



Promotion and Adaptation of Agricultural Investments in Morocco in the Face of Climate Change: Challenges and Sustainable Strategies

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Abstract

This article explores the impact of climate change on the agricultural sector in Morocco and examines the challenges and opportunities associated with adapting to and promoting agricultural investments in response to these changes. By focusing on sustainable agricultural practices, innovative technologies, and adaptation policies, we will analyze the effects of climate change on agricultural investments. The aim of our work is to assess the current and future impacts of climate change on agriculture in Morocco and to identify the main challenges faced by agricultural investments due to climate change, such as water availability, precipitation variability, and rising temperatures. We also aim to examine adaptation strategies and sustainable agricultural practices that could enhance the resilience of agricultural systems in the face of climate change. Finally, we will propose policy recommendations and innovative solutions to mobilize agricultural investments in climate change adaptation initiatives in Morocco.

Keywords: *climate change, agricultural investment, Morocco*

JEL Classification: Q14, Q54

Introduction

The agricultural sector is at the heart of international debates, particularly in light of the multiple crises affecting agricultural markets worldwide. The impact of climate change on production, combined with recent food crises, has compelled public authorities and global organizations to question issues related to agricultural productivity and investment, as well as global food security. It is widely recognized that agriculture plays a crucial role in the economic growth and sustainable development of countries. Productivity gains in the agricultural sector actively contribute to the development of economies, and Morocco is no exception, with the agricultural sector accounting for 15% of GDP and employing about 40% of the workforce. However, this sector faces various challenges, including inadequate infrastructure, particularly in transport and storage of products.

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Additionally, desertification and drought, which could lead to reduced yields and harvests, also represent obstacles to overcome. Indeed, climate change can negatively impact Moroccan agricultural systems and the livelihoods of farmers. The director of the National Institute for Agronomic Research (INRA), Faouzi Bekkaoui, warns that "due to climate change, Morocco's cereal production capacity is projected to decline by 30%." In this context, it is imperative to adapt agriculture to climate change and establish a structured and efficient agricultural sector capable of increasing agricultural production and diversifying agricultural products. This would allow for the accumulation of capital that could positively impact other sectors while ensuring an adequate standard of living through the stabilization of prices for basic agricultural products. Furthermore, investing the surplus generated by agriculture into other sectors contributes to job creation, increased income, and, of course, stimulates demand. Thus, investment in agriculture appears to be a crucial condition for the development of countries.

Our study aims to examine the influence of climate change on investments in the agricultural sector, as well as to highlight the main actions taken by Moroccan authorities to address these challenges. First, we will present the theoretical and empirical link between climate change and agriculture. Next, we will outline the context of agriculture in Morocco and detail our research methodology. Subsequently, we will analyze the results obtained and formulate relevant recommendations. Finally, we will draw a concise conclusion from our work.

1. The Literature Review

1.1. Theoretical Link Between Climate Change and Agriculture

Climate change negatively influences several sectors, particularly the agricultural sector ((Ben Mohamed et al., 2002; Blanc, 2012; Mendelsohn, 2009).

This sector is the most vulnerable to climate change due to its high sensitivity to weather factors, leading to significant economic repercussions. Changes in climatic phenomena, such as precipitation and temperature, significantly affect crop yields and, consequently, on the entire agricultural sector. (Malhi et al., 2021).

The impact of climate change on agriculture is complex and encompasses several dimensions, such as biological changes, including shifts in areas suitable for cultivation, population movements, and alterations in biodiversity. Additionally, the effects on hydrology, such as groundwater levels, river flows, and the quality of water in lakes and wetlands, are also be considered (Kim, 2012).

In their study, (Lambi & Forbang, 2009) indicate that climatic factors directly impact the spatial distribution of crop types and agricultural systems, as some crops require different amounts of moisture, heat, sunlight, and precipitation. Indeed, climate is a fundamental factor that determines the type of crop and yields.

