

Uses of artificial intelligence in achieving food security in Algeria.**استخدامات الذكاء الاصطناعي في تحقيق الأمن الغذائي بالجزائر****Dr. Souhaila Guettaf ¹**

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Received: 03/07/2024**Accepted:** 28/09/2024**Published:** 30/09/2024**Abstract:**

This study aimed to find out the extent of Algeria's adoption of smart agriculture as one of the methods of artificial intelligence and modern technology in order to achieve its food security, the descriptive method was relied upon by presenting the basic concepts of the two study variables, artificial intelligence and food security, and the analytical method was used to present smart agriculture experiences adopted by Algeria.

This study also found that artificial intelligence is the use of software and technological development in order to develop the field in which the farmer works to achieve food security, as is the case for Algeria, which is betting on encouraging smart agriculture to achieve the latter.

Keywords: Artificial intelligence; modern technology; food; food security; smart agriculture

JEL classification Codes: Q11, G20, O31

ملخص:

هدفت هذه الدراسة إلى معرفة مدى تبني الجزائر للزراعة الذكية كأحد أساليب الذكاء الاصطناعي والتكنولوجيا الحديثة من أجل تحقيق أمنها الغذائي، حيث تم الاعتماد على المنهج الوصفي من خلال عرض المفاهيم الأساسية لمتغيري الدراسة وهما الذكاء الاصطناعي والأمن الغذائي، كما تم الاعتماد على المنهج التحليلي في عرض تجارب الزراعة الذكية التي اعتمدها الجزائر.

كما توصلت هذه الدراسة إلى أن الذكاء الاصطناعي في الأصل هو استعمال البرمجيات والتطور التكنولوجي من أجل تطوير المجال الذي يعمل فيه الفلاح من أجل تحقيق الأمن الغذائي، كما هو الحال بالنسبة للجزائر التي تراهن على تشجيع الزراعة الذكية لتحقيق هذا الأخير.

الكلمات المفتاحية: الذكاء الاصطناعي؛ التكنولوجيا الحديثة؛ الغذاء، الأمن الغذائي، الزراعة الذكية

تصنيف JEL: Q11, G20, O31

INTRODUCTION:

The world is currently facing many challenges on many levels, but the most difficult of these challenges are those related to human life, nutrition and sustainability, and considering that the agricultural sector is the main sector responsible for providing food for millions of people, the decline in the efficiency and ability of this sector to meet the needs will threaten the food security of societies and even their political stability.

The issue of food security is one of the most important major challenges that citizens seek to achieve, by working to manage resources in sustainable ways to reach the goals of food security, in addition to societal conflicts in a number of countries in the region, droughts and severe climatic fluctuations, challenges related to high population growth, limited natural resources, especially water, low productivity and high levels of waste and pollution in general, not to mention the very high food prices and their volatility as most Arab countries are net importers of goods and food products and rely on imports to secure most of their food supplies. Therefore, it was necessary to develop strategies and policies to confront these variables to improve production and productivity through the use of modern technical methods, namely artificial intelligence.

Algeria is among the countries that suffer from a worsening food security issue, especially in recent times due to the coronavirus pandemic, which led to an increase in the demand for foodstuffs, in addition to the Ukrainian crisis, which increased the seriousness of the food gap in Algeria.

In this context, Algeria is endeavoring to use advanced modern technology represented by artificial intelligence methods in the field of agriculture, for example the idea it has adopted in this context is smart agriculture.

From here, the following question can be posed:

What are the uses of AI to achieve food security in Algeria?

sub-questions:

Through the previous question, the following sub-questions can be asked:

- What is the reality of food security in Algeria?
- How does artificial intelligence contribute to achieving food security in Algeria?

Study's hypotheses:

In order to answer the above questions, we proceed from the following hypotheses:

- Algeria is one of the countries that can reduce the food security gap by reducing its imports of basic materials that it is able to provide for the country.
- Among the modern mechanisms adopted by Algeria in achieving food security is smart agriculture.

