The modern agricultural technology as an imperative to achieve the food security and well-being in Algeria amid the global developments

التكنولوجيا الزراعية الحديثة كحتمية لضمان تحقيق الامن الغذائي و الرفاه في الجزائر في ظل المستجدات العالمية .

Bouchenaf Faiza [1]

Mohammed Cherif Messaadia University , Souk Ahras - Algeria

f.bouchenaf@univ-soukahras.dz

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Abstract:

The topic of this study raises the issue of achieving the food security. In this line, the last crises and the increase of the demand on food worldwide pushed many states, including Algeria, to adopt many agricultural developmental policies through supporting, encouraging, and reinforcing technology in the agricultural field as a fatal mechanism to achieve the food security Based on what was said, we used the descriptive analytical method and found out that the radical solution for a sustainable food security in Algeria is increasing and improving the productive capacity of the crops through the orientation towards the smart agriculture that depends mainly on the modern technological tools and the Artificial Intelligence systems.

***Keywords**: Food security; agricultural technology; smart agriculture; agricultural development.*

الملخص :

يثير موضوع الدراسة قضية تحقيق الأمن الغذائي ،حيث ومع الأزمات الأخيرة و تزايد حدة الطلب على الغذاء في العالم ، اتجهت الجزائر مثلها مثل العديد من الدول إلى تبني عدة سياسات تنموية زراعية ، من خلال تشجيع و دعم و تعزيز التكنولوجيا في المجال الزراعي كآلية حتمية لتحقيق الاستدامة في الأمن الغذائي، و لغرض ذلك تم الاستعانة بالمنهج التحليلي الوصفي ، و توصلت الدراسة إلى أن الحل الجذري لضمان أمن غذائي مستدام في الجزائر هو لابد من زيادة و تحسين الكفاءة الإنتاجية للمحاصيل ، و لن يتحقق ذلك إلا من خلال التوجه نحو الزراعة الذكية و التي تعتمد أساسا على التقنيات التكنولوجية الحديثة المدعومة بأنظمة الذكاء الاصطناعي.

كلمات مفتاحية :الأمن الغذائي، التكنولوجيا الزراعية ، الزراعة الذكية ، التنمية الزراعية .

1. INTRODUCTION

Covid-19 and the Ukrainian war proved the importance of achieving the food security for the states that rely on exporting the agricultural crops and the consumption products, such as Algeria. In this context, the lockdown during the pandemic hindered the supply chains and affected the trade of the agricultural products and food. Then, the Ukrainian war deprived the world states of the biggest share of the cereals, agricultural crops, and the food products because Ukraine and Russia together make the biggest share of the food exports. According to the estimations of the International Institute of Resources in USA, the international demand on food shall increase with 56% in 2050

[1] - *Corresponding author: Bouchenaf Faiza , e-mail: f.bouchenaf@univ-soukahras.dz*

due to the demographic growth and the change in the food habits. Thus, the world will have to feed 02 billion additional people, with an increase of 25% of the current world population.

Undoubtedly, the agricultural sector of many states, including Algeria, faces issues and challenges such as the climatic changes, drought, desertification, water shortage, etc that make it difficult to achieve food security and safety. In addition, the non-adoption of the technological tools of the agricultural field increases the issue. Thus, changing the agricultural activity to adapt with the climatic changes is a necessity. Furthermore, the adoption of the organic agriculture and the modern technologies in the agriculture is inevitable.

Based on what was said, we raise the following problematic, "to what extent is adopting the modern agricultural technologies important in achieving the food security in Algeria?" To answer this question, sub-questions arise as follows:

- What is meant by the food security? And what is the difference between it and the self-sufficiency?
- What are the policies of adapting the agricultural sector in Algeria to achieve the food security?
- What are the efforts undertaken by the Algerian state to achieve the food security?

Hypotheses of the study:

- The food security is among the priorities of the economic policies of various states, and the self-sufficiency is the 1st steep towards it.
- The agricultural sector in Algeria suffers and faces many challenges such as the climatic changes, drought, desertification, water shortage, etc that raise big challenges in front of the food security and safety.
- Most of the agriculture in Algeria is based on traditional practices and face the unexpected climatic changes. Therefore, it is necessary to adopt a clear strategy in the agricultural field to achieve the food security in the region.

Method of the study:

In order to cover our topic, we used the analytical descriptive method that describes and narrates the status-quo of the food security in Algeria and the various related concepts. Besides, we shed light on the ability of the government to apply the practices and requirements of the modern agricultural technology to achieve the target goal and face the climatic changes. In addition, we analyzed some indexes related to the food security to find results and make suggestions and, thus, evaluate the efficiency of the agricultural development policies adopted in Algeria to achieve a sustainable food security.

Importance of the study:

In the light of the efforts made by the Algerian government to get rid of the dependency on the oil and diversify its economy, the agricultural sector is very important as it can guarantee the food security for a sustainable economic development. Due to the problems faced in the Algerian agricultural sector such as the climatic changes, drought, desertification, and water shortage, technology can play a big role as a mechanism for protecting the agriculture.

The structure of the study:

- The relation between the food security and the modern agricultural methods (theoretical frame).
- The status-quo of the Algerian economy in the light of the dimensions of the food security.
- The efforts of the Algerian state to achieve the food security.

2. The relation between the food security and the modern agricultural methods (theoretical frame):

The issue of the agricultural sector worldwide comes from the scarcity of the water resources

and the climatic conditions that degrade the lands. Besides, maintaining a good level of food security requires developing sustainable tools for long-term storage and production.

2.1 The concept of the food security:

It depends on the circumstances of the society. This term is used in the developing states that face big issues in the production size. Therefore, the concept of the food security becomes very deep and depends on a set of complementary items. In this line, it includes various terms and concepts such as:

- It is the situation where the food self-sufficiency is achieved based on the state's ability to provide the needs of all the individuals regarding the nutritional products thanks to the local production (Al Sariti, 2000, p. 10).
- FAO defines the food security as the availability of the physical, economic, and social potentials for all humans to get enough healthy food that provides the necessary food elements for a healthy life (FAO, 2003, pp. 13-20).
- FAO defines the sustainable food system as any system that provides food security and nutrition for everybody without affecting the economic, social, and environmental bases needed for achieving the food security for the future generations (FAO, 2021, p. 26)
- UNICEF defines the food security as the material and financial ability of the families to guarantee the provision of one enough food for the whole family to get the maximum energy (physical and intellectual to produce and reproduce) (UNICEF, 1993, pp. 144-145).
- The Algerian law defines the food security as regularly getting and having access to enough safe food that allows an active life (official gazette, 2008, p. 06).