Global warming has a negative impact on the quality and quantity of crops, particularly by reducing the growing season due to a significant increase in temperatures. Furthermore, soil fertility is affected by increased decomposition of organic matter, which can lead to a decrease in productivity. Additionally, this global warming promotes the proliferation of weeds, pathogens, and harmful insects, which further threaten agricultural crops(Aydinalp & Cresser, 2008).

In the African context, (Boko et al. 2007) highlight that prolonged drought period in the Sahel and the Horn of Africa can lead to soil degradation and a reduction in crop yields, while also increasing the risk of wildfires.

The effects of climate change on the agricultural sector result in both positive repercussions, offering opportunities, and negative consequences, generating costs. Therefore, it is crucial to plan adaptation strategies that optimize these opportunities while minimizing costs. The goal is to promote investment and the sustainable development of agriculture. (Zilberman et al., 2004).

1.2. The Empirical Literature Review

Several empirical studies have investigated the impact of climate change on agriculture. Notably, (Akram, 2013) used panel data from eight Asian countries during the period 1972-2009 to analyze the impact of growth rates and agricultural GDP on temperature. The study's findings indicate that the increase in temperature and precipitation had a negative impact on GDP. This impact is more pronounced in the agricultural sector compared to other sectors such as industry and service.

In another study, (Bayraç & Doğan, 2016) examined the relationship between agricultural GDP, CO₂ emissions, agricultural yield, temperature, and precipitation in Turkey during the period from 1980 to 2013. The main findings indicate that changes in agricultural yield and precipitation positively impact agricultural GDP, while temperature changes negatively affect the agricultural sector. This negative effect is more pronounced than the positive effect of variations in precipitation, leading to an overall negative impact of climate change on the agricultural sector.

(Alam, 2013) observed a negative relationship between cereal yield and CO₂ emissions, while a positive relationship exists between cereal yield and economic growth, based on data from India during the period 1971-2011.

A sample of sixteen agroecological zones (Seo et al., 2009) found that climate change leads to poor agricultural production in dry and wet savanna areas, while better production is noted in humid and sub-humid forest zones.

Several empirical studies have explored the link between climate change and agriculture in the North African countries, namely Morocco, Algeria, Tunisia, Libya, Mauritania, and Egypt. Among these, the works of (Amouzay et al., 2023; Jeder et al., 2013; Nefzi A. et Bouzidi F., 2008.; Ouda et al., 2011; Zaied & Zouabi, 2016), stand out.

They highlight the main impacts of climate change on the agricultural sector, the vulnerability of agricultural systems, and emphasize the importance of developing adaptation strategies to help farmers address these challenges.

2. Climate Change and Agriculture in Morocco

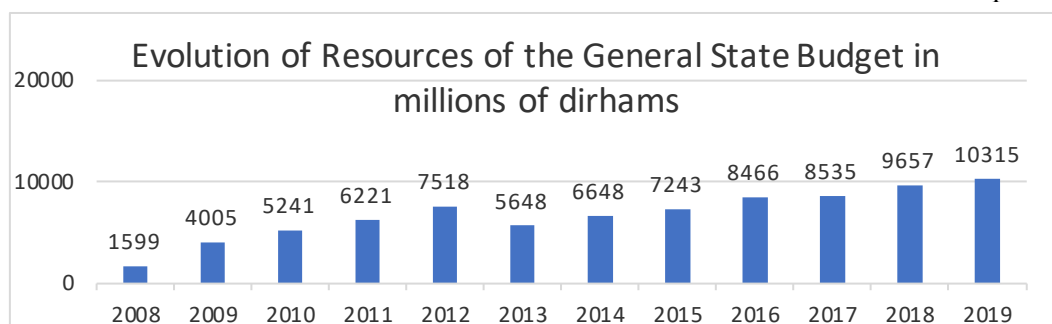
2.1. Importance of Agriculture for the National Economy

Agriculture is crucial for the economic development of Morocco, contributing over 15% of GDP in 2023. It plays a fundamental role in employment, accounting for 40% of total employment at the national level and approximately 74% at the rural level. Moroccan agricultural production focuses on several cereal crops, notably wheat and barley, which represent about 60% of the cultivated area. Morocco is also a major producer of fruits and

vegetables, including zucchini, tomatoes, citrus fruits, onions, and potatoes. It is also known for its olive cultivation.

