AKADEMIYA

CACCI

COMPREHENSIVE ACTION FOR CLIMATE CHANGE INITIATIVE

No. 03, July 2023

CACCI FIELD NOTES

Economic Impacts of Climate Change and Adaptation Strategies in Kenya

Ismael Fofana

About the CACCI Field Notes

AKADEMIYA2063 CACCI Field Notes are publications by AKADEMIYA2063 scientists and collaborators based on research conducted under the Comprehensive Action for Climate Change Initiative (CACCI) project. CACCI strives to help accelerate the implementation of Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs) by meeting the needs for data and analytics and supporting institutional and coordination capacities. In Africa, CACCI works closely with the African Union Commission, AKADEMIYA2063, the African Network of Agricultural Policy Research Institutes (ANAPRI), and climate stakeholders in selected countries to inform climate planning and strengthen capacities for evidence-based policymaking to advance progress toward climate goals.

Published on the AKADEMIYA2063 website (open access), CACCI Field Notes provide broad and timely access to significant insights and evidence from our ongoing research activities in the areas of climate adaptation and mitigation. The data made available through this publication series will provide evidence-based insights to practitioners and policymakers driving climate action in countries where the CACCI project is being implemented.

AKADEMIYA2063's work under the CACCI project contributes to the provision of technical expertise to strengthen national, regional, and continental capacity for the implementation of NDCs and NAPs.

AKADEMIYA2063 is committed to supporting African countries in their efforts against climate change through provision of data and analytics using the latest available technologies. This Field Note reviews Kenya's climate change and adaptation pathway scenarios, and then assesses their prospects and projected impacts.

CACCI is supported by the U.S. Agency for International Development (USAID) through the Feed the Future Innovation Lab for Food Security Policy Research, Capacity, and Influence (PRCI) led by Michigan State University (MSU). The views expressed in this publication do not necessarily reflect those of the funder.

About AKADEMIYA2063

AKADEMIYA2063 is a pan-African non-profit research organization with headquarters in Kigali, Rwanda and a regional office in Dakar, Senegal. Inspired by the ambitions of the African Union's Agenda 2063 and grounded in the recognition of the central importance of strong knowledge and evidence-based systems, the vision of AKADEMIYA2063 is an Africa with the expertise we need for the Africa we want. This expertise must be responsive to the continent's needs for data and analysis to ensure high-quality policy design and execution. Inclusive, evidence-informed policymaking is key to meeting the continent's development aspirations, creating wealth, and improving livelihoods.

AKADEMIYA2063's overall mission is to create, across Africa and led from its headquarters in Rwanda, state-of-the-art technical capacities to support the efforts by the Member States of the African Union to achieve the key goals of Agenda 2063 of transforming national economies to boost economic growth and prosperity.

Following from its vision and mission, the main goal of AKADEMIYA2063 is to help meet Africa's needs at the continental, regional and national levels in terms of data, analytics, and mutual learning for the effective implementation of Agenda 2063 and the realization of its outcomes by a critical mass of countries. AKADEMIYA2063 strives to meet its goals through programs organized under five strategic areas—policy innovation, knowledge systems, capacity creation and deployment, operational support, and data management, digital products, and technology—as well as innovative partnerships and outreach activities. **For more information**, visit www.akademiya2063.org.

Suggested Citation: Fofana, I. 2023. *Economic Impacts of Climate Change and Adaptation Strategies in Kenya.* CACCI Field Notes, No. 03. Kigali, Rwanda: AKADEMIYA2063. https://doi.org/10.54067/caccifn.03

Author:

Ismael Fofana is the Director of Capacity and Deployment at AKADEMIYA2063: ifofana@akademiya2063.org.

1. Introduction

In a show of their resolve to act on global climate change and in response to the 2015 Paris agreement, 52 African countries had submitted their Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) by 2021. All of these countries, except one, included National Adaptation Plans (NAPs) in their NDCs, although six of these NAPs were developed separately. The NDCs reflect efforts by individual countries to reduce national greenhouse gas (GHG) emissions and adapt to the impacts of climate change, while the NAPs are strategic planning documents which detail each country's medium- and long-term priorities and interventions for adapting to climate change.