From these definitions, we deduce that food security implies:

- The availability of food quantitatively and qualitatively.
- The ability to get food.
- The conditions of a healthy nutrition.

In this context, the food security does not mean the self-sufficiency. We may find a state that works on the diversification of the import source and the increase of the local agricultural production and, thus, achieve the food security. On the other hand, it relies on big imports and, thus, does not achieve the self-sufficiency (Mustafa, 2022). Therefore, we can define the self-sufficiency as the ability of a state to independently provide the food needs of its people. This ability can be determined through the food self-sufficiency index that takes into consideration a sample of the crops consumed by the families and all the foods available, including those meant for the external market (MINPAT/SIDA, n.d., p. 03). Consequently, the food self-sufficiency is a quantitative concept that can be measured as follows (Abdouche, 2000, p. 19):

$$\text{Self sufficiency} = = \frac{Self-sufficinecy}{Food\ Abudance} \text{ X } 100$$

2.2 The main principles for food and agriculture sustainability:

FAO developed a common vision and complementary method for sustainability in agriculture that can be summarized as follows:

- The improvement of the competency in the use of the resources is a core point for the sustainable agriculture.
- The sustainability requires taking a direct measure to protect and reinforce the natural resources.
- The individual, society, and ecological systems' reinforced ability to resist is among the necessary points of the sustainable agriculture.

- Sustainable agriculture and food require efficient and responsible governance mechanisms.
- The agriculture that fails in improving the agricultural living conditions, equity, and social well-being is not sustainable (The strategic program of FAO).

2.3 The modern technological methods used in agriculture:

Agriculture became digital starting from 2020. In addition, the farmers got innovative solutions to increase productivity and widen the benefits of the agricultural crops. Researches show that the international market of the agricultural robots shall jump from 4.1 billion USD in 2018 to 10.1 billion USD in 2021. Hence, the agriculture machines and the technological tools are the solution. The technological tools include:

- **Soil DNA test:** It helps test the soil and choose the microbium and the organic substances to analyze the health standards and take a better care of the soil. For instance, Agtech Company uses the soil DNA test to identify the insects, worms, bacteria, viruses, and the other causes of soil diseases. In addition, it predicts and bans the crops damages (Al Sahli, 2020).
- **Smart sensors:** The sensors that are developed in quantities are efficient regarding the costs and help control the humidity levels, evaluate the density of the soil, draw the crops maps, document and know the harvest time, and provide many data about the lands. Thus, the sensors help find better solutions and correctly manage what happens (Al Ali, 2023).
- **The genes:** the analysis of the genes spread during 2020 to discover and analyze many hereditary diseases of the plants (Al Sahli, 2020). The analysis of the genes paved the way for big horizons in agriculture to solve many chronic issues that were handled with traditional costly and polluting methods.
- **The use of drones:** Drones help trace and evaluate the crops, photograph the agricultural lands, draw the maps, measure the air components, identify the damaged plants to remedy them, and rapidly and safely spray pesticides and fertilizers with a rate of 40 to 60 times faster than with the hands (Zaher, 2020). In this line, it is expected that the drones market in agriculture shall reach 480 million USD in 2027 (Al Rawi, 2020).
- **The use of robots in the smart agriculture:** This shall be in the innovations related to the crops such as the use of the automatic harvesters, or in fighting the herbs that cause diseases. The robots work continuously, collect a high amount of data, and execute lot of tasks. This paves the way for increasing the production horizons, improving the quality, and limiting the use of fertilizers and herbicides (Ben Moussa et al., 2022, p. 363).
- **Auto-drive tractors**: This technique does not need labor force because these tractors do all the agricultural work from plowing the land until the harvest. In addition, there are no fears regarding the public safety and security because the work does not include people or other vehicles (Nazi, 2017).
- **Smart monitoring system**: The smart systems continuously monitor and analyze the behavior of the farm animals, for example. This gives the farmers an exact image about the animals' state (Soudani et al., 2022, p. 458).

2.4 The effect of the modern agricultural technology:

We can sum up these effects in these two levels:

- **On the health of the crops**: The new light sensors measure the light reflection on the agricultural crops and translate the nitrogen levels. Besides, the electronic control units that are connected with the sensors show the correct quantity of nitrogen and the other vital elements the crops need. This contributes to a high quality of the crops.

On the health of the soil: The sensors are used in measuring the features of the soil, the height of the land, the content of the organic substance, and the suitable hydrogen number for the health of the soil. Besides, they can discover the regions that suffer malnutrition that cannot be known by the

normal eye. Besides, they control the humidity levels (Al Ali, 2023).

3. The status-quo of the food security in Algeria:

The Algerian government works hard to cope with the developments of the digital agriculture. In this regard, it supports the smart agriculture through giving a big importance to the scientific research in Agriculture. Besides, it sheds light more on the agricultural innovations by urging the farmers to connect the lands with the digital techniques by 2024 to achieve the food security.

3.1 Algeria relies on the modern agricultural technologies as a mechanism to support the agricultural sector and reinforce the food security:

Algeria gives big importance to the scientific research on agriculture and encourages the youths to adhere to the agricultural programs. In the light of the continuous debate about the increase of the food prices, the economic strategy supports the local agriculture mainly in the Saharan region. Besides, it supports the youths to establish small projects to provide the necessary food products for the citizen. In a report by the World Food Security Program of the UN, Algeria ranked the 1st in Africa regarding the food security with a rate of 63.9. This makes it part of the states that can support the efforts of the UN program that aims at achieving "zero hunger" by 2030.

The contribution of agriculture to the GDP amounts up to 13%, i.e., around 25 billion USD. This rate may be increased if the smart agriculture is supported to widen the irrigated lands and improve the good exploitation of the lands (Saad, 2022). In this line, the government promised to redouble the numbers through supporting the smart agriculture. In addition, the future plan aims at developing the agricultural sector in the rural areas, supporting the fruits and vegetables, shedding light on the role of the owners of the small size projects, and providing the facilities to the youths who want to invest in agriculture. The Ministry of Higher Education and Scientific Research set a new work plan that aims at establishing two national schools for agriculture to link the agricultural projects with the modern scientific researches. Furthermore, the smart agriculture takes into consideration the rapid growth in technology through vulgarizing the renewable energies in irrigation and using the solar energy instead of the oil engines to provide about 15% to 40% of the energy (Allal, 2022).

