Climate Change and Food Security in Algeria: Implications and Proposed Strategies

Mohammed NACEF *

Hassiba Benbouali University of Chlef, Algeria, M.Nacef@univ-chlef.dz

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Abstract :
This paper examines the impact of climate change on food security in Algeria and the proposed strategies for adaptation. The study highlights that climate change, driven by human activities, negatively affects ecosystems and agricultural production, posing a significant threat to food security. In response, Algeria initiated the development of its National Climate Change Strategy in August 2024, led by the National Climate Committee, with the goal of enhancing the country's resilience to these challenges through sustainable policies and a participatory approach.
This strategy will focus on several key areas, including improving water resource management, supporting sustainable agriculture, strengthening food supply chains, and reducing waste. Additionally, it aims to foster international cooperation, secure funding for sustainable agricultural projects, and promote scientific research and innovation in the agricultural sector.
These measures seek to ensure food security in Algeria by safeguarding agricultural production, supporting rural development, and enhancing the country's ability to adapt to climate challenges, thereby contributing to the long-term sustainability of the agricultural sector.

Keywords: Climate change, natural disasters, food security, agricultural policies, natural resources.
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* **Corresponding author**

Introduction:

Climate change is one of the most pressing global challenges threatening food security, as it alters weather patterns, increases temperatures, and intensifies drought and desertification, negatively impacting agricultural production and the sustainability of natural resources. In Algeria, food security is a national priority, given that a significant portion of the population depends on the agricultural sector. With the escalating effects of climate change, adopting adaptive strategies has become essential to ensuring stable agricultural production and sustainable food supply. In response, Algeria launched its National Climate Change Strategy in August 2024, focusing on improving water resource management, promoting sustainable agriculture, and developing food supply chains.

This study aims to analyze adaptation strategies to climate change and their impact on food security in Algeria by examining relevant policies, implemented measures, and the challenges hindering the achievement of food security in the face of a changing climate.

Research Problem:

Given the increasing impact of climate change on agricultural production globally and, more specifically, on food security, a crucial question arises regarding the extent of climate change's effects on Algeria's food security. Additionally, it is essential to explore whether Algeria has adopted strategies to adapt to these changes and ensure sustainable food security.

Main Research Question:

To what extent does climate change affect food security in Algeria, and what strategies does the country implement to adapt to these changes and ensure long-term food security?

Research Objectives:

- Analyze the impact of climate change on food security and agricultural production in Algeria.
- Examine the national strategies proposed and implemented to adapt to climate change.
- Assess how Algeria's food security benefits from national adaptation strategies.

Significance of the Study:

- Highlights one of the major challenges facing food security in Algeria.
- Enhances understanding of the relationship between climate change and agricultural production.
- Provides practical recommendations for policymakers to improve adaptation strategies.
- Contributes to the scientific literature on climate change adaptation in the agricultural sector.

Review of Previous Studies:

In a comprehensive study conducted by Ikegwu et al. (2024), the impact of climate change on agricultural production and food security was examined across several developing countries, including Iran, Pakistan, Nigeria, Zambia, Vietnam, Ethiopia, and Mozambique. The researchers employed quantitative analytical tools such as the SACRED framework and the ARDL model to assess the economic and environmental implications of climate change. The study found that agricultural productivity had declined by 34% due to rising temperatures, recurring droughts, and extreme heatwaves, significantly affecting key crops such as rice, maize, and cotton. The findings underscored that climate change poses a serious threat to food security at both local and global levels and hampers progress toward achieving sustainable development goals. The authors recommended the adoption of flexible analytical models, the promotion of climate-smart agriculture, and the development of early warning systems to help mitigate the effects of climate variability. However, despite its analytical value, the study gave limited attention to the Algerian context and did not address Algeria's 2024 National Climate Strategy. This omission presents an opportunity for the current research to fill that gap by offering an in-depth analysis of Algeria's national response to climate change.

In a different context, Qerdaniz (2022) focused on the relationship between climate change and food security, particularly concerning food availability, accessibility, and nutritional quality, and the subsequent impacts on human health—especially in low- and middle-income countries. The study revealed that climate change disrupts dietary patterns and exacerbates malnutrition-related diseases, while also highlighting disparities in food balance across geographic regions and social groups. The study called for the implementation of integrated, climate-responsive food policies and the strengthening of resilient and sustainable food production chains as a means of improving food security. Nevertheless, the study primarily emphasized the social and health dimensions of food insecurity and did not delve into Algeria's national policy responses or institutional adaptation strategies. This gap is precisely what the current study aims to address by analyzing Algeria's climate adaptation policies and government-led initiatives.

