Reality of Desert Agriculture and the Techniques Used**

Desert agriculture in Algeria is witnessing remarkable development, especially in southern provinces such as Biskra, El Oued, and Ouargla, where these regions have become important agricultural hubs. This transformation reflects a strategic orientation toward exploiting the natural potential of the desert, supported by the adoption of modern techniques that have contributed to overcoming harsh climatic constraints.

This type of agriculture is characterized by the diversity of its production, as it includes basic crops such as cereals, in addition to potatoes, dates, and various vegetables. This has contributed to strengthening the local food supply. This diversity has enabled some provinces

28- Fatiha Khoumija and Fatna Senoussaoui, previously cited reference, p. 439.

to achieve significant levels in meeting national demand, especially for widely consumed products.

Modern agricultural techniques, such as drip irrigation, pivot irrigation, and protected agriculture, have also contributed to increasing productivity and improving crop quality while rationalizing water consumption. Thus, the role of desert agriculture emerges as a strategic option for supporting food security and reducing dependence on imports, with promising prospects for achieving sustainable agricultural development.

### 2.2.1 The Role of Investments in Developing Desert Agriculture and Enhancing Agricultural Production in Algeria

Desert agriculture in Algeria is witnessing remarkable development thanks to the increasing volume of major agricultural investments that have contributed to reviving agricultural activity in dry regions. This has been reflected in the reclamation of vast areas of desert land and the provision of modern means and equipment that make it possible to create suitable conditions for agricultural production, despite difficult climatic challenges[29].

The state has also played a pivotal role in supporting this orientation through the creation of specialized institutions and bodies, such as the Office for the Development of Desert Agriculture, which aims to support farmers and investors and provide guidance and technical assistance. In addition, these investments have contributed to the introduction of modern techniques in irrigation and protected agriculture, leading to improved productivity and higher crop quality[30].

Thus, these investments and public policies have contributed to strengthening agricultural production in desert regions by expanding agricultural land, increasing yields, and reducing dependence on imports, thereby contributing to the achievement of food security and supporting economic development in Algeria.

### 2.2.2 Modernizing Agriculture in Algeria Through Modern Techniques and Innovation

Desert agriculture in Algeria is based on the use of modern techniques and scientific innovation in order to overcome the limitations of the dry climate and water scarcity. This approach has contributed to transforming some desert regions into more stable spaces for agricultural production, especially in the fields of vegetables, palm cultivation, and protected agriculture.

**A. Pivot Irrigation and Drip Irrigation:**

Drip irrigation and pivot irrigation are among the most important techniques that have helped rationalize water use and increase productivity in desert environments. Field studies in southern Algeria indicate that most greenhouses are irrigated using drip irrigation because of its high efficiency in distributing water and fertilizers and reducing costs[31].

These techniques have helped exploit groundwater resources more effectively while reducing water loss caused by evaporation and seepage. Research experiments have also shown that

29- Haddad Linda and Tandjaoui Mourad, "The Implications of Agricultural Investment in the South for Achieving Food Security," The Journal of Research and Scientific Studies, No. 1, 2026, pp. 680–700.
30- Ibid.
31- For more details, see: Madani Zakaria and Madani Benchohra, "IoT Enhancements in Algerian Desert Agriculture," Journal of Economics and International Trade, No. 1, 2024, pp. 43–62.

adopting more efficient irrigation systems in dry environments directly improves agricultural yields and the sustainability of agricultural activity.

**B. Protected Agriculture:**

Greenhouses are one of the most prominent forms of agricultural innovation in the Algerian desert, as they allow the production of vegetables and fruits almost throughout the year, regardless of external climatic fluctuations. Research reports indicate that protected agriculture has spread widely in regions such as Biskra and has become an important driver in the development of desert horticulture.

This technique makes it possible to control temperature, humidity, and lighting, which improves crop quality and increases the regularity of production. The integration of cooling systems and automatic irrigation inside greenhouses also increases the capacity to produce during periods that were previously considered unsuitable for agriculture[32].

**C. Modern Agricultural Mechanization:**

Agricultural mechanization contributes to increasing efficiency and reducing human effort, especially in large areas that require repeated plowing, planting, and harvesting operations. In the desert environment, agricultural machinery becomes an essential tool for reducing time and physical costs and improving the precision of agricultural operations[33].

Mechanization also helps standardize production operations and improve control over the stages of agricultural work, which is reflected in both the quantity and quality of production. The expansion of desert agriculture in Algeria has been associated with a growing need for modern agricultural equipment capable of operating under difficult climatic conditions.

**D. Scientific Research and Innovation:**

Scientific research plays a decisive role in developing desert agriculture by improving seeds and crops so that they adapt to high temperatures, salinity, and water scarcity. Studies point to the importance of innovation in producing more resistant varieties and developing technical solutions suitable for arid environments[34].

