



## Climate change and crop allocation in Uganda: Comparative advantage and agricultural adaptation

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- Climate change will affect Ugandan crops unevenly: banana and coffee yields are predicted to increase, while maize and beans are likely to decline.
- Despite these changes, the relative value of producing different crops in Uganda remains broadly stable across climate scenarios. Climate change is therefore unlikely to fundamentally alter which crops Uganda is best suited to produce.
- Current production patterns do not fully reflect the crops that would generate the highest production value in Uganda. Some staple crops are produced more intensively than their potential value would suggest, while several export and horticultural crops appear under-produced.
- There is scope for adaptation through changes in crop allocation, including expanding production of crops whose productivity is expected to remain strong under future climate conditions.
- Improving agricultural productivity may matter even more than adaptation via changes in crop allocation. Potential yields under modern farming practices are estimated to be three to four times higher than current yields across the board, highlighting large gains from improved inputs and other modern technologies.

## Introduction

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Agriculture plays a central role in Uganda's economy and in the livelihoods of most households. The sector employs around 80 percent of the population and contributes roughly a quarter of GDP. Production is dominated by smallholder farmers who rely largely on rain-fed systems, making agricultural productivity highly sensitive to changes in climate conditions.

Globally, climate change is expected to affect agricultural productivity unevenly across regions and crops. Understanding how climate change may affect the relative productivity and value of different crops is therefore important for designing policies that support agricultural adaptation and strengthen the resilience of Uganda's farming sector.

## Changing weather patterns

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Climate projections for Uganda suggest considerable uncertainty about how rainfall patterns will evolve over the coming decades. Across climate models and emissions scenarios, projections differ in whether rainfall will increase slightly, decline modestly, or remain broadly stable. By contrast, the projections consistently indicate rising temperatures, including a substantial increase in the number of days with temperatures above 35°C. Overall, the models point to a warmer climate, though with less agreement about future moisture conditions.

Against this uncertainty in future projections, historical trends provide an important benchmark. Over the past four decades, Uganda has experienced declining rainfall, fewer rain days, and longer dry spells during the growing season. At the same time, the number of hotter days has increased and the length of the growing period has shortened. Taken together, these trends suggest that climatic conditions for agriculture have already worsened somewhat.

## The data

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To assess how climate change may affect agricultural productivity in Uganda, we use agro-climatic projections from the Global Agro-Ecological Zones (GAEZ) database developed by the FAO and IIASA. The GAEZ model provides historical weather and climate data and future climate projections and combines them with crop growth models to estimate the potential yields that could be achieved currently and under different future climate scenarios. The data is provided for 38 crops – regardless of whether they are currently grown or not – on a grid of 2,500 fields in Uganda.

These agro-climatic projections are combined with data on crop production and Uganda producer prices to assess how climate change may affect the value of producing different crops in Uganda and how current production patterns compare with the country's underlying production potential.

## Climate projections

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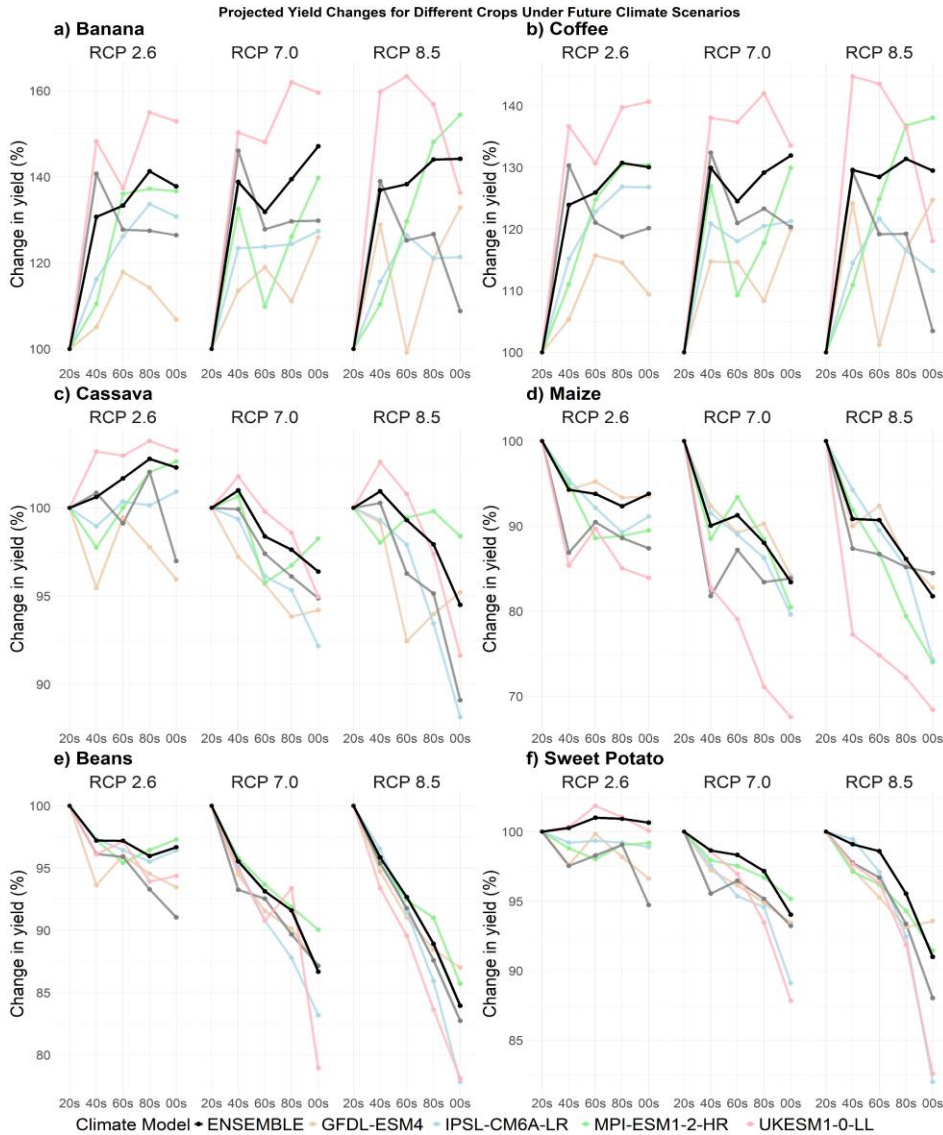
## Predicted effects on crop yields

