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The contribution of desert agriculture to sustainable agricultural development in the state of Oued Souf

ADJLANE Sabah  *	KHIARI Reguia 	MOKHNANE Tarek 
sabah_economie@hotmail.fr	khiari_rouka@yahoo.com	Tarekamin07@yahoo.com
Scientific and Technical Research Center on Arid Regions CRSTRA Biskra (Algeria)	Scientific and Technical Research Center on Arid Regions CRSTRA Biskra (Algeria)	Scientific and Technical Research Center on Arid Regions CRSTRA Biskra (Algeria)

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Abstract:

Algeria is seeking to achieve sustainable agricultural development due to its increasing effects in providing the growing food needs of the population and providing job opportunities for current and future generations. The agricultural sector is the main source of food and also contributes to providing inputs for many industries that depend mainly on agricultural products. It is also a source of hard currency through its ability to achieve a surplus for export, in addition to creating new job opportunities through various projects.

The aim of this study is to introduce the state of Oued Souf is rich in natural, human and water resources. It is especially known for producing some agricultural crops such as potatoes, wheat, barley, peanuts and more. It also aims at identifying the most important challenges it faces so that we can suggest a number of recommendations that contribute to addressing these challenges.

Key words: Desert agriculture, sustainable agricultural development, constituents, obstacles

JEL Classification Codes: Q1, Q01.

* Corresponding author

Introduction :

Algeria's agricultural sector is a vital strategic sector that aims to achieve food security, diversify the national economy, and promote sustainable agricultural development. In recent years, the government has implemented a set of measures and programs to advance the sector, especially in desert areas. These regions have unique economic and natural characteristics that make them capable of advancing economic growth. Desert agriculture in Algeria has witnessed a qualitative leap in recent years. Especially the Oued Souf region, which has witnessed a major shift in this sector. This resulted in an expansion of exploited agricultural land and a great diversity of agricultural crops. This is due to several factors, including natural ones. Indeed, Oued Souf has a huge reserve of groundwater. In addition, there is the human factor that stems from the nature of the local peasant and his ability to adapt to the harsh conditions that characterize the region.

Study problem:

The province of Oued Souf has abundant natural, human, and water resources, making it a viable option for achieving sustainable agricultural development, provided that the agricultural sector can overcome the challenges and limitations that prevent it from making the best economic use of these resources, which falls short of the anticipated outcomes.

Therefore, the problem of the study is to answer the following main question:

To what extent did the state of Oued Souf, with its natural and economic resources, contribute to the process of sustainable agricultural development in Algeria?

Sub-questions:

In order to answer the main question, we ask the following sub-questions:

- What do we mean by sustainable agricultural development and what are its components?

- How did the agricultural sector in the state of Oued Souf contribute to achieving sustainable agricultural development?
- Is it possible to achieve sustainable agricultural development in the state of Oued Souf through the ingredients that it possesses

Hypotheses

Formulation of the study's hypotheses, which were developed to address both the primary question and the sub-questions are as follows:

- Oued Souf has important agricultural potential through which sustainable agricultural development can be achieved.
- The agricultural sector in the state of Oued Souf contributed to achieving sustainable agricultural development in Algeria during the period (2017-2022).
- Sustainable agricultural development can be achieved in the state of Oued Souf by overcoming the obstacles and challenges that the agricultural sector in the state suffers from, by using modern agricultural production methods.

Study goals:

We seek through this study to achieve the following objectives:

- Defining the concept of sustainable agricultural development and its dimensions;
- Identifying the most important elements and pillars of the economic development of the agricultural sector in the state of Oued Souf.
- Assessing the contribution of the agricultural sector in the state of Oued Souf in achieving sustainable agricultural development by analyzing the reality of plant and animal production there.

Study Approach and tools

Study Approach

To answer the problem of the study and to test the hypotheses of the study, we relied on the descriptive analytical approach, which is an appropriate tool for collecting and analyzing data with respect to the nature of the subject.

Study tools: We relied on the following scientific tools and methods:

- Academic survey of research and previous studies related to the subject of the study.
- Field data: It was obtained from the Directorate of Agricultural Services of El Oued Province, during the period (2017-2021).