Meanwhile, Achachi (2016) presented one of the early efforts to examine the impact of climate change on plant and animal production in Algeria. The study highlighted Algeria's heavy reliance on rain-fed agriculture and the limited availability of arable land, which has led to a significant decline in productivity. It also noted that changes in precipitation patterns and the increasing frequency of droughts had severely affected cereal crops. Additionally, the emergence of climate-induced livestock diseases, such as bluetongue, had increased economic costs and reduced the availability of animal products. The study recommended expanding support for water-efficient irrigation systems, improving veterinary care for livestock, and redirecting agricultural policies toward climate adaptation. While the study provided valuable early insights, it was conducted before recent institutional developments and did not account for Algeria's newly adopted 2024 National Climate Strategy. Furthermore, it did not address key themes such as international cooperation, sustainable financing, or the role of scientific research in enhancing food security—all of which are central to the current study.

Structure of the Paper:

- **Section One:** The current state of climate change in Algeria.
- **Section Two:** The implications of climate change on food security in Algeria.
- **Section Three:** Strategies for adapting to climate change's impact on food security in Algeria.

Section One: The Current State of Climate Change in Algeria

1.1 Definition of Climate Change and Its Risks

1.1.1 Definition of Climate Change

Various definitions have been proposed to describe the causes of climate change and mitigate its consequences. Climate change has been defined as "a disruption in the usual climatic conditions, such as temperature, wind patterns, and precipitation, which characterize a specific region." Another definition describes it as "an imbalance in the system that regulates the climate, resulting from the increased capacity of the atmosphere to absorb infrared radiation caused by greenhouse gases." Additionally, it has been characterized as "any significant, long-term change in the average weather conditions of a particular area, which may be driven by natural Earth processes such as volcanic activity, external forces like changes in solar radiation intensity or meteorite impacts, and more recently, human activities" (Qerdaniz, 2022, p. 32).

From an operational perspective, climate change can be defined as the accelerated climatic fluctuations observed in recent decades, driven by disruptions in the Earth's climate system due to rising greenhouse gas concentrations in the atmosphere. These gases trap additional heat, preventing it from escaping into space, leading to increased global temperatures, changes in precipitation patterns, and seasonal shifts. These changes are largely attributed to unregulated human activities, particularly industrialization (Qerdaniz, 2022, p. 33).

Another definition describes climate change as "a long-term alteration in climate conditions caused by changes in energy balance and flow, affecting both natural and ecological systems." It is also understood as the continuous transformation of the Earth's climate, driven by cosmic,

natural, or human-induced factors, negatively impacting the atmosphere and leading to devastating environmental disasters (Qerdaniz, 2022, p. 33).

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as "a detectable change in climate conditions, identified through variations in average characteristics and/or their fluctuations (e.g., using statistical tests), persisting over extended periods—typically decades or longer. Climate change may result from natural internal processes, external factors (such as variations in solar cycles or volcanic eruptions), or anthropogenic activities that alter the atmospheric composition or land use" (Intergovernmental Panel on Climate Change, 2014, p. 5).

Based on these definitions, climate change can be summarized as a long-term shift in global or regional climate patterns, characterized by significant changes in temperature, precipitation trends, extreme weather events, and rising sea levels, which collectively impact ecosystems, economies, and human societies. Climate change may be driven by natural factors such as variations in solar activity, volcanic eruptions, and internal climate oscillations, or by human-induced factors, primarily greenhouse gas emissions from fossil fuel combustion, deforestation, and urban expansion, which disrupt the Earth's thermal balance and exacerbate global warming.

1.1.2 The Adverse Effects of Climate Change

A clear understanding of climate change's consequences and risks has become increasingly crucial due to the growing disruption of ecological systems. Climate change poses a significant threat to natural and human life, with its effects varying based on geographic location, environmental conditions, and the resilience of ecosystems and societies.

According to the United Nations Framework Convention on Climate Change (UNFCCC, 1999), the adverse effects of climate change are defined as "the alterations in natural or biological environments caused by climate change, which have significant negative impacts on the structure, resilience, or productivity of natural or managed ecosystems, as well as on the functionality of socio-economic systems, human health, and well-being" (United Nations Framework Convention on Climate Change [UNFCCC], 1992, p. 4).

The overwhelming majority of the scientific community recognizes that climate change is already occurring and is an unavoidable reality. This is supported by numerous reports, including the IPCC report (Paris, 2007), which confirmed a shift from merely predicting climate change to observing its actual manifestations. Similarly, the Stern Report outlined the anticipated consequences of climate change, drawing from models developed by the IPCC, the World Climate Research Program, the World Bank, the Organization for Economic Cooperation and Development (OECD), the United Nations Environment Program (UNEP), and various other studies (Hassi, 2009, p. 8).

The major adverse effects of climate change can be categorized as follows:

A- Environmental Impacts

- **Changes in Weather Patterns:** Increased frequency and intensity of hurricanes, droughts, heatwaves, and floods.
- **Rising Sea Levels:** Threats to coastal cities and loss of agricultural land.
- **Desertification:** Reduction in arable land and expansion of barren areas.
- **Water Resource Disruptions:** Variability in freshwater availability due to shifts in rainfall patterns and glacier melt.
- **Loss of Biodiversity:** Increased risk of extinction for various species due to habitat destruction.