Cooperation between research institutions and economic actors has also helped introduce new techniques, such as smart agriculture and environmental control inside greenhouses. This type of innovation links scientific knowledge with the practical needs of production, thereby enhancing the ability of desert agriculture to continue and grow.

These policies show that innovation is no longer a complementary element, but has become an essential condition for achieving sustainable productivity in desert regions. Therefore, modern agricultural techniques represent a strategic tool for strengthening national food security and supporting economic and social development in southern Algeria.

**2.3 The Role of Modern Desert Agriculture in Strengthening Food Security and Its Development Prospects**

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32- For more details, see: "Greenhouse Horticulture Algeria: Quick Scan," available at: https://www.agroberichtenbuitenland.nl/site/binaries/sitecontent/collections/documents/2023/01/26/sector-study-algerian-greenhouse-horticulture/Report+Greenhouse+Horticulture+Algeria_+Final+Version.pdf , consulted on March 22, 2026.

33- Selt, Mohammed Mostefa, "Rural and Agricultural Development in Algeria: What Policies for What Results?" Al-Riyada for Business Economics Journal, Vol. 11, No. 02, June 2025, p. 281.

34- Sheikh Tihami Ibrahim, previously cited reference, pp. 107–108.

Modern desert agriculture is one of the most important strategic transformations experienced by the agricultural sector in Algeria, as it has shifted from traditional methods with limited production to agricultural patterns based on modern techniques and the rational exploitation of natural resources. This orientation has become a necessary option for addressing challenges related to water scarcity, climate change, and the rising demand for food products, which has given it increasing attention within public policies for agricultural development.

In this context, the role of modern desert agriculture emerges as an effective mechanism for strengthening food security through the expansion of cultivated areas, the diversification of agricultural production, and the improvement of its yield thanks to the adoption of water-saving irrigation techniques, protected agriculture, and agricultural innovation. This approach has also contributed to reducing external food dependence and supporting national production, thereby strengthening the state's ability to achieve relative self-sufficiency in a number of strategic products (First Branch).

As for development prospects, modern desert agriculture opens wide fields for investment and scientific research, especially with the move toward agricultural digitalization and the use of smart technology in resource management. However, achieving these prospects remains dependent on the extent to which a supportive regulatory environment is provided, agricultural training is strengthened, and private investment is encouraged, allowing the Algerian desert to be transformed into a promising agricultural hub that contributes effectively to achieving sustainable food security (Second Branch).

**2.3.1 The Contribution of Desert Agriculture to Food Security**

Desert agriculture contributes to achieving food security by expanding the national agricultural production base through the reclamation of desert lands and their transformation into productive areas capable of providing a significant part of local food needs. This orientation is particularly important in Algeria, given the limited availability of fertile lands in the north and the increasing pressure this place on traditional agricultural areas. Therefore, investment in the desert makes it possible to diversify sources of production and strengthen the national capacity to meet domestic demand[35].

Desert agriculture also contributes to reducing food dependence on foreign sources through the production of strategic crops such as potatoes, vegetables, cereals, and fodder. This diversity in production supports relative self-sufficiency and limits reliance on imports, especially in light of fluctuations in international markets and the rising cost of food imports. The importance of this role becomes even more evident when it concerns widely consumed products or products directly linked to national food security[36].

35- The strategy of the Algerian state is based in particular on promoting Saharan agriculture, given the importance of the desert, which represents nearly 90% of the national territory. Within this framework, several measures have been put in place to attract investors to the south, particularly through the organization of exhibitions, forums, and debates. The objective is to strengthen the attractiveness of these regions and financially support young project holders in order to facilitate the realization of their projects. Published on the website: https://www.teamfrance-export.fr/infos-sectorielles/13698/13698-letat-algerien-mise-sur-lagriculture-saharienne, consulted on March 24, 2026.

36- . Maaskri Samra and . Moghrabi, previously cited work, p. 29.

The impact of desert agriculture is not limited to the food aspect alone; it also extends to stimulating economic development and creating job opportunities. The establishment of major agricultural investments in desert regions is usually accompanied by the emergence of parallel economic activities, such as transport, storage, refrigeration, and food processing, which adds value to the national economy and strengthens the local economic cycle[37]. These activities also help reduce food loss and improve the use of available resources.

The Algerian state supports this orientation through a set of public policies, including the granting of agricultural lands under concession contracts, the provision of loans and financial support to investors and farmers, the supply of agricultural machinery and equipment, and desert land reclamation programs. This framework reflects the state's interest in establishing legal and institutional foundations that encourage agricultural investment and link it to the objectives of food security and economic and social stability.

Based on this, it can be said that desert agriculture has become one of the strategic tools for achieving food security in Algeria by increasing production, reducing dependence on imports, revitalizing the local economy, and supporting public policies aimed at developing desert regions.