Study's objectives:

This study aims to have a number of objectives:

- Introducing artificial intelligence and its most important characteristics.
- Diagnosing the status of food security in Algeria.
- Touching on different modern technologies used in the field of food in Algeria that fall under artificial intelligence.

study's sections:

The paper is divided into three main section:

First: Concepts about Artificial Intelligence.

Second : Concepts about food security.

Third: The necessity of adopting artificial intelligence in achieving food security in Algeria.

1. Concepts about Artificial Intelligence

The term 'artificial intelligence' has become so widely used that some fear that it could mean that machines will take over and human's role will decline, although the reality is far from being close to this perception.

1.1 The concept of artificial intelligence:

It is a branch of computer science, sometimes called Machine Intelligence, abbreviated (AI), artificial intelligence defined as a technology that mimics human intelligence to perform tasks and can constantly improve its abilities basing on the information it gathers. (Belassel bent nabi, 2022, p. 1155)

Artificial Intelligence (AI) is defined as 'the intelligence displayed by machines and programmes that mimic mental abilities.' It is also defined as 'the study and design of intelligent systems that understand their environment and take actions that increase their chances of success.

While John McCarthy, who coined the term in 1955, defines it as 'the science and engineering of making intelligent machines.

1.2 The importance of artificial intelligence:

The relevance of artificial intelligence is highlighted in several aspects, the most important of them is:

- **Efficiency and productivity:** different tasks and duties can be automated, and this leads to increase productivity and efficiency.
- **Personalization:** AI can help allocate or dedicate skills and experiences to customers, employees and users.
- **Accuracy:** AI can treat an enormous amount of data and identifying patterns that people cannot discover or reach, what leads to more accurate predictions and better decision-making.
- **Innovation:** AI can develop new products and services not feasible before such as health care services with humanoid robots.

- **Cost- effectiveness:** AI can help for decreasing costs by automating tasks and reducing human intervention, what help enterprises and companies in several industries.
- **Improve safety:** AI can be used in different fields to improve safety such as transportation, marketing, risk assessments and investment management.

1.3 Characteristics of artificial intelligence:

Characteristics of artificial intelligence are: (eldofri, 2021/2022, p. 6)

- Solving problems in different domains;
- Perception and thinking;
- Learning from the previous experiences;
- The use and employment of ancient skills and experiences;
- Bring pertinent information to support the decision.

2. Concepts about food security

2.1 The concept of food security:

According to Food and Agriculture Organization (FAO) we can define food security as “providing sufficient quantity and adequate quality of food to communities in the way to meet their needs in a sustainable manner” (Bouguetaf Mohammad Habbib, 2022, p. 251)

And the Algerian legislature defines it in Article 3 of Act No.08-16 of 3rd August 2008 as “access and obtaining of safe and sufficient food by everyone to make him enjoying an active life”.

This definition is different from the traditional concept related to reaching self-sufficiency basing on own country resources and capacities to ensure locally its food needs.

2.2 Characteristics of food security:

Food security is characterized by a number of characteristics unanimously recognized by economists: (Oussama Ben Aziz, 2022)

- Sufficiency: it is the ability to produce and stock piling food needed to meet the needs and desires of society citizens;
- Autonomy: protect countries from fluctuations that affect the global markets in terms of food availability;
- Stability: seasonal and cyclical variation;
- Continuity: means to ensure food over time;
- Equity: it means, at least, that every people group has access to sufficient food.

2.3 Dimensions of food security:

We can resume dimensions of food security in following elements: (Amel, 2021, p. 272)

- **Sufficiency and abundance:** It is the availability of the minimum necessary food needs at the national level so that a large proportion of food is provided by relying on local production rather than imports from abroad.
- **Accessibility of food:** This term came to light after the famines that ravaged several regions of the African and Asian continents, as large groups were unable to access food