B- Economic Impacts

- **Damage to the Agricultural Sector:** Reduced crop yields due to unpredictable weather conditions and climate instability.
- **Increased Natural Disasters:** Higher costs for disaster recovery and reconstruction, exacerbating economic crises.

- **Negative Effects on Tourism:** Degradation of tourist destinations due to rising temperatures and extreme weather events.

C- Social and Health Impacts

- **Spread of Diseases:** Higher prevalence of climate-related illnesses such as malaria and respiratory diseases.
- **Environmental Migration:** Displacement of populations due to desertification and rising sea levels.
- **Food Insecurity:** Threats to food availability due to declining agricultural productivity.

D- Human Rights Implications

- **Right to Life:** Direct threats to human survival due to increasing natural disasters.
- **Right to Health:** Negative impacts on public health due to air pollution and disease proliferation.
- **Right to Housing:** Loss of homes due to flooding and sea-level rise.

Climate change is not merely an environmental issue but a multidimensional challenge affecting economic stability, social well-being, and fundamental human rights. Addressing these adverse effects requires immediate global action, sustainable policies, and the adoption of resilient adaptation strategies to mitigate its impacts.

1.2. Evolution of Major Climatic Factors in Algeria

Climate change in Algeria reflects global environmental transformations, with the country experiencing a steady rise in temperatures, a decline in precipitation levels, and an increase in extreme climatic events such as drought, desertification, and coastal erosion.

1.2.1. Temperature Changes

Since 1929, Algeria has witnessed a gradual increase in average temperatures, rising from 22.82°C to 24.11°C in 2022—an increase of 1.29°C or 5.65% between 1990 and 2022 (Bouaarab & Fathallah, 2022, p. 12). This increase is a clear indicator of the country's vulnerability to global warming, particularly in desert regions where temperatures have occasionally exceeded 50°C. Climate projections for 2024 suggest further temperature increases, potentially leading to more frequent and intense heatwaves that will significantly impact natural resources.

1.2.2. Changes in Precipitation Levels

Algeria heavily relies on rainfall for agriculture. However, data indicate a decline in precipitation since 1975, with rainfall becoming more irregular and accompanied by frequent droughts and catastrophic floods. The number of rainy days has also decreased, with precipitation now occurring in intense storms primarily during autumn, winter, and spring (Climate Knowledge Portal, 2024). Additionally, rainfall levels in 2023 dropped by 15–20% compared to the annual average of previous years, particularly in northern and central regions. This trend is expected to persist beyond 2024, exacerbating the risks of drought and water shortages.

1.2.3. Desertification and the Expansion of Arid Areas (Reduction of Agricultural Land)

The increasing frequency of droughts has intensified desertification. According to the IPCC (2007), Algeria's steppe regions are projected to transform into deserts, with arable land retreating 100 km northward by 2025. The most affected provinces include Naâma, El Oued, and Laghouat, where environmental degradation continues to worsen due to both climatic and human factors (Hafifi, Ben Haj Djelali Maghraoua, & Kouache, 2021, p. 302).

1.2.4. Coastal Erosion

Rising sea levels have led to coastal erosion in Algeria at a rate of 0.199 meters per year, according to an EU-funded study (2006–2008). Currently, 60% of Algeria's coastlines are affected by erosion, and this percentage is expected to rise to 70% by 2025 if preventive measures are not implemented (Hafifi et al., 2021, pp. 302–303).

1.2.5. Drought and Its Impact on Water Resources

Drought episodes have become more severe, leading to a decline in water resources and disruptions in rainfall patterns. In 2023, Algeria was significantly affected by drought, with provinces such as Tissemsilt experiencing extreme water shortages, resulting in dried-up watercourses and substantial damage to agriculture and natural pastures (Hafifi et al., 2021, pp. 301–302). Reports further indicate that Algeria's dam storage levels did not exceed 30% in 2024, reducing the country's ability to cope with prolonged droughts.

1.2.6. The "Gossen" Drought Index (1991–2022)

The Gossen Index is used to analyze drought in Mediterranean climates. Analyzing its data from 1991 to 2022 reveals that Algeria's dry period extends from April to October, with peak heat in July, while the wet period occurs from January to March, with relatively higher rainfall compared to temperatures. However, the overall trend indicates a longer dry season and a shrinking wet season, confirming the growing impact of global warming on Algeria's climate (Bouaarab & Fathallah, 2022, p. 16).

In 2024, Algeria continued to experience extreme heatwaves during the summer, with an increasing number of days surpassing 45°C. This further reinforced climate change effects and prolonged drought conditions. Additionally, the gaps between rainy days widened, with precipitation becoming more sporadic and less sustained, leading to significant disruptions in the hydrological cycle. As a result, water resources have been severely affected, with shorter wet seasons causing declining groundwater levels and reduced dam reserves. These conditions have heightened the risks of desertification and posed a serious threat to the country's water security.