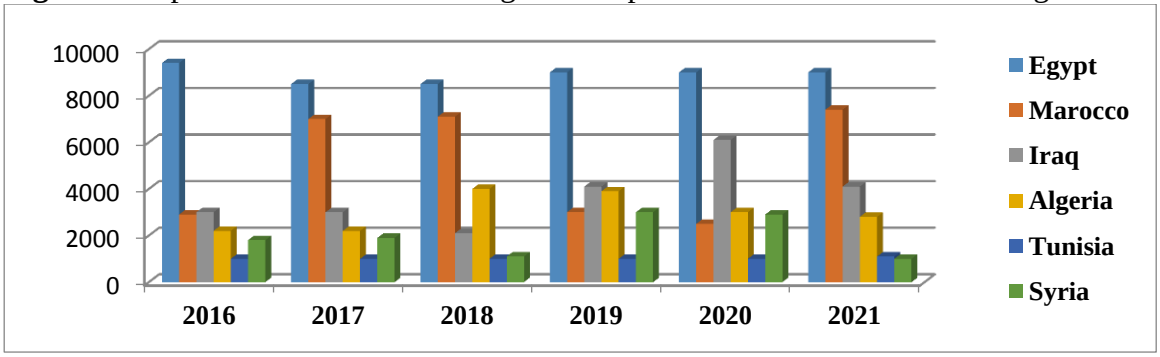
3.2 The state of the food security in Algeria during 2016-2021:

Providing food for everyone is among the food security axes. It expresses the ability of the state to provide the sufficient food supplies to the citizens, from its production or from the external markets. Here, we find that the cereals are among the most important goods in Algeria, as they take the lion's share of the lands. The cereals include:

3.2.1 The wheat:

It is consumed a lot in Algeria and is in the top of the most consumed products. In this regard, 94% of the wheat production in the Arab world is in 06 states including Algeria, which ranks 04th after Egypt, Morocco, and Iraq. In this context, Egypt ranked 1st in 2021 with a production of 9.02 million tons and a contribution of 33.1% of the wheat production in the Arab world. It was followed by Morocco 27.4%, Iraq 15.4%, Algeria 9.8%, Tunisia 4.16%, and Syria 3.84% (The Arab Organization for Agricultural Development, n.d., p. 15). The production of wheat in Algeria decreased with a rate of 13% in 2021 compared to 2020 due to climatic changes, the low level of rainfall, the water shortage, the drought, the desertification, and the temperature increase. Figure 01 shows the production of wheat in Algeria compared to some Arab states during 2016-202

Fig. 01. The production of wheat in Algeria compared to some Arab states during 2016-2021:

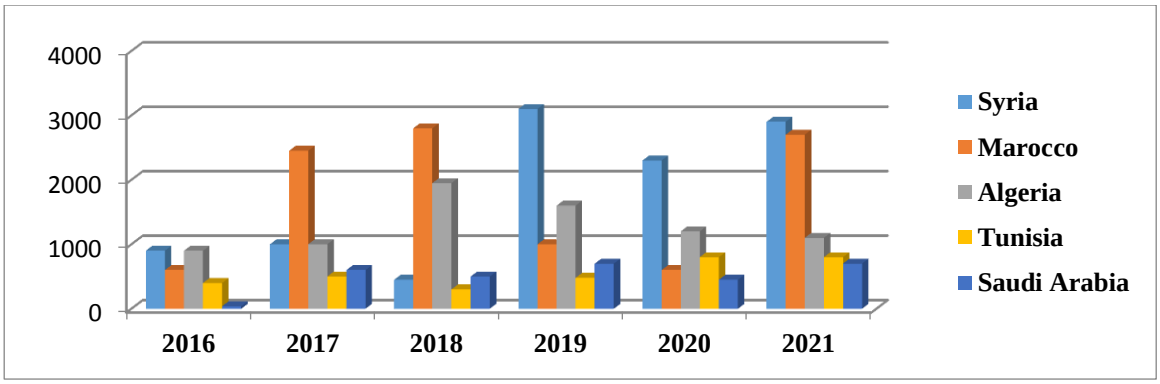


***Source**: The Arab Organization for Agricultural Development, the annual book of Arab agricultural statistics, different issues (2016-2021).*

3.2.2 The production of barley:

It is another important crop in Algeria as it is used in feeding the cattle and in some human foods. It ranks the 2nd after the wheat regarding the size. As for the production, Syria, Morocco, Algeria, KSA, and Tunisia together are the most important Arab states that produce it with a rate of 94% of the total production of the Arab region in 2021. In this line, Syria contributes with 33%, Morocco 31%, Algeria 13%, KSA 7%, and Tunisia 5% as shown in figure 02 (The Arab Organization for Agricultural Development, n.d., p. 19):

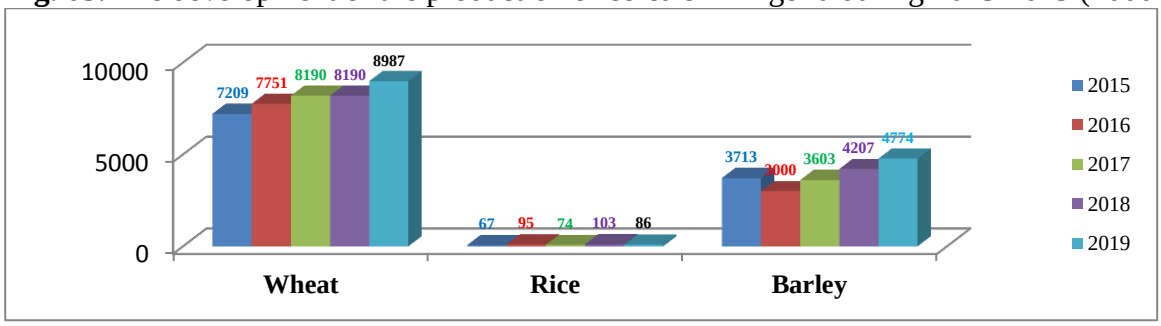
Fig. 02: The production of barley in Algeria compared to some Arab states during 2016-2021:



***Source**: The Arab Organization for Agricultural Development, the annual book of Arab agricultural statistics, different issues (2016-2021).*