In order to answer the problem and achieve the desired objectives of the study, the latter was divided into the following element:

1. sustainable agricultural development of desert lands: a theoretical framework

1.1. Definition of sustainable agricultural development:

Sustainability is the first pillar or criterion by which the success of agricultural projects is measured, By working with practices that ensure the safety of the environment, conservation of non-renewable natural resources as effective foundations towards permanent agriculture is one of the important concepts driving agricultural research in recent years. However, before addressing the concept of sustainable agricultural development, it is worth defining the concepts of agricultural development and sustainable development.

1.1.1. Agricultural development:

The agricultural sector is of great importance in providing livelihoods and generating income for a large population. As a result, agricultural development has been a prominent subject in economic literature. (Ahmed Jabr Salem, 2010, p. 08)

Agricultural development is defined as long-term planning that ensures the achievement of strategic goals based on two points: the first of which is achieving food self-sufficiency, and the second is the proper exploitation of available resources in order to maximize the return from it. (Talbi & salhi, 2015, p. 214)

Agricultural development is also defined as the process of improving agricultural production in quantity and quality, by bringing about a technical revolution in the methods and means of production used by relying on the organization of production in line with the general economic plan and the elimination of the problem of peasant poverty by providing a minimum standard of living for all workers in agriculture. (Ahmed Jabr Salem, 2010, p. 08)

1.1.2. Sustainable development

The concept of sustainable development is a modern concepts, as it was used for the first time during the last century. It emerged as a milestone in the evolution of international awareness of the relationship between population, development and the environment.

Sustainable development is defined as achieving parity, which guarantees the availability of the same current development opportunities for future generations, by ensuring the stability of comprehensive capital or its continuous increase over time. (Ahmed Jaber, 2014, p. 87)

It is also defined as managing and protecting the natural resource base and directing technological and institutional change in a way that ensures the fulfillment and continued satisfaction of human needs for present and future generations. (Adnan Dawood, 2016, p. 34).

The use of the term sustainable development has spread to include all areas such as sustainable foods, transportation, sustainable cities, sustainable industry, and sustainable agriculture. (Bakdi, 2019, p. 15)

It is the subject of our study, so what do we mean by sustainable agricultural development?

1.1.3. Sustainable agricultural development:

The idea of sustainable agricultural development took shape in the eighties in response to the growing observation that national and international agricultural policies and programmes should take into consideration a range of environmental, economic and social dimensions. And its importance became clear and confirmed at the top of the Earth Summit held in the city of Rio de Janeiro in 1992 in the agenda of the 21st century for specific programs and actions to encourage sustainable agricultural development. (Jaafar Talib, 2016, p. 303)

Many definitions of sustainable agricultural development have been received, including:

Sustainability in agriculture means the ability to continue production while preserving natural resources, that is, agriculture that is able to manage resources successfully to meet changing human needs with the maintenance and improvement of natural resources and maintaining its integrity in a way that guarantees the ability of future generations to use and benefit from it. (Yasmin Hilal Idris, 2017, p. 45)

The concept also includes the shift from limited agricultural production to more comprehensive agricultural systems. In addition to the growing linkage of agricultural development with international trade as well as information technologies communications, biotechnologies and life sciences. It also encompasses the regulatory aspects and quality represented by competitiveness. (Al-Saedy, 2010, pp. 9-10)

Sustainable agricultural development is also defined as the process of improving agricultural production in quantity and quality to achieve food security and reduce dependence on imports. This can be achieved by revolutionizing the methods and means of production used as well as bringing about social, cultural and health changes in society. In addition to the technical revolution and the use of appropriate technology which means the maintenance of living resources and production for all current and future generations. (Saad Hamdi, 2017, p. 13)

This also implies ensuring the well-being of people and fair distribution of opportunities and income as well as the efficiency of production systems and the reduction of poverty.

Sustainable agricultural development is enhanced by improving productivity and increase the volume of investment in agriculture according to a balanced sectoral pattern. Additionally, developing the social and cultural structure can also contribute to sustainable agricultural development. (Al-Saedy, 2010, pp. 9-10)

1.2. Elements of sustainable agricultural development:

There is a combination of economic, political and natural factors that have a direct and indirect impact on the process of sustainable agricultural development, which we can be, summarized as follows (Omer Hameed, 2020, p. 373).