The aforementioned climatic changes indicate an ongoing environmental transformation in Algeria, where the impacts of climate change are becoming more evident across all regions. Rising temperatures, decreasing rainfall, and increasing desertification represent major challenges that necessitate effective strategies to mitigate and adapt to the consequences of these climate shifts.

Section Two: The Implications of Climate Change on Food Security in Algeria

2.1. The Impact of Climate Change on Food Security

Climate change is closely linked to food security, as it affects the biophysical factors essential for plant growth, animal development, water cycles, and biodiversity. It also influences agricultural practices, land use for food production, and the suitability of land for various crops. Additionally, climate change disrupts key components of the food system, including production, storage, marketing, and transportation, exacerbating malnutrition, particularly in countries where agriculture serves as the primary livelihood.

The number of people experiencing acute food insecurity surged from 135 million in 2019 to 345 million across 82 countries by June 2022. Food insecurity continues to rise globally, driven in large part by climate-related phenomena. Global warming alters weather patterns, leading to heatwaves, heavy rainfall, and prolonged droughts. The surge in food prices in 2021 was a major factor that pushed approximately 30 million additional people in low-income countries into food insecurity. At the same time, current food production methods significantly contribute to the problem. According to recent estimates, the global food system is responsible for nearly one-third of greenhouse gas emissions, second only to the energy sector. It is also the primary source of methane emissions and biodiversity loss **(World Bank, 2022)**.

According to the World Health Organization, approximately 5.3 million people die annually due to malnutrition, in addition to the devastating losses and deadly diseases caused by droughts and floods. Unstable climatic conditions also impact grain and crop production. Looking ahead, projections indicate that around 670 million people—8% of the global population—will still suffer from hunger by 2030, even if a global economic recovery occurs. This figure is comparable to the level recorded in 2015, when the goal of eradicating hunger, food insecurity, and malnutrition by the end of this decade was introduced as part of the 2030 Sustainable Development Agenda **(World Bank, 2022)**.

The persistent challenge of meeting the ever-increasing food demand driven by global population growth is further exacerbated by climate change. Nevertheless, researchers are continuously working to develop optimal solutions. For instance, climate change has significantly disrupted agricultural systems, leading to a 34% decline in total factor productivity (TFP) due to rising temperatures, droughts, heatwaves, and other extreme weather events. These uncertainties continue to affect agriculture, as farmers in Iran have expressed concerns over changes in precipitation patterns, temperature fluctuations, and the effects of CO_2 fertilization (Ikegwu et al., 2024, p. 6).

Moreover, climate change has heightened agricultural vulnerability, as reported by farmers in Norte de Santander, Colombia, and the ASEAN agricultural sector. Similarly, the adverse effects of climate change on crops—such as maize, rice, cotton, sugarcane, bajra, and gram—have been observed in Pakistan, Nigeria, and globally, largely due to high CO_2 emissions. In Zambia, researchers examined the impact of climate change on household welfare and agriculture using a series of analytical modeling tools known as the Systematic Assessment of Climate-Resilient Development (SACRED) framework. This approach was designed to address the uncertainties associated with climate challenges and support adaptation strategies to ensure the sustainability of smallholder farming worldwide. Additionally, the SACRED framework provided a standardized methodology for data analysis, evaluating the impacts of temperature, precipitation, and evaporation across different climate scenarios using dynamic computable general equilibrium models in Ethiopia and Mozambique (Ikegwu et al., 2024, p. 6).

Further research has been conducted to assess the effects of climate change on agriculture. Studies in Vietnam analyzed both short- and long-term impacts on the agricultural sector at the macro level, with a particular focus on production and economic value. This study employed the Autoregressive Distributed Lag (ARDL) model, revealing that climate change negatively affects global food security in Vietnam and beyond, thereby hindering poverty alleviation and sustainable development efforts. Additionally, an assessment conducted in Central India, specifically in the Vidarbha region, found that 70 cotton farmers in the study area were marginalized due to their perception of climate change. Based on responses from a structured questionnaire, climate change was found to have detrimental effects on various agricultural activities, including crop sowing, growth, post-harvest processes, and livestock management (Ikegwu et al., 2024, pp. 6-7).

Overall, across the studies and cases reviewed, it is evident that climate change has a profoundly negative impact on agricultural practices and the long-term sustainability of food security. These findings align with broader predictions, which indicate that by 2025, global warming and its associated climatic changes will continue to manifest in varying degrees and intensities across Sri Lanka and other nations worldwide (Ikegwu et al., 2024, p. 7).

This shift in the fundamentals of the food system also brings about changes in key dimensions of food security, including food availability, accessibility for all segments of society, regional disparities, and shifts in consumption patterns. Consequently, these changes impact human health by affecting nutritional adequacy and altering dietary values, which in turn contributes to the emergence of various diseases **(Qerdaniz, 2022, p. 32)**.