**2.3.2 Challenges and Prospects for Developing Desert Agriculture in Algeria**

Despite the significant potential of desert agriculture in Algeria, it faces a number of challenges that limit its expansion and sustainability. Foremost among these challenges is weak infrastructure, particularly the lack of road networks and transport facilities, which hinders the marketing of agricultural products and increases the cost of transporting and distributing them. The geographical distance of desert regions from consumption centers and major markets also increases logistical difficulties and affects the ability of desert agricultural products to compete[38].

The high cost of investment is one of the most prominent obstacles facing this sector, as the exploitation of desert lands requires substantial expenses related to drilling wells, providing modern irrigation equipment, securing energy, and preparing land for production. Some studies have shown that the success of agricultural projects in the south is largely linked to the availability of financial and technical support and to investors' ability to bear the costs of launching and continuing their projects.

Desert agriculture also faces complex environmental and water-related challenges, represented by water scarcity, high temperatures, the worsening manifestations of desertification, and the limitations of certain soil characteristics. These factors increase the risks associated with agricultural production and require the adoption of precise methods of management and exploitation in order to ensure a balance between the use of natural resources and the preservation of their sustainability.

To address these obstacles, the state is moving toward encouraging local and foreign investment and providing incentives to farmers and investors within the framework of

37- Abdelrahim Turki and Mohamed El-Arabi Bebouche, previously cited reference, pp. 179–181.

38- https://www.teamfrance-export.fr/infos-sectorielles/13698/13698-letat-algerien-mise-sur-lagriculture-saharienne, consulted on March 12, 2026.

agricultural policies and legal regulations governing the exploitation of agricultural lands, particularly those related to concession contracts and facilitating access to agricultural land. The role of specialized bodies is also important, especially the Office for the Development of Industrial Crops in Desert Lands, in supporting investors and guiding them technically and administratively[39].

Among the promising prospects for developing this sector is the development of food industries linked to agricultural production, which would allow products to be valorized, post-harvest losses to be reduced, and the food value chain to be strengthened at its various stages. This orientation is important because it links primary production with processing, storage, and distribution, thereby increasing added value and creating new job opportunities in desert regions.

In the strategic long term, desert agriculture is still required to contribute to achieving self-sufficiency in basic products such as cereals, vegetables, fodder, and meat, as it represents an essential entry point for strengthening national food security. Therefore, the development of this sector is inseparable from the objectives of economic and social stability, as well as from public policies aimed at reducing food dependence on foreign sources and building a more balanced development model in southern regions.

## CONCLUSION

This study shows that modern desert agriculture represents an important strategic option for achieving food security in Algeria, given the significant natural potential of desert regions, such as vast areas of land, abundant groundwater resources, and a climate that allows certain crops to be grown outside their natural seasons.

In recent years, the Algerian state has sought to develop this sector by adopting policies and programs supported by national laws and national plans for food security and rural development, which aim to encourage agricultural investment, reclaim desert lands, and use modern techniques in agricultural production.

Despite the progress achieved, desert agriculture still faces several challenges, including high investment costs, lack of infrastructure, desertification problems, and water scarcity. This requires additional measures to ensure its sustainability and its success in supporting national food security.

The most important findings reached:

- Algeria possesses significant natural and human potential for developing desert agriculture.
- Desert agriculture contributes effectively to strengthening food security and achieving self-sufficiency in several strategic products.
- Developing processing industries related to agricultural production increases the economic value of production and reduces food waste.

Proposals and Recommendations:

39- Haddad Linda and Tandjaoui Mourad, previously cited work, pp. 670–690.

- Strengthening investment in desert agriculture: by providing incentives for local and foreign investors, facilitating access to agricultural land under concession contracts, and providing agricultural loans and support for agricultural equipment.
- Developing infrastructure in desert regions: this includes road networks, transport, energy, and water storage, in order to ensure the efficient marketing of products and access to local and international markets.
- Supporting scientific research and agricultural technology: by financing agricultural research projects to develop local seeds resistant to drought and salinity, and by using modern irrigation techniques and greenhouses, thereby increasing productivity and preserving natural resources.
- Encouraging food industries linked to agricultural production: in order to valorize agricultural products, reduce post-harvest losses, and develop processing industries such as the packaging of vegetables and fruits and the production of fodder, thereby enhancing the economic value of the national economy.
- Adopting environmental sustainability policies: by monitoring water use, combating desertification, and preserving ecological balance.
- Strengthening human skills: through training programs for farmers and agricultural engineers on modern techniques and methods of managing agricultural projects in the desert environment.

Through these measures, desert agriculture can be transformed into a sustainable productive sector that achieves food self-sufficiency, strengthens economic and social development, and ensures national stability.

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