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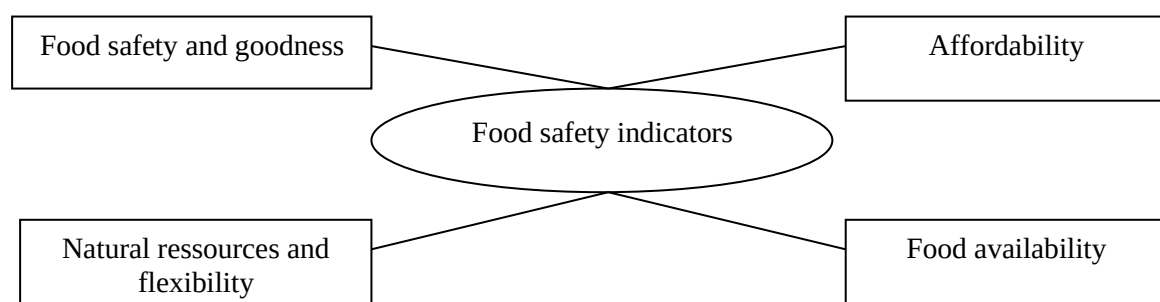
despite its availability in small quantities due to high prices as a result of poverty. If sufficiency is meant to take care of the macro level, the concept of food accessibility is to meet the increasing demand for food at the regional, household and individual level.

- **Safety:** Many researchers saw that the concept of security is the protection of these food supplies from risks, whether natural, such as natural disasters or economic, such as price fluctuations. This concept was prevalent until the 1990s to evolve into the concept of nutritional balance, meaning taking into account the amount of nutrients contained in the food ration per capita. After 2005, the term food quality emerged as an expansion of the concept of food safety, which aims to take into account all criteria and conditions during the production, processing, distribution and preparation of food.
- **Time:** It refers to the state of hunger or poverty suffered by individuals during a certain period of time.

2.4 Food security indicators:

To talk about the reality of food security, we must first address what are the indicators for measuring food security, which were identified and developed by the Economic Research Unit with the support of Corteva Agricultural Sciences, which updates the model annually to capture annual changes in structural factors affecting food security. The food security index is measured at the national level based on the criteria of abundance, quality and health safety of food, natural resources and resilience in 113 countries around the world in 2021, namely: (global food security, 2022)

Fig (01): Food security indicators



Source: Prepared by the researcher based on available information on food security indicators

Affordability: Measures the ability of consumers to purchase food, their vulnerability to price shocks, and the existence of programmes and policies to support consumers when shocks occur.

Food Availability: Measures agricultural production and capacity, risk of supply disruptions, national capacity to distribute food and research efforts to expand agricultural production.

Quality and Food Safety: Measures the variety and nutritional quality of average diets, as well as food safety.

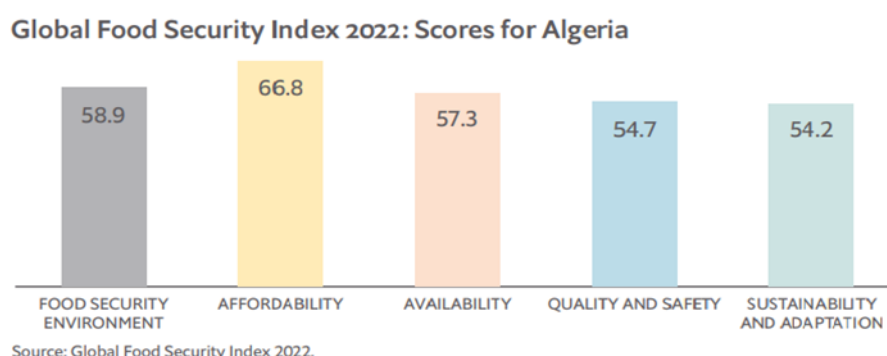
Natural Resources and flexibility: Assesses a country's vulnerability to the effects of climate change, its exposure to natural resource risks, and how the country adapts to these risks.