The Africa Adaptation Acceleration Program (AAAP), led by the Global Center on Adaptation (GCA) and the African Development Bank (AfDB), aims to mobilize US$ 25 billion to scale up and accelerate climate change adaptation initiatives across Africa. The AAAP will support countries in making transformational shifts in their development pathways by centering adaptation and resilience to climate change in their critical growth-oriented and inclusive policies.

AKADEMIYA2063 is supporting GCA and AfDB with the mainstreaming of climate change adaptation into agricultural policies and expenditures, by providing technical assistance to inform and facilitate the effective implementation of NAPs as well as to identify adaptation pathways and related policy options. This work is currently being undertaken in two African countries, Kenya and Mali. This report presents the case of Kenya.

Kenya's economy is heavily reliant on tourism and rainfed agriculture, both of which are vulnerable to climate change and extreme weather events. Rising temperatures and recurring droughts contribute to severe crop and livestock losses, resulting in famine, displacement, and other threats to human health and well-being. Kenya's vulnerability score in the Notre Dame Global Adaptation Initiative (ND-GAIN) Index, which measures the country's exposure, sensitivity, and capacity to adapt to climate change, is 0.52 (rank 143/182), while the ND-GAIN Index score for adaptation readiness is 0.30. The country's current and future climate change challenges combined with the difficult political and socio-economic conditions make Kenya highly vulnerable to climate change.

The National Climate Change Policy and the Climate Change Act outline the country's guiding philosophy in response to climate change as moving 'towards a low carbon, climate resilient development pathway'. Kenya launched the National Climate Change Response Strategy (NCCRS) in 2010. The country has been operationalizing this strategy through various consecutive National Climate Change Action Plans (NCCAPs), with the most recent one being NCCAP 2018-2022. The National Adaptation Plan (NAP), Nationally Determined Contributions (NDCs) and NCCAP 2018-2022 state that adaptation is a priority for Kenya and these policies detail the actions that will help the country achieve this goal. These documents identify priority adaptation actions to help households and communities manage climate risks and keep emissions low, while also prospering economically and socially despite the changing climate. The strategic objectives of the NCCAP 2018-2022 are aligned with the government's Big Four Agenda which prioritizes increased manufacturing, food and nutrition security, affordable housing, and universal health coverage. They are also aligned with Kenya's Vision 2030 whose objective is 'to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment'. The country recognizes the important roles played by the national and county (sub-national) governments, private sector, civil society organizations, research organizations, institutions of higher learning, and the media, among other actors. Each actor is expected to contribute to the successful implementation of the priority actions listed in the NCCAP which will help achieve Kenya's contributions towards the Paris Agreement as captured in its NDC and NAP, the Big Four Agenda, and ultimately, Vision 2030.

This report defines Kenya's climate change and adaptation pathway scenarios, and then assesses their prospects and projected impacts.

2. Methodology

Economic simulation models are practical tools to support evidence-based planning and the implementation of development programs. They establish a relationship between program inputs and expected outputs and outcomes. As such, they facilitate the prioritization of public interventions and investments. This ex-ante analysis of climate change and adaptation strategies is carried out using a mix of macro- and micro-economic models. The macro-economic model captures issues related to growth, employment, and income generation, while the micro-economic model addresses issues related to income distribution, poverty, food security and nutrition. The macro- and micro-models are linked in a top-down fashion through a set of interrelated variables used in both models. The models are applied to Kenya's economy using the most recently updated databases.

The methodology is implemented in a stepwise manner. First, simulation scenarios are developed through an exhaustive review of existing literature to collect evidence on climate change impacts and adaptation options on agricultural productivity. Second, evidence on the productivity effects of climate change shocks is used in the macro-model to assess economic growth and changes in employment and income by type of production factor and household category. Third, income changes from the macro-model are used in the micro-model to evaluate the poverty and food security outcomes.