1.2.1. Natural Resources:

This means land, water, plant and animal wealth. If these resources are scarce or neglected and misused, it will be an impeding factor for the process of sustainable agricultural development. But if it is preserved and developed according to the correct scientific methods, they will become supporting factors for achieving sustainable agricultural development

1.2.2. Human Resources

Human resources are distinct from all other economic resources. They are both the means and end of development and purpose, making them one of the most important elements of sustainable agricultural development. The employment policy in agriculture aims to efficiently use available human resources while also ensuring a fair distribution of income among these resources.

1.2.3. Technical and technical resources:

This category includes mechanization and technological equipment used in the agricultural production process, as well as production methods and the optimal use of human resources .If not used in a proper scientific manner, these factors may operate as barriers to the development of sustainable agriculture.

1.2.4. Political and social factors:

The factor of political and social stability is one of the most important factors necessary to create a favorable environment for the process of sustainable agricultural development .Its absence impedes sustainable agricultural development.

1.2.5. Organizational factors:

There are a number of factors that are important for achieving sustainable agricultural development, and their absence serves as major impediment to the development process Among these factors, we list: The effectiveness of the marketing devices,

preparation of appropriate storage according to the production plan, planning agricultural investment and giving it greater priority compared to other economic sectors.

1.2.6. Health factor:

Health is a global necessity and a fundamental right for both humans and animals. It is the basis of sustainability and is essential for preserving biodiversity and ecosystems.

1.3. Dimensions of sustainable agricultural development:

Sustainable agricultural development is achieved if the following conditions and dimensions are met:

1.3.1. Environmental safety:

This means preserving natural resources and increasing the vitality of the entire agro-ecosystem. In other words, it is employing local resources in a way that reduces the loss of nutrients and prevents pollution. In this context, focus is placed on the use of renewable energies. (Saad Hamdi, 2017, p. 14)

1.3.2. Economic Feasibility: (Sarah & Amina, 2017)

- That farmers should be able to produce enough to achieve self-sufficiency or profit management or both.
- Obtaining sufficient revenues to cover labor costs and production requirements.
- Reducing risks and conserving resources.
- Economic feasibility is not measured by direct production only, but by conserving resources and reducing risks.

1.3.3. Social Justice:

Social justice is achieved through the distribution of resources and productive capacities in a way that meets the basic needs of all members of society and guarantee their rights, land use, adequate capital, technical assistance and marketing opportunities (Talbi & Aiche, 2010, p. 60). It is also achieved through farmers achieving self-sufficiency and achieving a certain amount of profit. (Rabiaa, Benazza, & Labdi, 2022, p. 119)

1.3.4. Attention to human requirements:

This means the respect for all forms of life and basically acknowledging the dignity of all human beings and respect for relationships and legacies as well as respect for basic human fundamental values such as trust, honor and cooperation (Saad Hamdi, 2017, p. 14) .

1.3.5. Adaptability:

This implies that rural communities should be able to adapt to the continuous and impactful changes in the agricultural sector (Karouch, 2019, p. 523). For example: population growth, policies, Market demand...etc. This includes the development of appropriate new technologies and the ability to innovate in the social and cultural fields (Sarah & Amina, 2017, p. 71)

These standards may conflict or differ from the farmer's and community's point of view. There may be a conflict between current and future needs, and between meeting immediate needs and preserving the resource base and the farmer may seek to obtain a high income by raising the prices of agricultural products while the national government gives priority to providing an adequate amount of food at affordable prices (Talbi & Aiche, 2010, p. 61)

