Climate Change Agriculture: From Biophysical Shock to Economic Impact

Introduction

- With a GDP per capita of USD 1,546, Senegal remains predominantly an agricultural country. Over 60% of its 15 million inhabitants live in rural areas. The agricultural sector employs about 46% of the labor force and contributes 16% to the national GDP (World Bank, 2020).

- In terms of food security, the prevalence of undernourishment was 11% in 2017—showing a significant decline from 28% in 2000 (FAO, 2019).

Objectives

- Produce credible estimates of climate change impacts on agriculture.

- Use an integrated modeling approach that combines climate, agricultural, and economic models.

- Systematically integration of these models enables a comprehensive assessment of climate change effects on the agricultural sector, supports the design of adaptation strategies, and allows for the simulation of associated adaptation costs.

Materials and methods

This process will follow a structured sequence, from data processing to the quantification of climate change impacts. Specifically, a range of approaches and tools will be applied:

- Analysis future trends in agro-climatic indicators coupling Global Climate Models (GCMs) with crop models

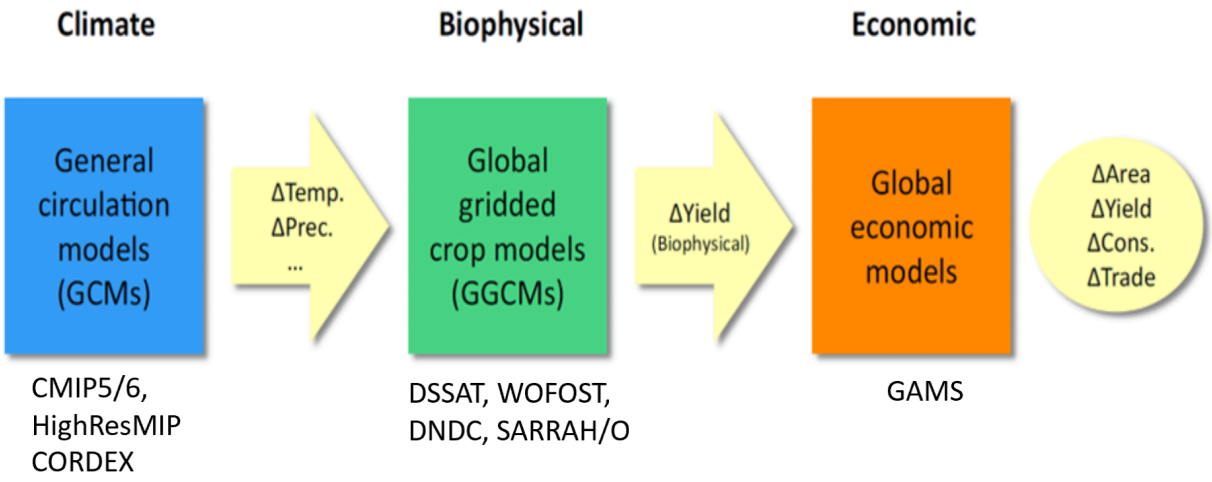
- Development of future agricultural yield scenarios