Climate change is expected to affect crop productivity in Uganda unevenly. Projections for six major crops – banana, cassava, maize, beans, sweet potato, and Arabica coffee – suggest that some crops may benefit from future climate conditions while others may experience moderate declines in potential yields.

As seen in Figure 1, the projections indicate particularly favourable outcomes for banana and coffee, whose potential yields are expected to increase across most climate scenarios. By contrast, staple crops such as maize and beans are projected to experience declines in potential yields, especially under stronger warming scenarios. Cassava and sweet potato show more mixed patterns, with relatively stable yields under mild warming but declines under more extreme climate scenarios.

Taken together, these projections suggest that climate change may create both winners and losers across crops, highlighting the importance of enabling farmers to adapt crop choices as climate conditions evolve.

**Figure 1. Projected yields for different crops under future climate scenarios.**



The figure reports projected attainable yields (indexed to 2001–2020 = 100) for six major crops in Uganda under three climate scenarios (SSP1-2.6, SSP3-7.0, and SSP5-8.5). Each line represents a different climate model, showing projected yield changes across four future time periods, 2021-2041, 2041-2060, 2061-2080 and 2081-2100.

## Potential crop value and production patterns

Agro-climatic potential is one important consideration in choosing what crops should be produced, the other is price. Comparing current production patterns with the value that crops could generate given Uganda’s growing conditions and prices reveals a number of systematic differences. Some staple crops, such as cassava and sweet potato, are produced more intensively than their potential value, based on prices and agro-climatic conditions, would suggest. This may reflect their importance for domestic consumption and food security. By contrast, several export-oriented and horticultural crops appear to be produced less intensively than their potential value would suggest. Crops such as coffee and cocoa, as well as a number of fruits and vegetables, rank relatively highly in

terms of their potential production value but occupy a smaller role in current production. This suggests that Uganda may have scope to increase the value of agricultural production by expanding the production of some of these crops.

At the same time, the comparison shows that production patterns are quite aligned with underlying production potential. Several important crops, including maize, tomatoes, and onions, lie close to the benchmark implied by their potential production value, indicating that current production broadly reflects Uganda's growing conditions and market prices.

Looking ahead, climate change is expected to shift the relative value of producing some crops in Uganda. If current production patterns persist, several crops that already occupy a large share of production – including white potato, tea, sugarcane, banana, and cassava – would remain produced more intensively than their future production potential would suggest.

For banana and cassava, projected improvements in growing conditions mean that this mismatch becomes somewhat smaller, though production would still remain overly concentrated in these crops.

By contrast, several crops appear likely to become relatively more attractive to produce under future climate conditions. In particular, cocoa stands out as having strong future production potential, while crops such as rice, coffee, yam and cocoyam, groundnut, and sunflower may also offer opportunities for adaptation through gradual shifts in crop allocation.

## Policy implications

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The results highlight the importance of enabling farmers to respond to both agro-climatic conditions and market price signals when making crop choices. As climate conditions evolve, the relative productivity and value of different crops may change, creating opportunities for farmers to shift production toward crops that generate higher returns under local growing conditions. Policies that improve access to information, strengthen agricultural extension services, and reduce barriers to switching crops can help farmers adapt production decisions over time.

At the same time, the analysis shows that raising productivity across crops may be even more important than changes in crop allocation. The gap between current yields and the yields that could be achieved under improved farming practices remains large across many crops. Policies that support agricultural intensification are therefore crucial in increasing farm incomes and strengthening the resilience of Uganda's agricultural sector in the face of climate change.