The vital role of agricultural activity in the Moroccan economy, as the leading creator of wealth and jobs, has prompted Moroccan authorities to engage in various international and national initiatives over the past two decades to enhance this sector. Additionally, strategies have been implemented to promote agricultural investments and strengthen the resilience of Moroccan territory and its civilization against the challenges of climate change. Since the launch of the Green Morocco Plan (PMV) in 2008, private and public investments in agriculture, along with state budget resources, have experienced significant revitalization. This can be seen in the accompanying graphs.

Graphic 1.

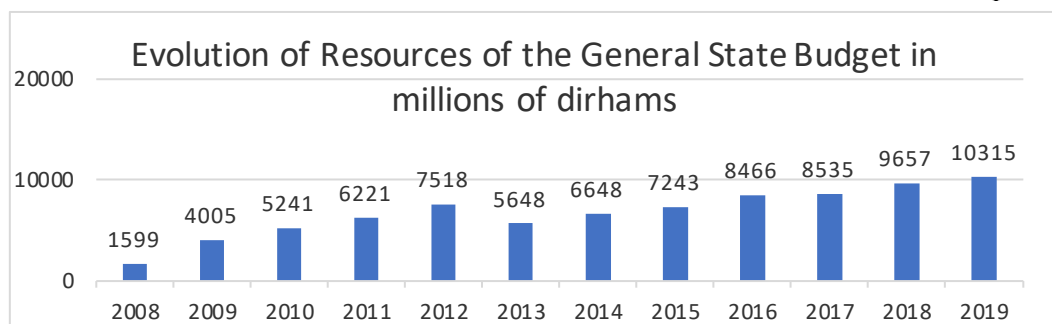


(Source : www.agriculture.gov.ma)

Global investment has experienced positive evolution, increasing from 3.7 billion dirhams to 71 billion dirhams. This investment effort has primarily focused on productive infrastructure and support for solidarity agriculture. This investment is mainly facilitated by incentives provided through the Agricultural Development Fund (FDA).

Indeed, more than 29.8 billion dirhams in direct incentives have been granted between 2008 and 2019 in various areas such as: water-saving projects at the plot level, assistance for the development of mechanization and equipment for agricultural operations, development of livestock sectors and support for farmers in using selected seeds at subsidized prices.

Graphic 2.



(Source : www.agriculture.gov.ma)

The resources of the general budget have experienced positive evolution, increasing from 1.6 billion dirhams in 2008 to 10.3 billion in 2019. This evolution highlights the importance of the efforts made by Morocco to position agriculture as an essential lever for economic and social development.

2.2. Impact of Climate Change on Moroccan Agriculture

Climate change is considered a major challenge to the development of the agricultural sector in Morocco. Indeed, this climatic variability leads to a trend of increasing aridity, resulting in rising temperatures and a decrease in precipitation. These factors are likely to have negative impacts on the agricultural landscape and the availability of water resources. Over the past 70 years, more than twenty agricultural seasons have experienced climatic droughts in Morocco.

According to the General Directorate of Meteorology, the period from 2019 to 2022 is the driest since the 1960s. Additionally, 2023 has been marked by five heatwaves and low precipitation. The rise in temperature increases water evaporation in the dams, which are only filled to 23%, negatively impacting farmers in various regions of Morocco.

3. Adaptation Strategies and Promotion of Agricultural Investments

To minimize the negative effects of climate change on agricultural activity, the Moroccan authorities have established a national strategy for sustainable development, composed of two key components: adaptation to climate change and the mitigation of greenhouse gas effects. The first component includes four major programs:

➤ The water management and irrigation program: As part of this program, the water management and control policy is structured around three main initiatives:

- The National Water Economy Irrigation Program (PNEEI): This program aims to develop localized irrigation over an area of 550,000 hectares to increase the efficiency of water use in agriculture.