2.2. Analysis of Algeria's Food Security Situation Amid Climate Change

Algeria is also among the countries that are not immune to the negative effects of climate change. In this section, we will detail and analyze the impacts of climate change on the agricultural sector in Algeria.

2.2.1. The Effects of Climate Change on Plant Production:

Climate change has a significant impact on the agricultural sector in Algeria, which heavily relies on rainfall. This dependence greatly affects agricultural productivity, which already suffers from low levels due to several factors, such as agricultural policies, soil stress, and natural constraints (droughts, floods, erosion, or water scarcity) (Achachi, 2016, p. 256).

Despite efforts made to improve the sector's situation through agricultural support policies and some successes, such as increasing irrigated areas from 350,000 hectares in 2000 to 929,000 hectares in 2008 (a third of which is irrigated using water-saving systems like pivot irrigation), predictive studies indicate that the agricultural sector in Algeria will face a deepening crisis in the future due to the impacts of climate change. These impacts include fluctuating rainfall and irregular precipitation seasons, which affect soil moisture and water availability, as well as rising temperatures that modify traditional agricultural calendars and shorten crop cycles and average agricultural yields, particularly for dry crops and those that consume large amounts of water, such as cereals (Achachi, 2016, p. 256).

Agriculture in Algeria consumes significant amounts of water, reaching up to 65% of mobilized water resources, while it contributes only about 15% to the Gross Domestic Product (GDP). This situation poses a major obstacle to the growth of other sectors, such as industry and tourism. Additionally, cereals, which are the main food source for the Algerian population and are water-intensive crops, only cover about 20% of local needs. The Ministry of Agriculture estimates that production may decline by about 10% due to climate disruptions. For example, the effects of water scarcity and drought during the growth stage of wheat result in fewer spikes and reduced grain weight, leading to lower yields; this gap is expected to widen further in the future (Achachi, 2016, pp. 256-257).

In the same context of plant production, there are products affected by climate change, such as olives and almonds, as well as other rain-fed tree crops. Today, the price of one kilogram of fresh olives in the market exceeds 150 DZD, whereas in previous years, it did not exceed 50 DZD. The same applies to almonds, which have also reached very high prices.

The effect of climate change on plant production is a decrease in the quantity of crops that depend on rainfall, leading to a reduced supply against increasing demand. This situation results in higher prices—according to the law of supply and demand. Furthermore, there is an attempt to compensate for the reduced production by relying on irrigated agriculture, which increases production costs and consequently leads to higher prices for these crops. For instance, the price of chickpeas in Algeria, which relies on rainfall for irrigation, has risen, along with other legumes such as beans and lentils, which are now sold at prices exceeding those of some types of white meat and fish. For example, after being sold at 70 DZD in 2008, lentils are priced at 270 DZD in 2023 at grain cooperatives (local lentils). As of 2025, the retail price of lentils in stores has reached 280 DZD.

From the above analysis, it is clear that climate change significantly affects plant production. Ultimately, it leads to reduced productivity and, subsequently, an increase in agricultural prices, which in turn impacts the purchasing power of Algerian citizens. As a result, citizens find that their income is insufficient to meet the minimum daily nutritional needs, prompting them to compensate for this by opting out of purchasing some higher-priced, nutrient-rich food products in favor of lower-nutrient alternatives. This shift negatively affects their diets and ultimately impacts human health, as evidenced by rising cases of obesity, irritable bowel syndrome, and various abdominal health issues.

2.2.2. The Effects on Animal Production:

Animal production has also been affected by climate change, particularly through diseases that afflict livestock, such as bluetongue disease, which primarily affects ruminants like sheep in tropical and subtropical areas after the disease is transmitted via a specific type of mosquito. However, due to global warming, this disease has started to spread northward. It was first reported in Algeria starting in July 2000 in the northeastern provinces, and later appeared in the central and western regions in 2006. It has even been reported in Southern and Western Europe and Germany. This disease can lead to significant mortality among infected animals or cause permanent disabilities, necessitating periodic vaccination campaigns that increase economic costs (Achachi, 2016, p. 257).

The negative impacts of climate change, such as reduced rainfall and rising temperatures, manifest in two major ways concerning animal production. The first is the decline in vegetation cover in natural pastures, while the second is the decrease in crops that are entirely or partially used as feed for livestock, resulting in a reduced supply of animal feed in the markets. The occurrence of the first issue, which we are currently experiencing, means that herders cannot provide free food for their sheep through natural grazing, forcing them to purchase animal feed from the market to fill this gap. This situation leads to increased livestock costs, which in turn raises their market prices, whether alive or at the butcher's. The second issue causes the price of livestock feed to rise in the markets—again, according to the law of supply and demand—negatively impacting livestock prices as well.