- Organization of methodological workshops with the Agriculture Consortium

- Production and dissemination of knowledge and tools to support decision-making

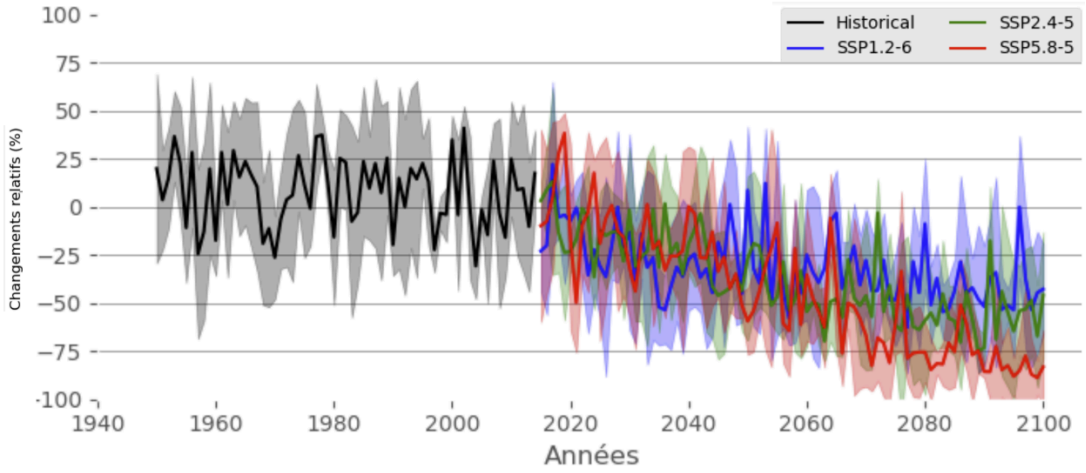
This multidisciplinary approach, focused on the systematic integration of climate, crop, and economic models, will enable a robust assessment of climate change impacts on the agricultural sector. It will also support the formulation of adaptation strategies and simulate the financial costs associated with agricultural adaptation.

A conceptual diagram illustrating the various layers of the modeling process is provided below.



Results

Impact of climate change on agricultural systems



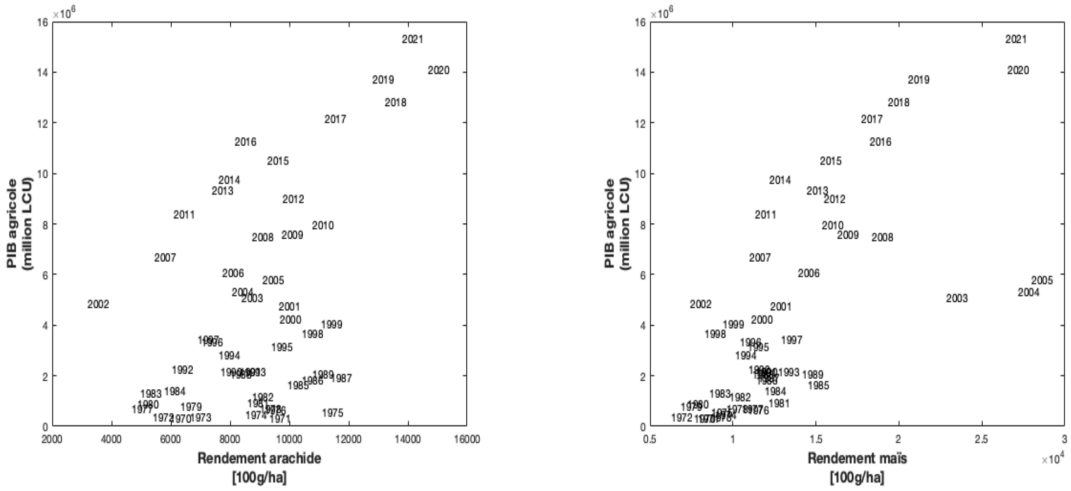
Decrease in Mil yields which could reach -75% for the SSP585 scenario, -50% for the SSP245 and -25% for the SSP126 by the end of the century.

Adaptation options are included:

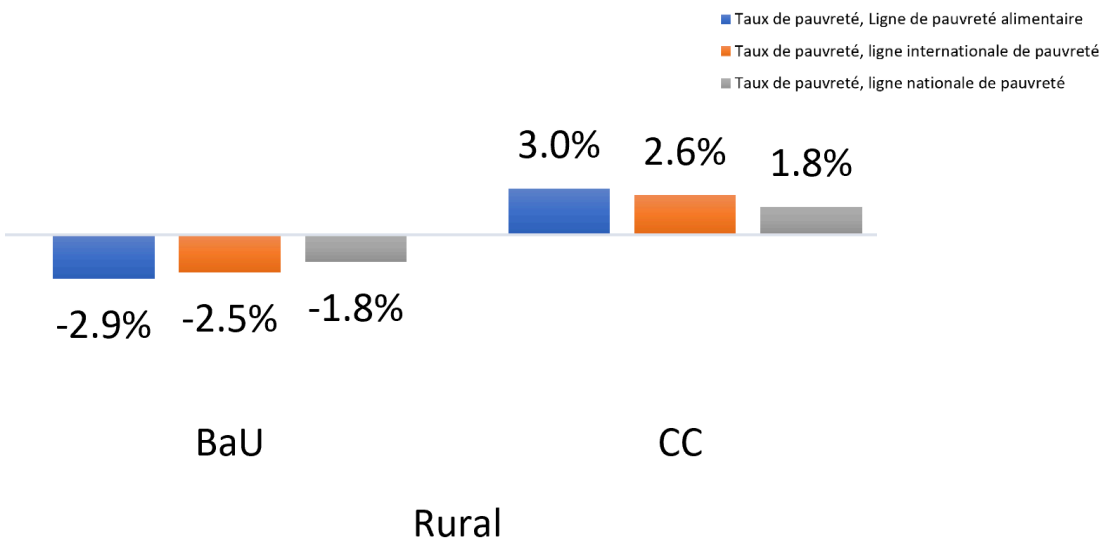
- Develop early warning systems to anticipate and respond to climate risks more effectively.
- Enhance research on climate-resilient crop varieties, particularly those with short growth cycles and higher heat tolerance.
- Increase resilience by diversifying production systems, with a focus on promoting integrated agricultural approaches.
- Institutionalize the use of climate information and services to support evidence-based agricultural decision-making.

- Strengthen risk and disaster management frameworks to address climate-induced challenges in the sector.
- Promote agricultural insurance schemes as a financial buffer against climate shocks.
- Improve post-harvest handling and storage practices, including drying and preservation techniques, to reduce losses.
- Tailor agricultural practices to agro-ecological zones based on climate projections to enhance long-term sustainability.

Economic impact and cost of adaptation



Between the 1970s and 2000s, periods of high agricultural yields coincided with relatively low GDP, a pattern that may be explained by the nature of agricultural policies in place at the time. Over the period 1970 to 2021, Senegal implemented a succession of agricultural strategies, including the Agricultural Program (1960–1980), the Economic and Financial Recovery Program (1981–1984), the New Agricultural Policy (1985–1994), the Agricultural Development Programs and Policy Statements (1995–2003), and the ongoing Program for Accelerating the Pace of Senegalese Agriculture (2013–present).



A climate shock is projected to lead to a rise in both the poverty rate and the Gini coefficient, indicating increased inequality. This upward trend holds true across different poverty thresholds. However, the impact is expected to be especially severe in rural areas, where the shock could significantly exacerbate poverty levels.

Impact and potential beneficiaries

These activities are strongly aligned with the strategic objectives of the Senegal 2050 Plan. Actively contributing to national documents that outline climate change adaptation actions and international commitments is crucial to ensuring the coherence and effectiveness of interventions. Moreover, these efforts can offer a robust scientific foundation for designing and implementing a low-carbon and climate-resilient development strategy (Long-Term Vision – LTV, Long-Term Strategy – LTS).

Conclusion and Perspectives

The approach adopted in this project seeks to bring together a multidisciplinary team of scientific experts, institutional actors, and civil society stakeholders in the agricultural sector. The goal is to collaboratively develop yield projections, evaluate the economic impacts of climate change on agriculture, and design and assess appropriate adaptation strategies.

Results showed that projected impacts are closely linked to radiative forcing and the equilibrium climate sensitivity of General Circulation Models (GCMs), both of which play a crucial role in determining crop yield forecasts. A deeper understanding of the intra-seasonal variability of key climate parameters is therefore essential for the development of effective, climate-resilient agricultural strategies.

By leveraging the collaborative framework of the think tank, the project ensures continuous dialogue between researchers and technical services within relevant ministries. This exchange will help incorporate stakeholder needs at each phase of the process—from methodological design to the scaling-up of results. Ultimately, the creation of a centralized climate and climate impact database will support technical and strategic partners in integrating climate adaptation into decision-making processes, particularly within the context of Nationally Determined Contributions (NDCs) and long-term development strategies.