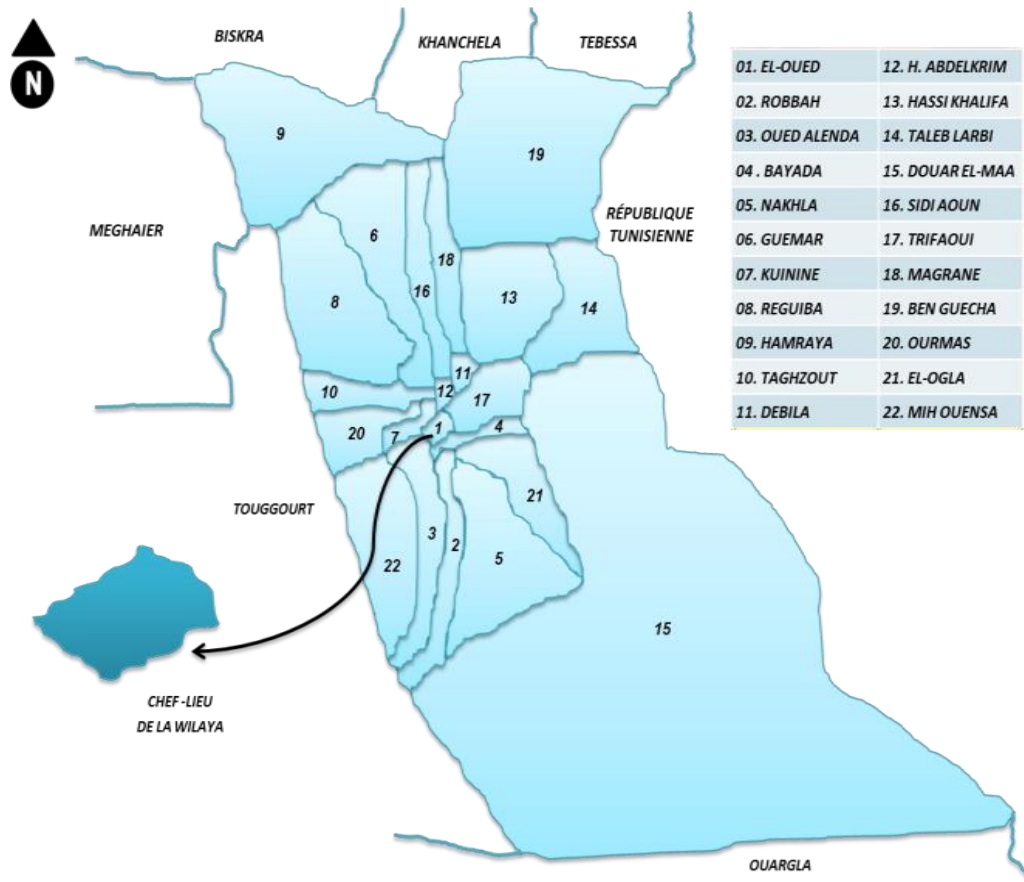
2. Elements of agricultural development in the state of Oued Souf

2.1. Geographical location of the state:

The Oued Souf is a known Algerian province. The Oued Souf is located in the northeast of the Algerian south. (Mokhnane, Adjlane, & Khiari, 2023, p. 06)

El Oued is the 39 the wilaya of Algeria, its capital is El Oued city, which is known as a thousand domes and a dome, and it was established after the administrative division of 1984, it is located in the southeast of the country. The region spreads over an area of 35,572 Km², and its population at the end of 2021 reached 716905 people, bordered to the north by Khenchla, to the northeast by Tebessa, to the northwest by Al-Mughayir, to the west by Tougourt, and to the southwest by Ouargla. It has a land border of 260 km of distance from the Republic of Tunisia. (Directorate General of The DPB Budget, 2021, p. 04)

Figure 1. Geographic location and administrative boundaries of El Oued



Source: Monograph of El Oued, 2021.

2.2. Elements of agricultural production in the state of the valley

Despite its dry desert climate, the state of El-Oued is rich in resources and great potentials that have contributed to making it a leader in the production of many agricultural products at the national level. In the following, we will try to present the various elements of agricultural development in it, mainly represented in natural, human and water resources.

2.2.1. Natural potential:

- Farmland:

Land resources constitute an essential and important element for agricultural development. Land is one of the main determinants of agricultural production. The process of inventorying the available land resources and knowing how to use them is

the first step necessary for proper planning to achieve agricultural development (Rabab A. M. & Hossam Eldeen, 2022, p. 166)

The area of Oued Souf covers an area of 35,752 square kilometers, or 1.5% of the country's total land area. It is part of the vast and rich Southeast region. It is also one of the most important major cities at the national level . (Directorate General of The DPB Budget, 2021, p. 02)

As for agriculture, it occupies an area of 51,000 hectares, what made it a pioneer desert agricultural pole in the production of many agricultural crops .The area of agricultural lands in Oued Souf has witnessed a continuous increase from year to year .This increased the dynamism of agricultural development in the region .The area of land used for agriculture (S.A.U.) increased from 90,000 thousand hectares in 2015 to 105,500 thousand hectares in 2019, to reach 105,600 thousand hectares in 2020. (Directorate General of The DPB Budget, 2021)

- Climate:

Knowledge of climatic characteristics is of importance to all human studies because of the impact of climate on human activity, as it is considered the main controlling factor in agricultural activity, as well as in the preparation processes.