3. Adopting artificial intelligence to achieve food security in Algeria

3.1 analysis of security food indicators in Algeria:

As for Algeria, it is one of the first countries in the Maghreb according to the previous categorisation of food security indicators, which can be illustrated in the following figure:

Fig (02): Global food security index 2022 for Algeria



Source: Global food security index 2022

It is clear that Algeria achieved the highest score in terms of food affordability with a total score of 66.8 out of 100, followed by food availability with a score of 57.3 with a moderate score, followed by quality and food safety with a score of 54.7 with a weak score, and the weakest is sustainability and adaptation with a score of 54.2 with a weak score, It is also clear from the results of the index dimensions that there is a lack of policy commitments in the form of a nutrition plan or dietary guidelines, and Algeria also needs stronger measures for food quality and safety. The following table shows more clearly these dimensions:

Table (01): Illustrates dimensions of each of the indicators of food security in Algeria for 2022

FOOD SECURITY ENVIRONMENT										Score	Δ		
										58.9	↑ +8.4		
		Score	Δ			Score	Δ			Score	Δ		
1	AFFORDABILITY	66.8	↓ -9.0	2	AVAILABILITY	57.3	↑ +25.7	3	QUALITY AND SAFETY	54.7	↑ +3.3		
1.1	Change in average food costs	48.5	↓ -30.5	2.1	Access to agricultural inputs	49.0	↑ +1.9	3.1	Dietary diversity	49.1	↑ +3.2		
1.2	Proportion of population under global poverty line	96.2	↔	2.2	Agricultural research & development	43.1	↑ +16.3	3.2	Nutritional standards	0.0	↓ -29.8		
1.3	Inequality-adjusted income index	63.1	↓ -0.3	2.3	Farm infrastructure	54.1	↑ +36.6	3.3	Micronutrient availability	64.7	↑ +18.5		
1.4	Agricultural trade	50.0	↓ -8.7	2.4	Volatility of agricultural production	78.2	↑ +61.2	3.4	Protein quality	67.3	↑ +3.2		
1.5	Food safety net programmes	79.3	↔	2.5	Food loss	58.2	↓ -4.0	3.5	Food safety	92.4	↑ +21.9		
				2.6	Supply chain infrastructure	34.4	↑ +9.2						
				2.7	Sufficiency of supply	100.0	↑ +59.6						
				2.8	Political and social barriers to access	42.1	↓ -6.2						
				2.9	Food security and access policy commitments	52.5	↑ +52.5						
										4	SUSTAINABILITY AND ADAPTATION	54.2	↑ +17.2
										4.1	Exposure	76.2	↔
										4.2	Water	33.7	↔
										4.3	Land	64.7	↓ -0.2
										4.4	Oceans, rivers and lakes	26.6	↓ -20.7
										4.5	Political commitment to adaptation	28.5	↑ +25.9
										4.6	Disaster risk management	100.0	↑ +100.0
Very good (80–100) Good (70–79.9) Moderate (55–69.9) Weak (40–54.9) Very weak (0–39.9)													
Source: Global Food Security Index 2022.													

Source: Economist_Impact_GFSI_2022_Algeria_country_report_sep_2022.pdf

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It is clear from the above table that there are some points that show the strength of food security indicators in Algeria, which take the green color in the table (4.6-3.5-2.7-1.2), mainly due to the existence of legislation related to food safety. Improving food quality through food standards should be a priority. Reduced dependence on food aid is one area that reflects an adequate supply of food to citizens.

Improving the supply chain infrastructure will increase the availability of food in the country, as the table above shows through.

- **Food standards:** Algeria ranks 109th in this indicator.
- **Supply Chain Infrastructure:** Algeria ranks 74th in this indicator.
- **Political commitment to adaptation:** Algeria ranks 95th in this indicator.
- **Sufficiency of supply:** Algeria ranks first in this indicator with a 'very good' score of 100. The sufficiency of the country's food supply remained stable and improved during the GFSI reporting period, and its reliance on chronic food aid was low.
- **Food safety:** Algeria ranks 49th in this indicator. The country achieved a full score of 100 in sub-indicator 3.5.1 Food safety related to legislation, helping to strengthen its position in this indicator.