Generally, we can say that the production of wheat witnessed an increase during 2015-2022 with 24.66% because it is the 1st food in the goods balance as it is the main source of the Algerians' food. As for the secondary cereals (barley), they are an important source for the cattle food. It increased considerably during the same period, reaching an increase with 28%. On the other hand, the production of rice in Algeria witnessed fluctuations during the same period. Figure 03 shows the development of the production of cereals in Algeria during 2015-2019:

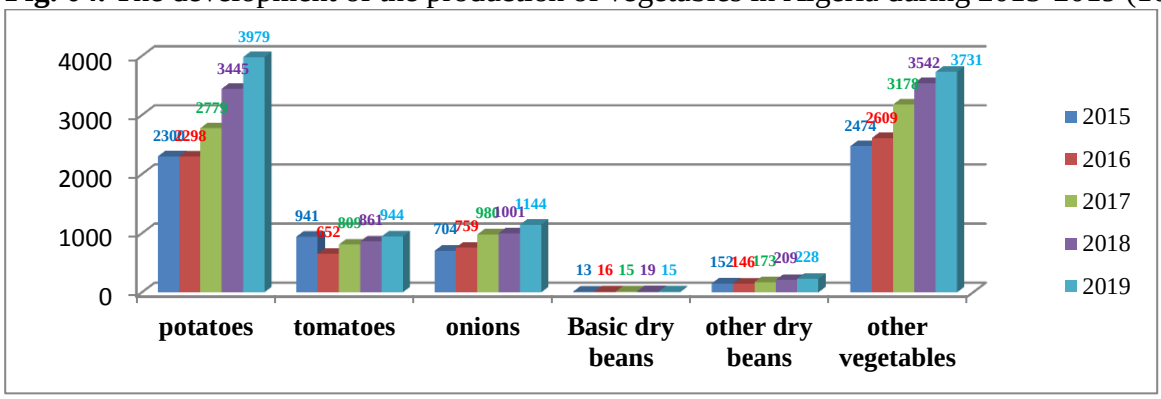
Fig. 03. The development of the production of cereals in Algeria during 2015-2019 (1000 tons):



Source: *made by the author based on FAOSTAT*

As for the vegetables, they witnessed a development all along the period. In this context, potato is the 04th in the list of the available quantities in the food balance. Its quantity increased with 2%. Besides, the onion increased with 63% while tomatoes witnessed fluctuations. Concerning the other vegetables, the quantity increased considerable while the dry cereals increased with 15% as shown in figure 04.

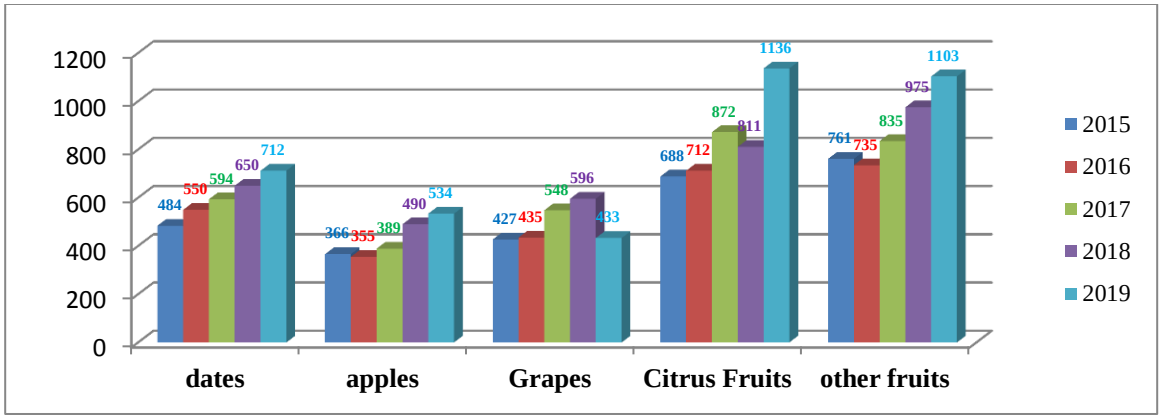
Fig. 04. The development of the production of vegetables in Algeria during 2015-2019 (1000 tons):



Source: *made by the author based on FAOSTAT*

Regarding the fruits, they increased with 40%. In this context, the citrus rank first with 65%, followed by dates 47%, apple 46%, other fruits 45%, and the grape 40%, as shown in figure 05:

Fig. 05. The development of the production of fruits in Algeria during 2015-2019 (1000 tons):

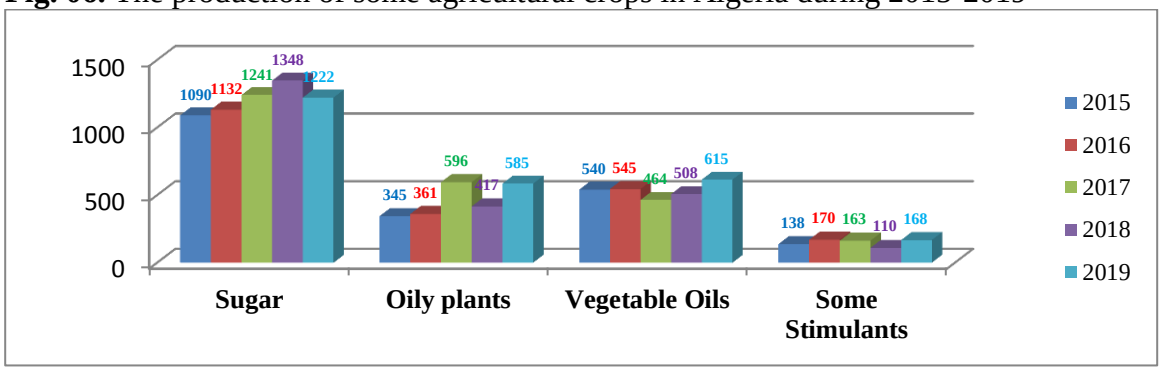


Source: *made by the author based on FAOSTAT.*

3.2.3 The production of olive and oilseeds:

The production of plant oils in the Arab world reached 4.07 million tons in 2021, with an increase of 7.8% compared to 2020. Algeria is among the important producers of the plant oils in the Arab region. Nevertheless, it is preceded by Sudan with 45.9%, Egypt 17.7%, while it, Tunisia, and Morocco together produce between 6% and 8.2%, according to the statistics of 2021 (The Arab Organization for Agricultural Development, n.d., p. 21). In general, most of the industrial crops in Algeria witnessed fluctuations during 2015-2019 because most of these substances are exports. Therefore, it is not possible to control their availability or prices. Figure 06 shows the production of some agricultural crops in Algeria during 2015-2019:

Fig. 06. The production of some agricultural crops in Algeria during 2015-2019

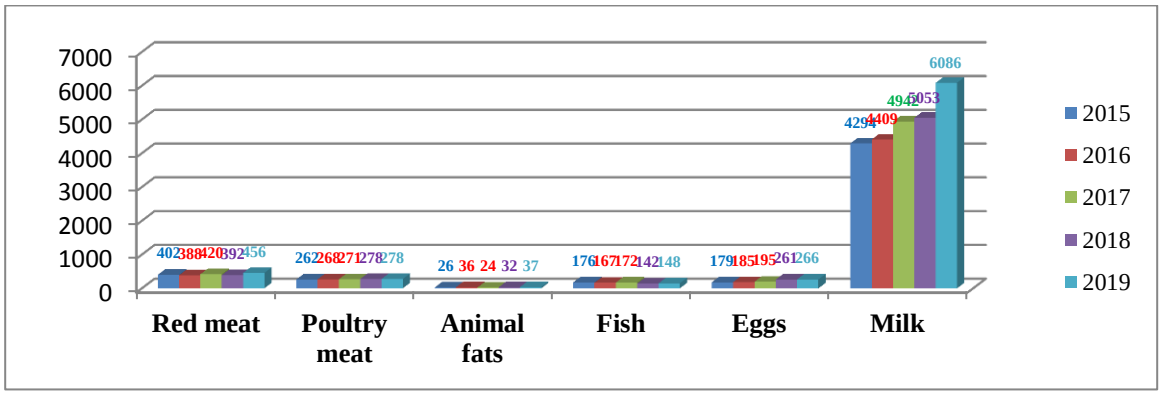


Source: *made by the author based on FAOSTAT*

3.2.4 The animal and fish products:

The animal and fish products represent two important sources for animal protein. In this line, the milk is the 2nd available substance in the Algerian food balance after the wheat because it is consumed by most of the age classes. The size of the milk kept increasing during the study period and rose with a rate of 2% during the study period. In addition, the eggs, chicken meat, and the fish witnessed fluctuations. They registered an increase of 13%. As for the fish, they decreased with 13.5% as shown in the following figure.

Fig. 07. The development of the animal wealth in Algeria during 2015-2019 (1000 tons)



Source: *made by the author based on FAOSTAT*

Generally speaking, the animal wealth in Algeria depends on the natural prairies and does not find the suitable systems to grow. As for the fish wealth, despite the big potentials than can achieve a surplus, there are big opportunities to increase the current production through the optimal

use of the available potentials that include the giant resources, the long coast, the water courses, the valleys, and the bays; in addition to the unexploited potential of fisheries until 2021.

3.3 Providing food as an axis of the food security in Algeria:

Providing food is a basis of the food security. It can be achieved through the charities such as the Algerian Red Crescent and some international organizations such as the Arabic Organization for Agricultural Development that provides food aid to some Arab states that face undesired circumstances.

3.3.1 The index of food availability in Algeria:

This index measures the sufficiency of the national food supplies and the risk of cutting the supplies, the national ability to distribute foods, and the various efforts to enlarge the food and the agricultural production. The Global Food Security Index GFSI classified Algeria in 2021 among the 1st states in Africa out of 113 states, as it achieved an additional balance of 10.7 points in the last 10 years, and ranked 43 internationally out of 17 states with a balance of 6.66 points. Based on the same index, there was a continuous development from 2012 to 2021 as shown in table 01:

Table 1. The food availability index in Algeria during 2012-2021 according to GFSI (0-100°)

Years	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Performance	53.2	51.3	57.4	58.2	62.9	63.5	63.3	67.7	61.6	63.9

Source: *The Global Food Security Index 2012-2021*

GFSI is measured based on 05 points:

- The sufficiency of the food supplies.
- The public expenditures on the agricultural researches and development.
- The agricultural infrastructure.
- The fluctuation of the agricultural production.
- The risks of the political instability.

In 2021, the mean FSI in the Arab world was 54.6° (it measured 14 states). It is less than the global mean of 56.7° as shown in the table:

Table 02: The FSI in Algeria compared to some Arab states during 2019-2021 (0° to 100°)

States	**Egypt**	**KSA**	**Qatar**	**Kuwait**	**UAE**	**Oman**	**Bahrain**	**Tunisia**	**Algeria**	**Morocco**	**Jordan**	**Syria**	**Sudan**
2019	74.3	70.7	69.5	60.0	66.8	63.9	56.2	59.6	**59.0**	51.9	51.7	42.4	37.5
2020	62.8	73	70.7	68.3	66.5	59.1	56.8	56.7	**55.7**	51.4	48.2	41.3	30.8
2021	60.0	67.8	74.4	72.3	71.3	57.3	67.5	54	**58**	51.8	55.2	30.1	31.6
Change between 20-21	4.5-	7.1-	5.2+	5.9+	7.2+	1.3-	18.8+	4.8-	**4.1+**	0.8+	14.5+	27.1-	2.6+

Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, Arab League, the annual book of Arab agricultural statistics, different issues (2016-221), p. 31*

The table shows that the index was between 27.6° and 31.6° in 2021 in Syria, Yemen, and Sudan; between 51.8° and 60° in Morocco, Tunisia, Jordan, Oman, Algeria, and Egypt; and between 67.5° and 74.4° in the rest of the states. Generally, we can say that there is a clear improvement in the FSI in Algeria between 2020 and 2021. However, it does not exactly reflect the situation because it does not show the real demand and consumption of the food products in Algeria.