El-Oued has a dry desert climate characterized by cold winters and hot summers. The temperature is variable in the summer. Precipitation is very low .In 2022, the total precipitation throughout the year was about 45.9 mm..The rainiest month is January with a precipitation rate of 13.9 mm. As for temperatures, they are generally very high. In summer, temperatures exceed 40 °C under the shade, while in winter they drop to less than 12 °C. (Directoral General of The D.P.B Budget, 2022, p. 06)

- Water resources:

Water resources are one of the main foundations for development, given its direct relationship to human biogeological, economic and social activities. (Rabab A. M. & Hossam Eldeen, 2022, p. 167)

Groundwater is the only water source of nutrition in the Oued Souf province, due to the lack of surface streams such as valleys and rivers, and groundwater consists of three layers (Djawadi & Other, 2021-2022, pp. 60-61) .

- **Surface water layer:** Depth of 1-60 m.
- **Middle water layer:** The depth of this layer is 100-400 m.
- **Deep water layer:** The depth of this layer ranges from 1400-1800 m, which is the source of the artesian water.

The state of Oued Souf contains more than 38,000 wells of directed surface water directed to basins and seasonal crops .As for the water of deep and medium wells, there are 400 wells intended for agriculture. Out of 620 wells, 23 of them are deep wells, with a depth of 2000 m , and flow rates over 360 liters / second in single well (Seaad, 2021, p. 71)

2.2.2. Human capabilities:

The population factor is one of the important factors affecting the agricultural activity .They are the workers and the consumers, and through them the volume of consumption and demand is determined. Production increases as a result of increase in demand arising from the increase in population (Hussein Ja'az & Ruqaya Fadhil, 2018, p. 774)

The state of Oued Souf witnessed a remarkable development in its population, as it increased from 791,000 in 2015 to 846,000 in 2017. In 2021, the population increased to 716,905 people. This increase was accompanied by a fluctuating increase in the total labor force, as it increased from 259,943 in 2015 to 328,540 in 2019, to reach 455,252 in 2021. This employment is distributed among the various economic sectors, as the labor force balance indicates that the agricultural sector includes the largest percentage of employment, as indicated in the following table:

Table 1. Employment in the agricultural sector

	2015	2016	2017	2018	2019	2020	2021
Total population	791000	820000	846000	873200	900000	925000	990000
total labor force	259943	251102	284533	340024	328540	368059	220556
the agricultural sector	126055	128580	284533	143771	139600	134360	96100

Source: Directorate of Agricultural Interests, El Oued 2023.

The increase in the labor force in the agricultural sector reflects the strategic direction adopted by the state of Oued Souf towards the agricultural sector, as this is due to several factors, including (Seaad, 2021, p. 73)

- Easy access to water;
- Poor technological development in the sector, which is compensated by abundant labor force;
- Availability of agricultural land through the two schemes of reclamation and agricultural concession.

3. The contribution of desert agriculture to sustainable agricultural development in the state of Oued Souf

Despite the difficult desert climate of the region, it was not an obstacle to the development and diversification of agricultural production, both plant and animal.

3.1. Plant production :

Agricultural production in Oued Souf has experienced a remarkable development, due to policies based on agricultural development programs and agricultural reclamation, which helped the emergence of products that were not known in the region such as peanuts, grains, olives, and potatoes, and crops, which is what the following table indicates:

Table 2. Evolution of plant production

unit (area: hectare, production: quintal)

	Agricultural season									
	2017/2018		2018/2019		2019/2020		2020/2021		2021/2022	
	area	production	area	production	area	production	area	production	area	production
Dates	14991	1271080	15129	1167382	15238	1185104	15374	1216669	15402	1223200
Cereals	11841	283276	9833	266618	7479	208493	8966	264064	8050	131405
fodder	1921	261500	2584	360289	1984	290660	1934	438040	2114	497130
Industrial crops	5050	140910	5285	148770	5210	149125	5474	161810	5504	164358
peanuts	3240	97470	3405	104805	3380	104200	3946	124000	4003	127000
Field Crops	48173	15874922	49666	17124406	49090	17249967	48686	19257500	51893	17278600
Potato	36123	11335300	36948	12123300	36482	11959090	36199	12939100	40200	12050500
Tomato	3042	2103990	3298	2339010	3823	2627210	4365	3292230	3680	2550000

Source: Directorate of Agricultural Interests, El Oued 2023.