- The Irrigation Extension Program (PEI): This program seeks to create new irrigation perimeters and strengthen existing systems, particularly those supplied by completed or planned dams, covering an area of 130,000 hectares. The goal is to address the underutilization of nearly 1.2 billion cubic meters of water mobilized by these dams for irrigation.

- The Public-Private Partnership (PPP) Program: This program aims to improve the technical, economic, and financial conditions for managing irrigation services within the affected perimeters.

➤ ***The program for the conversion of cereals and the intensification of fruit tree cultivation***: This program aims to rehabilitate and maintain existing plantations in order to improve agricultural production. It seeks to enhance the benefits introduced by the modernization of irrigation infrastructure, the optimization of agricultural practices, mechanization, and the valorization of production.

➤ ***The climate risk coverage program***; In order to contribute to improving farmers' resilience to climate variability, including drought, strong winds, sandstorms, and excess water, this program has implemented two insurance products:

- Climate multi-risk insurance for cereals, legumes, and oilseeds.
- A multi-risk climate guarantee program for fruit tree cultivation.

➤ *The programs for the conservation of ecosystems and biodiversity:* This program aims to conserve and develop fragile areas from economic, social, and environmental perspectives. It is primarily conducted within the framework of the Strategy for the Development of Oasis Areas and Argan Trees.

The second component consists of greenhouse gas emission mitigation programs. Although Morocco is internationally recognized as a low emitter of greenhouse gases, it actively participates in the global process of combating climate change, as evidenced by its ratification of the Paris Agreement and its determined national contributions. As part of its mitigation efforts, Morocco has implemented several actions that include 55 measures, 14 of which are related to agricultural activities and primarily focus on programs for planting fruit trees.

In order to develop eco-efficient and resilient agriculture, the Department of Agriculture in Morocco has deployed and continues its efforts to establish a new agricultural strategy called "Green Generation 2020-2030." This involves several actions, such as:

- Encouraging the energy transition of farmers towards renewable energies.
- Improving water efficiency by relying on irrigation management programs and agricultural space planning, as well as mobilizing non-conventional water resources.
- Continuing planting programs, particularly for species more suited to arid climates.
- Continuing to raise climate funds from donors, particularly through ADA's direct access to financial resources from the Green Climate Fund and the Adaptation Fund.
- Developing organic agriculture.
- Disseminating soil conservation techniques.
- Adopting and promoting Green Tech and advancing agricultural digitalization.

Conclusion

Agriculture serves as the backbone of Morocco's economy, accounting for a significant portion of the nation's wealth and providing numerous job opportunities for its citizens. As a result, the economic and social progress of the country is closely tied to the resilience and sustainability of the agricultural sector.

Among the numerous challenges faced by this vital industry, climate change stands out as a formidable threat. Its effects can be seen in reduced crop yields, altered growing seasons, and shifts in the types of crops that can be viably cultivated. For instance, increased temperatures and erratic rainfall patterns can lead to drought conditions in some regions while causing flooding in others, making it difficult for farmers to rely on traditional agricultural practices.

These climatic shifts necessitate the development of targeted investment strategies that are specifically designed to adapt to these new environmental realities. This could involve investing in innovative irrigation systems, climate-resistant crop varieties, and advanced agricultural techniques that optimize land use. Additionally, changing weather patterns may redefine the most suitable areas for certain types of farming, prompting a need for research and policies that guide farmers toward more sustainable practices in new locales.

To navigate these pressing challenges effectively, Morocco must focus on integrating robust adaptation strategies into its agricultural framework. This includes promoting sustainable farming methods, enhancing soil health, and increasing farmers' access to resources and training. By prioritizing these adaptation efforts, Morocco can bolster its

agricultural sector's sustainability and resilience, ensuring food security and economic stability for the nation's future. By fostering innovation and adopting sustainable practices, Morocco can safeguard its agricultural output while promoting eco-efficiency. Collaborative efforts involving local communities, policymakers, and agricultural stakeholders will be crucial in developing and implementing these strategies. Ultimately, this proactive approach will not only secure food production but also bolster economic growth and social development across the nation, ensuring a more resilient future for Morocco's agriculture.

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