3.3.2 The potentials of getting food and the affecting factors:

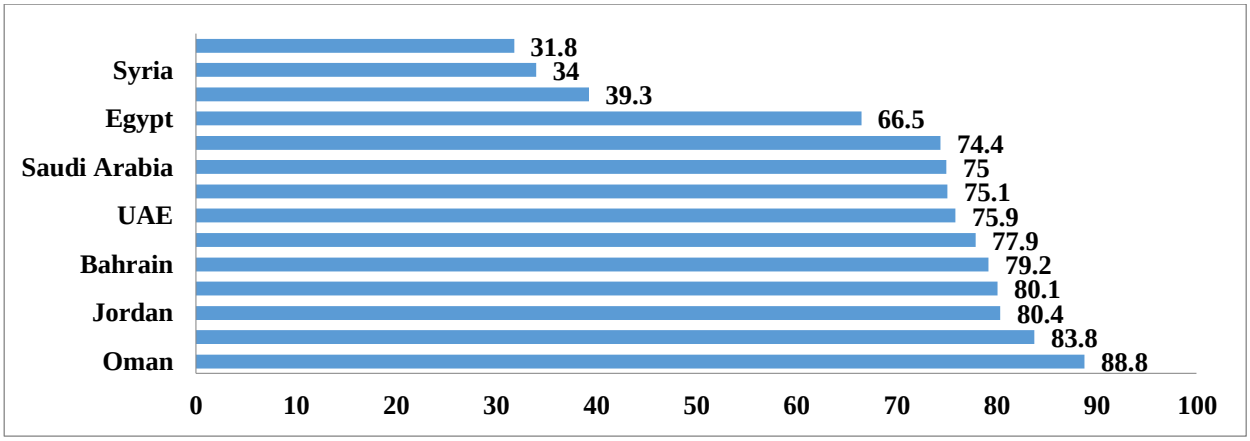
The potential of getting food is measured with the ability of individuals to satisfy their needs of the food products. Thus, it represents the demand by the consumers on the products according to their material abilities, and the factors affecting the potentials of getting the products. Among these

factors, we find the individuals, the prices, the demographic growth, the development of the food production, the development of the marketing systems, etc. The index can be measured through 06 secondary indexes as follows:

- The consumption of food as a percentage of the total expenditure of the family.
- The percentage of people living under or near the international poverty line.
- The GDP per capita.
- The customs taxes on the agricultural products.
- The programs of the food security nets.
- The potentials of farmers' access to funding.

Figure 08 shows the average value of the index of the potential of getting food in Algeria compared to some Arab states:

Fig. 08: the index of the potential of getting food in Algeria compared to some Arab states in 2021



Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, Arab League, the annual book of Arab agricultural statistics, different issues (2016-221), p. 32*

The figure shows that the potential of getting food in the Arab world in 2021 is higher than the rest of world. The value of the index is between 79° and 89° in Oman, Kuwait, Bahrain, Qatar, and KSA; between 66° and 78° in Algeria, Jordan, morocco, UAE, Tunisia, and Egypt; and between 32° and 39.3° in Syria, Yemen, and Sudan. In this line, as previously mentioned, there are various factors affecting the potential of getting food, mainly:

- **The income levels:** The statistics of the World Bank in 2021 show that the annual growth average of the individual income in Algeria improved in 2021 compared to 2019 and 2020. This fluctuation was a result of the decrease of the oil and gas revenues since 2014 and the various crises, including Covid-19.

Table 3: The per capita income in Algeria of the GDP compared to some Arab states in 2021 (1000 USD)

States	Egypt	KSA	Qatar	Kuwait	UAE	Oman	Bahrain	Tunisia	Algeria	Morocco	Jordan	Syria	Sudan
2019	3.02	23.45	62.09	32.37	42.7	17.7	23.55	3.57	**3.99**	3.24	4.41	0.92	0.76
2020	3.57	20.2	50.12	24.81	36.28	14.49	20.41	3.6	**3.31**	3.06	4.28	0.93	0.62
2021	3.88	23.59	61.28	28.59	39.49	16.44	22.23	3.92	**3.77**	3.5	4.41	0.9	0.76
Change between 20-21	8.7+	16.8+	22.3+	15.2+	8.8+	13.5+	8.9+	8.9+	**13.9+**	14.4+	3.0+	3.2-	22.6+

Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, the annual book of Arab agricultural statistics, different issues (2019-221), p. 31.*

The income level differs in the Arab world. In this regard, it is between 16.4 and 61.3 thousand USD in the Gulf States; 3.36 and 6 thousand USA in Libya, Iraq, Jordan, Tunisia, Egypt, Algeria Palestine, and morocco; and between 0.45 and 2.67 thousand USD in the rest of the states.

- The agricultural product per capita: The share of the individual in Algeria differs. However, it ranked 2nd in the Arab world after KSA during 2015-2021 as shown in table 04:

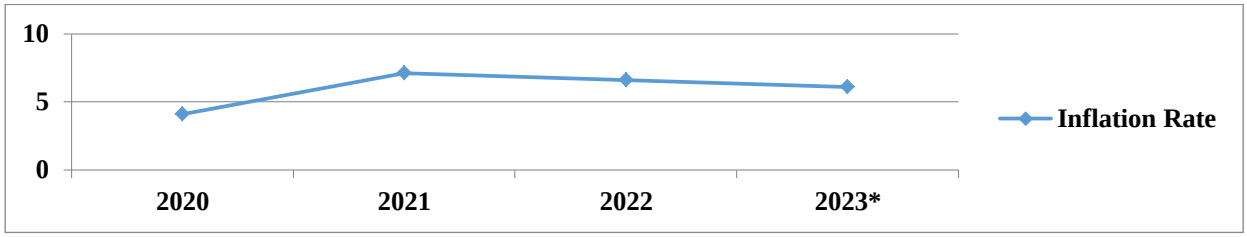
Table 04: The GDP per capita in Algeria compared to some Arab states in 2021

States	Egypt	KSA	Qatar	Kuwait	UAE	Oman	Bahrain	Tunisia	Algeria	Morocco	Jordan	Syria	Sudan
2018	280.17	519.16	120.69	149.33	315.09	367.92	69.38	363.12	**487.55**	400.5	208.7	199.4	347.7
2019	333.5	550.3	113.5	221.5	330.8	318.9	83.1	235.6	**477.1**	429	325.7	70.9	616.8
2020	285.4	568.1	118.2	216.7	340.9	345.9	86.4	201.5	**475.5**	419.9	368.6	70.6	473
2021	299.7	578.4	121.7	225.9	349.2	368.1	86.8	266.7	**480.1**	416.4	371.9	70.8	445.8

Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, the annual book of Arab agricultural statistics, different issues (2018-221), p. 31.*

- The prices of the food products: With the ascending trend of the international prices of the main food products between 2020 and 2021, the power of getting enough food with the desired quality and quantity was affected. Figure 09 shows the inflation rate in Algeria:

Fig. 09. The inflation rate in Algeria during 2020-2023



Source: *made by the author based on data of the World Bank (2020), URL https://data.albankaldawli.org, accessed on 10/05/2023.*

The decrease of the oil prices since 2014 and the following crises such as Covid-19 predicted an increasing inflation in Algeria and a deeper crisis. Thus, the purchasing power of the Algerians decreased.