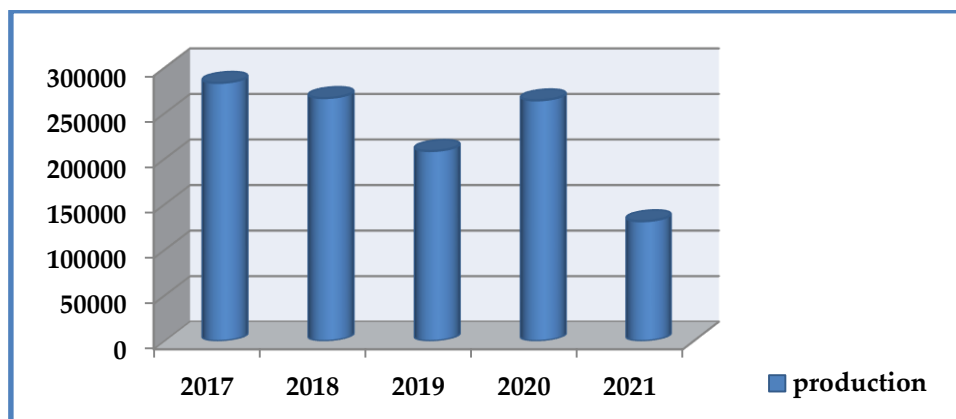
Through the data of the previous table, which indicates the development of plant production, we note that the region of El Oued, despite its fame for the production of dates, However in recent years, it has known the production of several field crops which made it among the most important agricultural poles at the national level. Of which :

3.1.1. Cereal:

The grain crop is considered the main food for the population in Algeria in general, and we especially mention hard wheat and soft wheat, while barley is considered as animal feed (Nassib & Jamal, 2017, p. 42)

The state of El-Oued is considered to be new to the cultivation of grain as a result of the desert nature. The region witnessed the first experiences in the nineties of the last century. It achieved a quantum leap in grain production that had not been witnessed before, especially in recent years. This is due to the efforts made by the state and farmers, especially when acquiring production factors such as seeding, fertilizing and weed control equipment (Nassib & Jamal, 2017, p. 43). The following figure shows the development of grain production, which reached its highest levels in 2018, with a production volume of 283,276 quintals.

Figure 2. The development of grain production in the state of Oued Souf

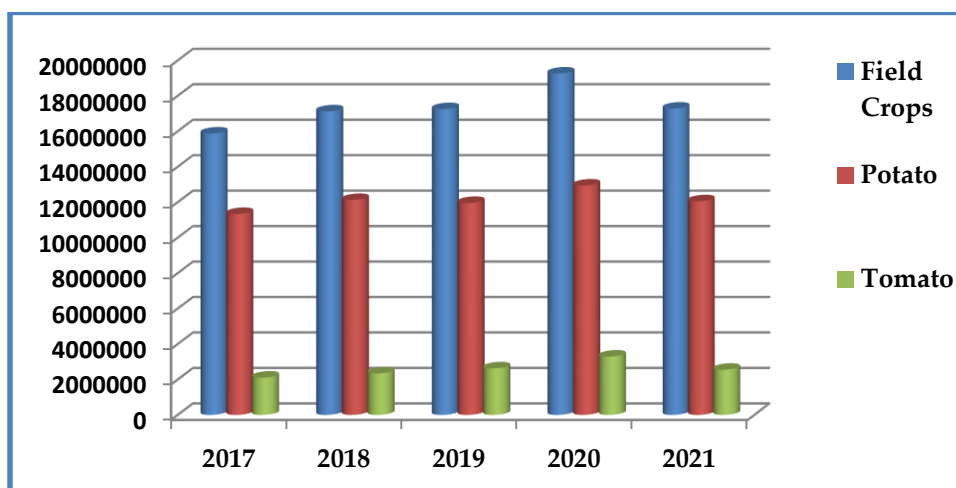


Source: Prepared by the researchers based on table2.