The continuous rise in livestock prices has been a phenomenon experienced by Algerian citizens in recent years, particularly noticeable during the Eid al-Adha holiday. Each year, citizens find that the price of sacrificial animals has increased significantly compared to the previous year by over 20,000 DZD. Furthermore, there has been a persistent increase in the prices of livestock meat at butcher shops, which has been on the rise. For instance, after previously costing 1,200 DZD, lamb meat now exceeds 3,000 DZD in 2025 and can reach up to 3,500 DZD or more in major cities. This situation significantly impacts the purchasing power of Algerian citizens, leading them to choose between high-nutrient red meat and lower-nutrient white meat. Ultimately, this shift leads to the substitution of red meat in their diets with white meat. Given the rising prices of white meat due to increased production costs (such as the costs of chicks and poultry feed), Algerian citizens now rarely purchase white meat, opting instead for lower-nutrient food products to meet their daily dietary needs.

In other words, climate change negatively impacts animal production by affecting the availability of livestock feed, which ultimately drives up livestock prices, whether live or in the form of meat at butcher shops. This situation results in Algerian citizens being unable to afford meat on regular days, nor can they afford to purchase sacrificial animals during Eid al-Adha.

2.2.3. The Effects on Fishery Resources:

The fishery resources in Algeria are not measured solely by the length of its coastline, which stretches approximately 1,650 km, but also by the narrow continental shelf, which is very limited. The natural fishery resources in Algeria are estimated at around 220,000 tons. Despite the economic importance of these resources, they suffer from weaknesses for several reasons, the most significant of which are overfishing, non-compliance with biological rest periods, marine pollution, and global warming.

Algerian citizens are fully aware of the prices of various types of fish in Algeria, especially sardines, which maintain high prices throughout the year, with further increases in winter. One of the primary reasons for rising prices is global warming. The relationship between this climate change and rising prices is evident, as climate change negatively affects sea temperatures and acidity levels, which significantly impacts marine organisms by affecting the food supplies for fish and altering the chemical makeup of the sea. This gradual decline in the quantity of these plants in warmer waters will reduce the availability of nutrients for animals along the food chain. All these factors play an important role in the life cycles of many marine plants and fish.

Climate change negatively affects fishery resources, leading to a decline in reproduction rates, which results in reduced quantities of fish caught and available in the markets. When supply of a certain good decreases in the market while demand remains stable or increases, prices are driven up—according to the law of supply and demand—resulting in a continual rise in fish prices throughout the year. Algerians have been suffering from exorbitant fish prices for years; for instance, sardines (specifically those with spots on their sides) that were priced at no more than 50 DZD in winter during the 1990s and 30 DZD in summer are now sold for no less than 600 DZD in summer and exceed 1,500 DZD in winter.

The previous analysis indicates that climate change has significantly affected food security in Algeria by directly impacting crop production, livestock farming, and fishery resources. It has

led to a decline in agricultural yields and a rise in the prices of essential food products, thereby reducing citizens' purchasing power and posing challenges in meeting their basic nutritional needs. Moreover, it has exacerbated pasture degradation and livestock production difficulties, driving up meat prices and limiting access to animal protein. Similarly, the fisheries sector has suffered from declining fish stocks due to ocean warming, resulting in higher fish prices and reducing their viability as an alternative protein source.

Section Three: Adaptation Strategies to Climate Change Impacts on Food Security in Algeria

Climate change adaptation refers to the measures taken to reduce exposure to current or anticipated climate change impacts, such as extreme weather events, rising sea levels, biodiversity loss, and food and water insecurity (United Nations Development Programme, 2024).

Many adaptation measures must be implemented at the local level, making rural communities and cities crucial players in this process. These measures include cultivating drought-resistant crop varieties, practicing regenerative agriculture, improving water storage and usage, managing land to reduce wildfire risks, and building stronger defenses against extreme weather events such as floods and heatwaves (United Nations Development Programme, 2024).

However, adaptation must also be driven at the national and international levels. In addition to developing policies to guide adaptation efforts, governments must consider large-scale measures such as strengthening or relocating infrastructure in coastal areas affected by rising sea levels, constructing climate-resilient infrastructure to withstand extreme weather conditions, enhancing early warning systems and disaster information access, developing climate risk insurance mechanisms, and establishing new protections for wildlife and natural ecosystems (United Nations Development Programme, 2024).

Scientific studies indicate that the Earth's average temperature has risen by approximately **1.**1°C compared to the 19th century, leading to widespread and rapid changes in the atmosphere, oceans, and ecosystems. As a result, extreme weather and climate events have become more frequent and intense globally (United Nations Development Programme, 2024), including in North Africa, where Algeria faces increasing climate challenges.

Climate models suggest that, in the absence of significant climate action, global temperatures could rise by 2.5 to 2.9°C above pre-industrial levels this century—far exceeding the safety thresholds established by scientists (United Nations Development Programme, 2024). This temperature increase is expected to exacerbate droughts, water scarcity, and disruptions in rainfall patterns, directly affecting the agricultural sector, which serves as the foundation of Algeria’s food security.