2.1. Review of Climate Change Impacts on Agricultural Yields

Available literature provides evidence on the likely impacts of climate change on agriculture in Africa. The first step in implementing this methodology involves conducting an extensive review of evidence on the impacts of climate change on the agricultural sector in Kenya, East Africa, and Africa. The review covers several agricultural activities (i.e., crops, livestock, forestry, and fisheries). Predictions of the likely effects of climate change on yields are documented in annexed Tables A.2 to A.7.

Management practices at the farm level such as irrigation, crop protection with chemicals, use of fertilizers, and adjusting sowing dates have been proven to enhance crop adaptation to climate change. This review also examines existing evidence on how these practices can contribute to mitigating the impacts of climate change impact on agricultural yields in Kenya.

2.2. Modeling the Macro-Economic Impacts of Climate Change

The ex-ante analysis of climate change and adaptation pathways primarily uses a Computable General Equilibrium (CGE) model customized to Kenya's economy using a Social Accounting Matrix (SAM). The CGE models are macro-economic models that combine economic theory and empirical data to capture the effects of economic policies and shocks. They consider the interdependencies between different sectors, agents, and markets in the economy. They can therefore shed light on the wider economic impacts of shocks and policies, occasionally revealing their indirect or unintended effects. Considering the long-term outlook and impacts of climate change shocks, we developed a static CGE model for Kenya with long-term, macro-economic closure rules.

Key features of the model are borrowed from the static version of the CGE model developed by Decaluwé et al. (2013).[1] This standard CGE archetype is modified to fit climate change issues by adopting a long-term closure rule that more accurately considers the aspect of time. As such, labor, agricultural land, and other forms of capital are fully mobile between economic activities, representing the long-run where the economy has time to adjust. Current public expenditures and fiscal balances are fixed relative to Gross Domestic Product (GDP). The integration of a compensatory mechanism through taxes or subsidies on household gross income, makes it possible to capture the effects of variations in government income on household welfare following climate change shocks. Kenya is a small country in terms of its trading links with the rest of the world, i.e., the country has no influence on international prices of both imported and exported products, which remain fixed in the model. The external current account balance is kept fixed relative to GDP, thereby effectively linking external financing to the economy's performance. The volume of investment is also kept fixed relative to GDP through household savings. The model is therefore investment-driven in the sense that total investments determine total savings, i.e., the sum of private, government, and foreign savings. This closure rule enables the capturing of the full effects of climate change shocks. In other words, inter-generational transfers of welfare are not allowed. Flexible prices equilibrate the demand and supply of domestically marketed products, and the exchange rate is the numeraire in the model.

1 More details on the CGE model are provided by Decaluwé et. al (2013).

Many studies use a deterministic approach to assess the effects of climate change on agriculture. However, deterministic shocks ignore the uncertainty associated with climate change and its implications on yields as depicted in annexed Tables A.2 to A.7. In this analysis, we use a stochastic approach to consider the uncertainties inherent to climate change and its effects on agricultural yields. Climate change shocks are translated into variations in agricultural productivity, and consequently, are propagated throughout the economy through the upstream and downstream linkages of the agricultural sector with the rest of the economy.

The primary data sources for CGE models are country SAMs which are "a comprehensive, flexible, and disaggregated framework that elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups" (Round, 2003). Kenya's 2019 SAM accounts for 42 industries, including 18 agricultural activities, five factors of production (including agricultural land and three categories of labor), and 10 representative household groups. Thurlow (2021) provides more detailed information on the 2019 SAM for Kenya.

2.3. Modeling the Micro-Economic Effects of Climate Change

Micro-economic models deal with the economic decisions and actions of economic agents in reaction to policy shocks. They integrate the heterogeneous behavior of individuals and firms while accounting for the aggregate costs and benefits of interventions or shocks (Bourguignon and Spadaro, 2006). There is a growing interest in combining CGE and Micro-Simulation (MS) models to assess the effectiveness of macro-economic policies and shocks. CGE models address macro-economic and sectoral issues such as growth, employment, and earnings. However, unlike MS models, they do not capture issues related to income distribution, inequality, and poverty. Relatedly, MS models focus on individual and firm level distributive effects but fail to capture general equilibrium effects, as well as macro and sectoral issues linked to policies and shocks. Combined CGE-MS analysis can be conducted in many ways and the choice among the available approaches depends on data availability, the research questions and time constraints (Cockburn, Savard, and Tiberti, 2014).