3.1.2. Field cultivation:

It is considered one of the important crops due to its association with human daily food. As for production, it has also witnessed an increase from year to year, with an increase in the total area cultivated for field crops. It increased from 15,874,922 quintals in 2017 to 17,278,600 quintals in 2021 as shown in the following figure:

Figure 3. The evolution of field crop production



Source: Prepared by the researchers based on table2.

Field crops vary in the region, but we will mention the most important and widespread ones:

- Potatoes:

Despite the difficult conditions of the region, the potato crop has become one of the main crops in the Oued Souf region. The municipality of Tahazout was the first to grow this crop in the nineties .In the beginning, it was a subsistence crop, until it became a production offered in the national and international markets.

The reason for the spread of this crop is due to several reasons, perhaps the most important of which are:

- Possibility of planting it twice in one agricultural season: early in September, and late in March.
- Soil suitability
- Quick profit.
- Lack of entry and exit barriers for this type of agriculture.

The state of El- Oued ranks first nationwide in the production of this crop. Production witnessed an upward trend from year to year, as it increased from 11,335,300 in 2017 to 12,939,100 in 2020. This increase in the volume of production is due to the agricultural reclamation policy pursued by the state in the region.

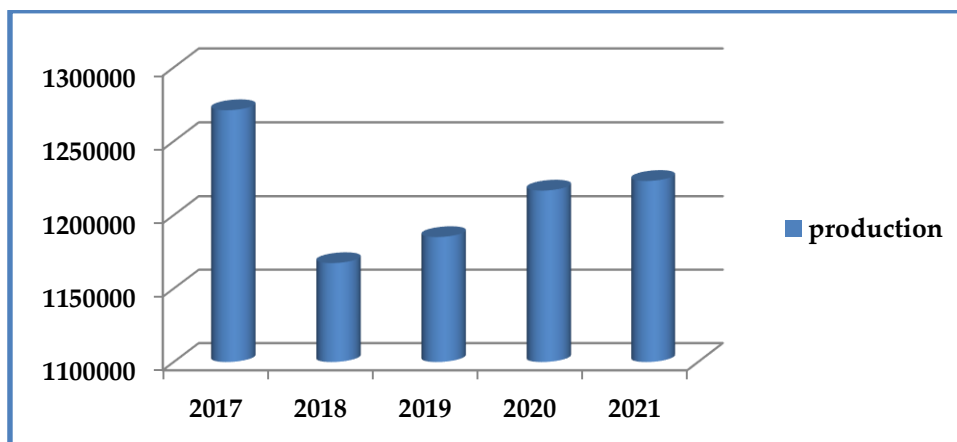
- Tomatoes:

Tomato is one of the most important field products in El Oued Province .The production of this crop has known fluctuations, as shown in Figure 4.The volume of production in 2017 was estimated at 2,103,990 quintals, to rise in 2018 to 2,339,010 quintals, to decline in 2019 to 2,627,210 quintals.

3.1.3. Dates production:

Palm cultivation in the Souf society is distinguished from the rest of the desert states by unique characteristics .It is considered one of the most important economic resources for the population of the state since the establishment of the state (Zouheir & Yousef, 2021, p. 268) The state of Oued Souf holds the second place after the state of Biskra in the production of dates ,The development of date production in the state of El-Oued can be illustrated through Figure 4, which indicates that the largest production volume achieved by the state was in 2018, with a production of 1,271,080 quintals.

Figure 4. Evolution of Date production in El Oued



Source: Prepared by the researchers based on table2.