3.2 New technologies' models used in Algeria in agricultural field

In recent times, Algeria has seen a rise and instability in food prices, which prompted the Algerian government to try to find a mechanism to control prices on the one hand and achieve self-sufficiency on the other, by working on the application of modern technology strategies represented by artificial intelligence and its actual embodiment, especially in desert areas. Among the modern strategies adopted by the government is the smart agriculture project calling for 'zero hunger' by 2023, involving under the United States project.

Artificial intelligence is the use of electronic means and various programmes carried out by the farmer to study the information available on the environment used in order to make decisions that enhance the farmer's information, including soil suitability, humidity, weather conditions, watering and other interest data, because the goal of using AI techniques is a huge database that enables the storage of large information that can be analyzed quickly compared to the human mind.

Moreover the use of AI in the agricultural development helps in cultivation prediction by analyzing historical and meteorological data in order to provide accurate information on planting dates, i.e. determining the exact appropriate period for planting crops and how to develop them, in addition to continuous monitoring of crops through the use of remote sensing techniques and aerial photography, the condition of crops can be tracked with high accuracy, and early signs of stress or diseases can be identified, allowing farmers to intervene quickly and apply the necessary measures.

3.2.1 Artificial intelligence to improve productivity :

Under the Roadmap 2020-2024 Algeria's agricultural sector is entering a new era with the main objective of strengthening the country's food sovereignty through self-sufficiency and reducing the import bill

Fig (03): the use of AI to improve productivity



Source: on the site <https://almostathmir.dz>, Date of access : 16/06/2024.

According to technology experts, the use or exploitation of artificial intelligence (AI) technologies in the development of agriculture in Algeria will significantly contribute to producing better crops and optimizing a wide range of tasks related to agriculture in the entire food supply chain.

According to experts, AI can be applied in the agriculture sector due to several technological advancements (the coverage of AI advisory services, data analytics, the Internet of Things, the use of cameras and other sensors, and so on). By examining various data sources such as weather, soil, crop performance and temperature, AI in agriculture will become specialized enough to produce better predictive insights.

3.2.2 Smart agriculture one of the new tendency to reach self-sufficiency:

We can first talk about smart agriculture which is a system that relies on advanced technology to cultivate or grow food in a sustainable and clean way and rationalize the use of natural resources, especially water. One of its most prominent features is its reliance on information management and analysis systems to make the best possible production decisions at the lowest costs, as well as agricultural operations such as irrigation, pest control, soil monitoring, and crop monitoring.

Fig (04): shows the use of smart agriculture.



Source: on the site <https://almostathmir.dz>, Date of access : 16/06/2024.

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Algeria is betting on promoting smart agriculture to achieve food security by giving great importance to scientific research in the field of agriculture and encouraging young people to engage in agricultural-related programmes. In light of the ongoing debate over rising food prices, the economic strategy is in the context of supporting local agriculture, especially in desert areas, while encouraging young people to set up micro-enterprises to provide essential food items that citizens need on a daily basis. And the latest report of the United Nations World Food Programme ranks Algeria in the first place in the list of African countries in term of food security, with a score of 63.9% , making it one of the countries able to support the efforts of the UN's programme aspiring to achieve zero hunger by 2030 and indicates that agriculture's contribution to GDP does not exceed 13% , or about \$25 billion, and the government has pledged to double that figure by supporting smart agriculture, to expand irrigated areas and improve the rational use of agricultural land via digitalization of the sector programmes. And according to the head of the Agricultural Organisation, the future plan aims to develop the agricultural sector in rural areas in order to implement the rural agricultural renewal policy.

3.2.3 AI robots break into agriculture world:

Intelligent agricultural machinery can treat plants on an individual basis by spraying them with pesticides, weed killers, fertilisers and fungicides.

Fig (05): show the use of AI in agriculture world



Source: on the site <https://www.alquds.co.uk> , Date of access : 16/06/2024

3.2.4 The use of smart greenhouses:

In a first of its kind, the Algerian authorities have announced a new agricultural project related to the popularisation of smart greenhouses to increase crop production.

Fig (06): demonstrate how smart greenhouses works.



Source: on the site : <https://www.maghrebvoices.com/technology/2023/05/1> , Date of access : 16/06/2024

The project will be realised in partnership with the Dutch Agricultural University of Wageningen in the semi-urban areas of northern Algeria.