With each degree of warming, the effects of climate change become more severe and frequent, making adaptation increasingly complex and costly (United Nations Development Programme, 2024). Like many developing countries, Algeria faces compounded challenges due to its geographical and climatic conditions, heavy reliance on natural resources, and limited adaptive capacity. Climate adaptation is a necessity, particularly for vulnerable groups, including farmers, rural communities, and marginalized populations whose livelihoods depend heavily on agriculture and natural resources.

Even in optimistic scenarios where greenhouse gas emissions are significantly and rapidly reduced, the impacts of climate change will persist for decades due to the energy already trapped in the climate system (United Nations Development Programme, 2024). This means that emission reduction alone is insufficient to address the climate crisis—Algeria must adopt sustainable adaptation strategies such as improving water resource management, developing drought-resistant agriculture, enhancing early warning systems, and investing in climate-resilient infrastructure. Implementing these policies will not only safeguard food security but also strengthen Algeria’s resilience to future climate challenges.

As part of its commitment to tackling climate change and enhancing resilience, Algeria initiated the development of its National Strategy for Combating Climate Change in August 2024. This effort is being led by the National Climate Committee, which brings together representatives from 22 ministerial sectors. The strategy aims to provide a clear and structured roadmap to strengthen the country's capacity to address climate challenges, leveraging scientific data and sector-specific policies while aligning with both national priorities and international frameworks (Ministry of Environment and Quality of Life, 2024).

The Ministry of Environment and Renewable Energies has underscored the need for a comprehensive and integrated approach that accounts for Algeria's environmental, social, and economic realities. The strategy will build on best practices and accumulated expertise, ensuring that policy decisions are informed by rigorous analysis. A key component of this process involves an in-depth evaluation of national and sectoral development models, enabling the projection of climate scenarios through 2050 and the assessment of potential impacts (Ministry of Environment and Quality of Life, 2024).

To maximize the strategy's effectiveness, Algeria is adopting a participatory approach that emphasizes broad national consultations and multi-sectoral collaboration. The strategy will identify priority areas and establish strategic partnerships to enhance the country's capacity to adapt to climate change and mitigate its adverse effects. These efforts align with Algeria's international commitments, including its reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and its adherence to the Paris Agreement (Ministry of Environment and Quality of Life, 2024).

To date, the content of Algeria's National Strategy for Combating Climate Change has not been officially disclosed. However, its general framework can be inferred from the participation of Algeria's Minister of Agriculture and Rural Development in the United Nations Security Council's open debate held in February 2024 on "The Impact of Climate Change and Food Insecurity on the Maintenance of International Peace and Security."

Based on the proposals presented by the Algerian minister to promote stability and address the long-term effects of climate change, it can be deduced that Algeria's strategy in this regard may focus on the following key areas **(Ministry of Agriculture and Rural Development, 2024)**:

- **Enhancing mechanisms for conflict prevention and resolution**: This involves implementing proactive measures to address the root causes of crises and minimize the likelihood of their occurrence, thereby contributing to national and international stability and security.
- **Strengthening the resilience of communities and ecosystems**: This can be achieved by supporting sustainable agricultural practices, improving natural resource management, and reinforcing water conservation policies to effectively mitigate the impacts of climate change.
- **Addressing the root causes of food insecurity**: This entails identifying weaknesses in production systems and supply chains and working to rectify them by fostering sustainable economic development, combating poverty and inequality, promoting good governance, and facilitating access to global markets for agricultural products from the Global South by eliminating trade barriers.
- **Enhancing international cooperation**: This includes building multilateral partnerships to exchange knowledge and resources, supporting international organizations such as the Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), and the World Food Program (WFP), and developing effective strategies for both climate change mitigation and adaptation.
- **Providing sustainable financing mechanisms**: These mechanisms would enable developing countries, including Algeria, to secure adequate and appropriate financial support to tackle climate challenges and ensure food security.

- **Encouraging scientific research and innovation**: This involves advancing agricultural research related to climate change, strengthening early warning systems to anticipate future risks, and fostering innovative and sustainable solutions for climate adaptation.

These strategic orientations align with Algeria's broader vision to reinforce national food security, achieve sustainable agricultural development, and actively contribute to international efforts aimed at mitigating the repercussions of climate change on global peace and stability.

By analyzing the content of previous strategies that are expected to be included in Algeria's National Strategy for Combating Climate Change, we have identified key elements of the strategy and linked them to the concept of food security. This analysis highlights how these strategic measures can strengthen food security in Algeria. The following are the primary ways in which Algeria's food security can benefit from this strategy:

A. Protecting Agricultural Production from Climate Change Impacts

- Climate change phenomena such as drought and desertification negatively affect agricultural production, posing a threat to food security.
- By promoting sustainable agricultural practices and developing advanced irrigation systems, Algeria can maintain stable production levels of essential food commodities.

B. Enhancing Water Resource Efficiency

- Agriculture heavily depends on water, and the strategy will support more efficient water resource management through conservation policies and modern irrigation techniques.
- Improved water management reduces crop losses due to water scarcity, thereby increasing food production.