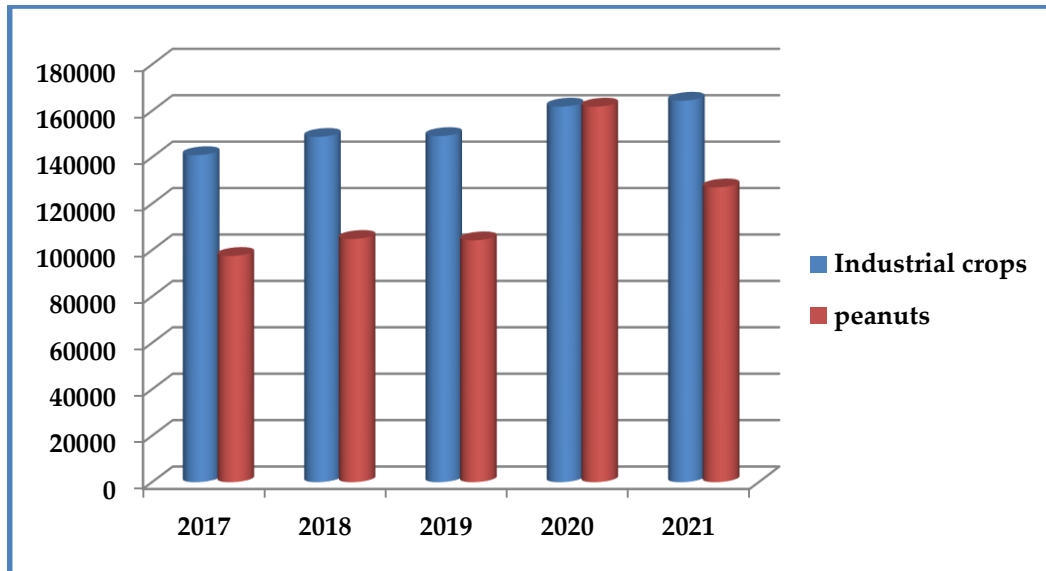
3.1.4. Industrial crops:

The state of El-Oued has been cultivating industrial crops through the cultivation of peanuts and tobacco since the colonial period. , These crops were mainly grown in the regions of Reguiba and Gumar. (Mohamed & Brahim, 2018, p. 170)

As can be seen from figure 5, the output of industrial crops rose at an increasing rate from 140,910 quintals in 2018 to 164,358 quintals in 2021. Alongside this growth,

there was also a rise in the volume of peanut output, which went from 97,470 quintals in 2018 to 127,000 quintals in 2021.

Figure 5. The development of industrial agriculture



Source: Prepared by the researchers based on table2.

3.2. Animal production:

Livestock is an integral and complementary part of agriculture in desert areas and has always been associated with water resources like other sectors.

Where livestock in Oued Souf has known in recent years a continuous increase as a result of the policy pursued by the state in this area, by allocating large financial provisions to farmers to increase their livestock and products, which is shown in the following table:

Table 3. Animal census in the region of El Oued

Species	278sheep	Cows	Goats	Camels
2017	530800	22228	421900	4101
2018	604500	24367	389700	44110
2019	608530	20533	375900	53720
2020	623300	20522	357380	53825
2021	638550	22891	338400	54000
2022	641400	19400	200200	54000

Source: Directorate of Agricultural Interests, El Oued 2023.

Through the table shown above, we notice that animal production in the state of El Oued has witnessed a continuous increase in recent years, especially in the breeding of sheep and camels, with some fluctuation in the breeding of goats and cows. This is a result of governmental strategy in this area and the provision of significant funding for development. Additionally, Oued Souf state's cattle population is growing, as is the propensity to invest in this industry.

3.3. Animal products:

Animal products in the Oued Souf have been on the upward trend in recent years, especially in the production of red and white meat, with some fluctuations in milk production, as can be seen from the table below:

Table 4. Animal products

Types	Red meat	White meat	Milk(m ³)Litre
2012	105624	5759	31600
2013	109940	15438	31700
2014	123000	20000	32500
2015	127655	21570	32800
2016	148780	38815	33800
2017	149000	54700	35500
2018	152600	63188	33400
2019	159000	64890	32550

Source: Directorate of Agricultural Interests, El Oued 2023.

Conclusion:

Desert agriculture in El Oued province is a national achievement that needs more support and guidance .The agricultural sector has achieved very significant results in terms of animal and plant production ,despite the difficult and harsh climate .The agricultural sector contributed a significant percentage of the national production This made the state ranked second nationwide ,in addition to being ranked first in the production of potatoes, peanuts and tobacco .This suggests that, in the event the state

utilizes its agricultural capacities in a more sensible and rational manner, it can rank first nationwide .Accordingly, the study recommends:

- Expanding the reclamation of agricultural lands in the state.
- Preserving the water resources in the state and rationalizing its use through the use of modern irrigation methods in order to provide additional quantities of water for agricultural development.
- Overcoming all the obstacles that the farmer faces from in the state of Oued Souf, by providing technical and material assistance to achieve sustainable agricultural development in the state.
- Directing farmers wards the practice of healthy and environmentally friendly biological agriculture.

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