The move reflects a new trend in Algeria towards the use of advanced technology in agricultural activity, which remains largely dependent on traditional methods that have shown limited effectiveness compared to what is happening in many developed countries in this field.

According to Ali Daoudi, a professor at the National School of Agriculture, previous experiments using smart greenhouses have shown impressive results, with a production level of about 40 kilograms per square metre. ‘This yield is double that of traditional greenhouses, where the average yield is around 20 kg per square metre,’ the professor told Algerian Radio.

3.2.5 Drone agriculture:

Algerian engineer Adel Mohamed has developed new techniques in the field of reforestation and planting tree seedlings high up in forests and mountains, using drones capable of carrying seedlings of different sizes and launching them at a speed that allows them to be planted in the soil.

Adel explain his forestation technique which involves releasing seed pellets and seedling shells, a successful method used around the world, but my version allows the seeds to remain protected inside a cocoon for long periods of time while waiting for rain, retain moisture for a long time, and withstand high degrees of impact with the ground.

He adds “the seed pellets are very light, weighing only 7 grams, allowing the drone to carry large quantities of seed pellets per flight. The drone can carry 5,700 seed pellets per flight, releasing 91,000 pellets per day. Even with a small success rate, say 10 per cent, a single aircraft can afforest about 10 hectares per day. The figure rises if the success rate is higher, with more than one seed in each pellet. The results of testing this method have been impressive, and I am currently interested in developing a mass production line for these pellets to overcome the high cost of adopting this technology”.

Fig (07): demonstrate how to use drones in agriculture



Source: on the site : <https://www.al-watan.com/article/74686/SCIENCE> , Date of access : 16/06/2024

3.2.6 Remote sensing system for agriculture domain:

Remote sensors installed at carefully placed locations allow us to know potential variations in environmental conditions within the field to measure soil parameters such as nitrogen and phosphorus levels, moisture content, pH, soil temperature, healthy growing conditions, weather patterns for the coming days and weeks, and other information. The data is collected periodically in a precise system for storing, analysing and retrieving the data, which helps to make the best decision at the right time.

Fig (08): demonstrate the use of remote sensors in agriculture



Source: on the site : <https://www.farmtrader.co.nz/reviews/1209/pasture-care-tracmap-465-gps>, Date of access :

16/06/2024

In general, to achieve food security, experts emphasised the need to accelerate support for the cultivation of fruit and vegetable products, and to highlight the role of micro-entrepreneurs, which is why the government has provided great facilities for young people want to invest in agriculture domain, after solving one of the most difficult obstacles in remote areas that had been standing in the way of the country's economic growth, regarding the census of agricultural land, the preparation of a new law on its redistribution to small agricultural investors and basing on smart agriculture as a strategic option to achieve food security in Algeria.

Conclusion:

The issue of food security, which has become a goal sought by most countries, especially in light of the current global economic transformations and the multiple challenges posed by modern technological developments, especially in the field of artificial intelligence, we find that Algeria, despite recording acceptable rates of food security indicators and despite the Algerian state's efforts to adopt many modern technologies to advance this sector, is still below average and far from the required level due to low rates of self-sufficiency.

Results of the study:

- Algeria's Global Food Security Index for 2022 improved by 4.8 points to 58.9 with a medium score, which is still below the required level;

- The various dimensions of food security have improved slightly, with the exception of the deterioration of food affordability due to rising food prices;
- Therefore, the food situation in Algeria is currently facing very great challenges, in particular the need to promote smart agriculture, which is a key component of the smart agriculture programme;
- Algeria is betting on promoting smart agriculture to achieve food security by giving great importance to specialised scientific research in the field of agriculture;
- Artificial intelligence is the use of electronic devices and programmes to perform simple, manual, analytical or intellectual work carried out by the farmer;
- AI can be applied in the agriculture sector, due to several technological developments such as the coverage of AI consultancy services, data analytics, the Internet of Things (IoT), and the use of cameras and other sensors.

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