C. Improving Food Supply Chains and Reducing Waste

- Identifying weaknesses in production and distribution chains and implementing corrective measures will minimize food waste, increasing food availability in local markets.
- Strengthening agricultural and storage infrastructure reduces risks to food security caused by climate-related disruptions.

D. Supporting Rural Communities and Increasing Local Production

- By fostering rural development, farmers will be able to adopt modern techniques that enhance productivity, reducing reliance on food imports and promoting self-sufficiency.
- Improving farmers' economic conditions contributes to stable agricultural production, ensuring long-term food availability.

E. Enhancing International Cooperation and Securing External Funding

- The strategy will provide Algeria with opportunities to access financial and technical support from international organizations, such as the Food and Agriculture Organization (FAO) and the Green Climate Fund, aiding in the implementation of sustainable agricultural projects.
- Collaboration with international partners will facilitate knowledge exchange and the adoption of advanced technologies to address food security challenges.

F. Encouraging Scientific Research and Agricultural Innovation

- Investing in agricultural research and developing innovative technologies, such as drought-resistant crops, will help sustain agricultural production despite climate challenges.
- Establishing early warning systems for natural disasters will enable proactive measures to protect agricultural output and minimize losses.

Algeria can benefit from the experiences of several leading countries in climate change adaptation, many of which have demonstrated significant ambition and innovation despite their limited resources. Analyzing these experiences presents a valuable opportunity to enhance the national strategy for combating climate change by developing effective adaptation strategies that focus on strengthening food security and ensuring its sustainability in the face of growing climate challenges. Some notable examples of these pioneering experiences include:

- In the Pacific, the small island nation of Tuvalu has leveraged the best available science—and approximately 270,000 cubic meters of sand—to reclaim a 780-meter-long and

100-meter-wide strip of land, protecting against rising sea levels and extreme waves beyond 2100. This initiative is crucial for a low-lying coral island nation with only about 26 square kilometers of land (United Nations Development Programme, 2024).

- Other countries, such as Malawi and Pakistan, are advancing climate data collection and early warning systems, equipping communities, farmers, and policymakers with essential information to safeguard lives and livelihoods (United Nations Development Programme, 2024).
- Cuba and Colombia are at the forefront of nature-based approaches, restoring critical ecosystems—such as mangroves and wetlands—to mitigate floods and droughts. In this process, Colombia benefits from the invaluable knowledge of its Indigenous communities, who have extensive expertise in adapting to extreme environmental changes (United Nations Development Programme, 2024).
- Bhutan, the world's first carbon-negative country, and Chad, one of the least developed nations, have successfully completed their national adaptation plans. These plans, the result of years of careful planning and consultation, serve as essential roadmaps for future adaptation efforts. In Bhutan's case, the strategy is deeply rooted in the country's unique philosophy of Gross National Happiness (United Nations Development Programme, 2024).

Conclusion:

This research paper examined the impact of climate change on food security in Algeria, focusing on the strategies implemented to adapt to these challenges and mitigate their negative effects on the agricultural sector. It explored the general framework of Algeria's proposed National Climate Change Strategy, analyzing its key components, including improving natural resource management, enhancing adaptive capacities, and reducing the risks of drought and desertification. Additionally, the study highlighted the importance of adopting sustainable agricultural policies, promoting scientific research and innovation in agriculture, and strengthening international cooperation to ensure long-term food security. Based on an analysis of current policies and practices, this study presents a set of conclusions and recommendations that can enhance Algeria's ability to address climate change challenges and maintain food production stability.

Findings:

- Climate change poses a significant threat to food security in Algeria, leading to decreased agricultural production due to drought, desertification, and changes in rainfall patterns.
- Despite national efforts to combat climate change, more integrated and comprehensive policies are needed to enhance the agricultural sector's resilience to these challenges.
- Improving water resource management is crucial for ensuring sustainable agricultural production, particularly given water scarcity and increasing demand.

Recommendations:

- Algeria should strengthen its climate change adaptation strategies by implementing modern agricultural techniques, such as climate-smart agriculture and the expansion of drought-resistant crops, to ensure continuous agricultural production.
- Enhancing water resource efficiency is essential. This can be achieved by developing advanced irrigation systems, investing in water desalination technologies, and reusing treated water in agriculture to minimize climate change's impact on food security.
- Scientific research on the effects of climate change on agricultural production should be encouraged, along with the development of innovative solutions such as early warning systems for climate-related disasters to enhance Algeria's capacity for effective response.
- Algeria should expand its partnerships with international organizations such as the Food and Agriculture Organization (FAO) and the United Nations Development Programme

(UNDP) to secure financial and technical support for implementing agricultural projects that strengthen food security.

- Providing financial and technical support to farmers, improving transportation and storage networks, and increasing investments in the agricultural sector will help reduce food waste and ensure sustainable food availability.

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