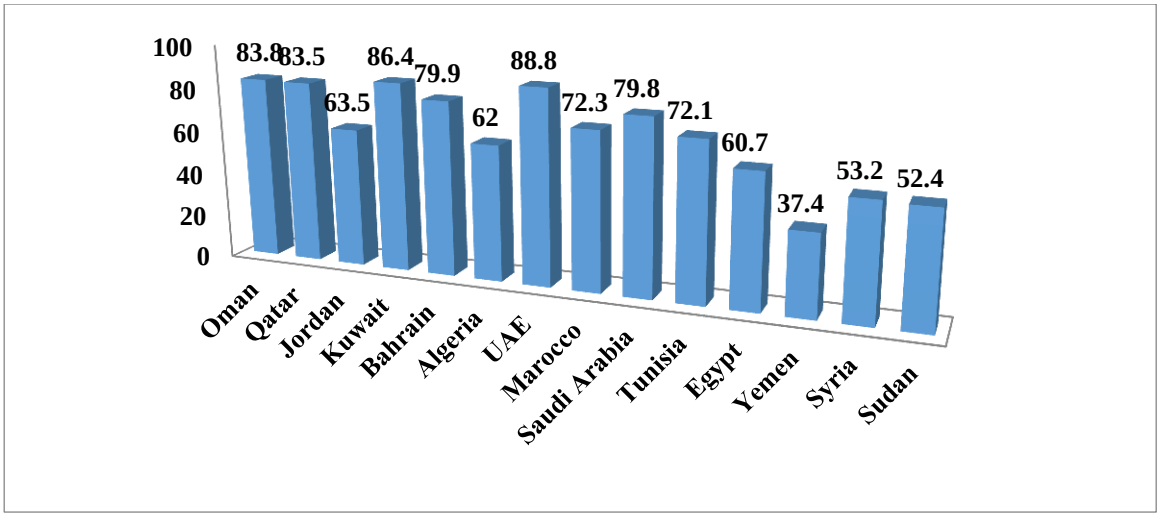
3.2.3 The index of the food safety and quality in Algeria in 2021:

The use of the food provides the body with the various elements it needs. The nutritional state of the consumer is defined based on taking enough food that contains energy, protein, fats, and small components, and on the suitable biological use of the consumed foods. In this context, the index of the food safety and quality is measured through 05 secondary indexes as follows:

- The diversity of the nutritional system.
- The governmental commitment to improve the nutritional situation.
- The availability of the small nutritions, the quality of the protein, and the food safety.

According to the components of GFSI in 2021, the index of the food safety in Algeria in 2021 was 62°. This is low compared to the Gulf States whose index reached 79.8° to 88.8°, morocco 72.3°, and Tunisia 72.1° as shown in figure 10.

Fig. 10. The index of the food safety and quality in Algeria compared to some Arab states in 2021



Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, Arab League, the annual book of Arab agricultural statistics, different issues (2016-221), p. 38.*

4. The status-quo and horizons of the food security in Algeria:

The world, mainly Algeria, has been recently making continuous efforts to guarantee the stability of the national food security through the strategies, programs, and projects of the food security.

4.1 The conditions of reinforcing the food security in Algeria:

The Algerian government adopted a set of mechanisms to boost the food security as follows:

- It reinforces the role of the agricultural sector in the national economy through the governmental programs and policies of the agricultural and rural renovation and health.
- It focuses on redoubling the production of the cereals, mainly the wheat, and works to make a real revolution in the production of cereals and seeds through redirecting the efforts in the agricultural sector, mainly in the South.
- It reconsiders the human resources, mainly the youth, and attempts to change the mentalities.
- It optimally exploits the agricultural surfaces to increase the yield through the available agricultural technology.
- It reinforces the production of meat to suit the support provided by the state.
- It encourages the investors, mainly the young ones, in the South and encourages establishing a national center for the development of the South agriculture.
- It establishes a new milk factory in Algiers with a daily production rate of more than a million liter (The People's Democratic republic of Algeria, 2022).
- It encourages the professionals to work with the modern methods and apply the contemporary techniques like the developed states.
- It encourages the initiatives and rewards success in the Agricultural sector.
- It reinforces the techniques and tools of the modern agricultural technology, mainly in the air control and the use of the drones to evaluate the agricultural abilities.
- It supports the scientific research on the agriculture.
- It faces the climatic changes, drought, land degradation, and the pandemics such as Covid-19 that have effects on the movement of the international trade and hinders goods transportation (The Arab Organization for Agricultural Development, n.d., p. 48).

The agricultural sector, in general, and the production, in particular, are an important national issue. In this regard, Algeria has the necessary potentials, resources, and material and human energies to achieve the food security. It needs hard work, good intention, determination, and cooperation to reach "zero hunger" in 2030.

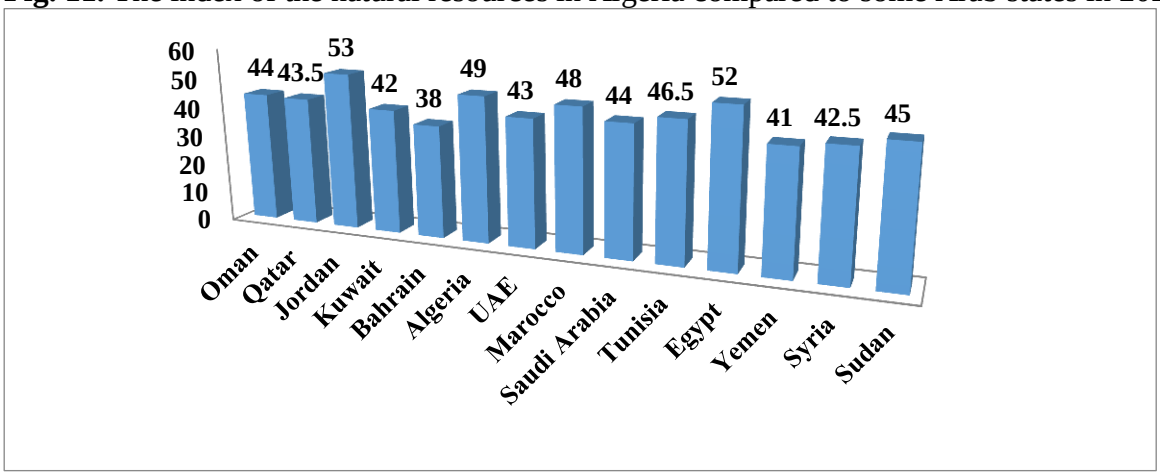
4.2 The suggested strategies to achieve the food security in Algeria:

According to the World Bank, Algeria needs to invest in the food security and the sustainable food through supporting the food systems to make them stronger against the increasing risks (conflicts, climate, scourges, diseases…), the troubles in the trade movement, and the economic crises, and to balance the short-term needs and the long-term investments (The World bank, 2022). In this line, the future strategy of Algeria is based on prioritizing agriculture through supporting the investment in the agricultural products that provide the food security of the state. This requires maintaining all the pillars of the food security in all the times through:

- Adopting the research and development policy in the agricultural sector.
- Reducing the risks of the short food supply through developing and supporting the capacity of the agricultural lands to make big productions.
- Empowering the consumer to permanently get food (Ibid).
- Increasing the agricultural investment and reinforcing the infrastructure.
- Facing the natural, political, economic, and environmental factors such as seasonal climate changes and the price fluctuations that affect the supply and demand.
- Developing the policy of the agricultural marketing to increase the agricultural exports.
- Adopting a national strategy to transform the agricultural surplus through the transformation industries (Draouo, 2022, p. 86).

In this regard, 2021 witnessed an improvement in the index of the natural resources and the ability to resist in many states. Thus, the index was 51° in Algeria, 52° in Egypt, 54° in Jordan. These indexes are good compared to the other Arab states who are below the international index. Compared to the states of the South Sahara, the Arab index is higher as it is 45.7°. On the other hand, it is lower than that of the UK that reached 69°, and of the USA that reached 61.3° as shown in figure 11:

Fig. 11. The index of the natural resources in Algeria compared to some Arab states in 2021



Source: *The Arab Organization for Agricultural Development, the situations of Arab food security, Arab League, the annual book of Arab agricultural statistics, different issues (2016-221), p. 38.*

4.3 The efforts of the Algerian government in supporting the food security:

The Algerian government works hard to achieve its food security and reduce the challenges. Thus, it adopted many measures and mobilized many parts. Moreover, the Ministry of Agriculture and the Agricultural Development designed extensive programs to lift up the agricultural sector as follows:

- The National Plan for Agricultural Development 2000-2002 aimed at promoting the technical, systematic, and financial supervision to achieve a competent developed agricultural sector.
- The National Plan for Agricultural and Rural Development 2002-2008 was a complementary plan for the previous one. It is a reaction to all the challenges and the technical, organizational, and institutional pressures that declined the food security pillars in Algeria.
- The phase of the agricultural and rural renovation 2010-2014 aimed at transforming the agricultural sector into a real engine for the comprehensive economic development, and at intensifying the production in the other agricultural branches and the strategy of the equal development of all the rural territories.
- The plan of the work of the agricultural sector 2015-2019 aimed at increasing the agricultural product before the end of 2019.
- The plan of the work of the agricultural sector 2020-2024 aims at the sustainable development after the crises that hit the state, including the crisis of the fuels in 2014 and Covid-19. Therefore, the government has to think about sustainable sources of income. In so doing, the government focuses on:

  - Developing the Saharan agriculture through establishing the Office of the Development of the Industrial Agriculture in the Sahara to accompany the investors and allow for them many legal benefits.
  - Encouraging the use of the renewable energies in the agricultural projects in the High Plateaus and the South.
  - Relying on the university as a partner in promoting the innovation and research, mainly in the field of citrus, environmentally friendly pesticides, and innovative solutions.
  - Promoting the green economy to rationalize the natural resources (Filaha, 2022).

- Establishing financial formulas for the agricultural sector, such as the efficiency contracts for the Wilayas 2009-2014 (that support the five years program 2010-2014), the partner loan 2008, the challenge loan 2011, the rural mutual loan 2012, and the clearance of the agricultural debts that are estimated at 41 billion DZD (Bekdi, 2013, pp. 211-215).

However, providing water is still a big challenge to guarantee the sustainability of the food security. It is a main pillar for the food security. As the other states, Algeria works hard to respond to the increasing needs for water. So far, 22.5 billion USD have been invested to improve the quantity and quality of the water, take the necessary measures to preserve and import water, build new desalination stations, and enlarge the irrigation system.

We must point that the Ministry of Agriculture called the farmers in the underdeveloped regions to invest in the solar system as a source of renewable energy for irrigation and exploitation of the degraded lands. Lately, after Covid-19 and the Ukrainian war, Algeria focused on its abilities that include the weather and the lands to guarantee its food security, unlike the previous years when it relied on contracts with other states for food security. In this line, Algeria relies on the smart agriculture to support the food security through giving big importance to the agricultural scientific research and supporting the youths to engage in agricultural programs. In the light of the continuous debate about the prices of the products, the economic strategy focuses on supporting the local agriculture mainly in the Sahara, and on encouraging the youths to launch small projects to provide the food products. In this context, Algeria goes steadily towards reinforcing its food security and achieving the comprehensive self-sufficiency (Djennad, 2023, p. 442).

5. CONCLUSION:

The food security is one of the main challenges in Algeria. Despite the availability of the necessary requirements for its achievement, the Algerian agriculture still cannot satisfy the needs and requirements of the citizens due to the challenges and difficulties such as the demographic growth. In this regard, the government focuses on developing the agricultural sector through support policies and the economic reforms that include the national plans for the agricultural development and the establishment of the agricultural funds that support the agricultural sector to produce the main food products and exploit the lands. In addition, the state adopted governmental programs and policies of the agricultural, rural, and health renovation.

Nevertheless, Algeria still faces challenges that must be fought through:

- Encouraging the innovation and collaborative researches about the ecology of agriculture.
- Encouraging and supporting the innovation, technology, and scientific research in the agricultural field.
- Developing the water exploitation, modernizing the irrigation method, and urging the use of the good seeds and fertilizers.
- Taking into account the necessary requirements to lift up the agricultural sector.
- Raising awareness about the smart agriculture to preserve the agricultural resources and their sustainability.
- Establishing the infrastructure and the social protection structure, supporting the renewable energy systems, and using the solar and wind energies mainly in the rural areas.
- Developing the strategic agriculture through investment in the Southern regions and exploiting the vast fertile regions that are rich with water and big potentials. This shall create jobs and meet the food demands and security.

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