The proposed MS model builds on the flexibility of the reweighting technique. This technique involves altering the sample weights in the MS model to reproduce changes in employment and earnings from the CGE model, and other population variables. The new weights are generated in such a way that new aggregate population values for selected variables are reproduced with minimal adjustments to the original weights. In other words, the approach minimizes the distance between new and old weights subject to a set of constraints on aggregate values. Shocks are therefore generated by the CGE model and transmitted to the MS model. Consistency between the two models is created by adjusting the household weights. In a comparison of the behavioral and the reweighting micro-simulation approaches, Herault (2010) concludes that the two approaches delivered similar results when applied to the issue of trade liberalization in South Africa.

The CGE and MS models are linked through the productive factors, i.e., three categories of labor, agricultural land, and other forms of capital. One of the advantages of the reweighting approach is the ability to project the changing dynamics for several population groups, for instance, based on region, gender and age. This feature is important in the context of climate change studies which assess long-term impacts on people's livelihoods.

The MS model is implemented using the latest available survey data. The 2015/16 Kenya Integrated Household Budget Survey (KIHBS) is used to calibrate the MS models and to conduct the micro-economic analysis.

2.4. Simulation Scenarios

The economic impacts of climate change and adaptation pathways are assessed by comparing two scenarios: (i) Business-as-Usual (BaU); and, (ii) Climate change (CC) scenarios. The first scenario, or BaU, is based on the agricultural yield trends for the past 20 years, i.e., 2000-2019 (Table 1). The low bounds are the average values of negative changes in agricultural yields. The high bounds are the average values of positive changes in agricultural yields. The BaU scenario therefore does not take climate change into account, and instead projects the continuation of historical trends in the agricultural sector and the economy in general. This serves as the reference scenario to which the outcomes of other scenarios are compared.

Table 1: Changes in agricultural yields in Kenya, 2000-2019

Agricultural Activities	Yield Variation (%)		
	Mean	Low bound	High bound
Maize	1.2	-10.5	13.0
Rice	3.9	-9.1	16.8
Other Cereals	5.7	-14.1	29.9
Pulses	3.6	-11.0	15.6
Oilseeds	-0.9	-17.2	15.5
Roots & Tubers	3.2	-13.6	17.0
Vegetables	4.6	-10.1	16.7
Sugarcane	1.0	-7.2	9.2
Tobacco	-1.9	-11.3	7.5
Cotton and Fibers	3.6	-16.9	22.4
Fruits & Nuts	0.3	-9.6	10.1
Coffee & Tea	0.5	-9.5	15.4
Other Crops	1.1	-6.9	7.7
Cattle	4.6	-10.4	23.1
Poultry	5.7	-14.0	19.9
Other Livestock	1.8	-9.0	7.7
Forestry	1.8	-0.5	2.4
Fisheries	-1.5	-12.1	7.1

Source: FAO (2022).

The second scenario is the climate change (CC) scenario which is built on the existing empirical evidence on the impacts of climate change on agricultural yields and production. Table 2 presents the results of the Kenya review with further details available in annexed Tables A.2 to A.7. These annexed tables display variations in agricultural yields driven by changes in global temperatures (i.e., from 0.5°C to 5.5°C) and precipitation levels.[2] The analysis considers the extreme values (low and high bounds) predicted by these studies.

Table 2: Climate change impacts on agricultural yields in Kenya

Agricultural Activities	Yield Variation (%)	
	Low bound	High bound
Maize	-25.0	6.3
Rice	-16.0	15.0
Other Cereals	-35.0	25.0
Pulses	-4.9	-4.9
Oilseeds	-13.5	-13.5
Roots & Tubers	-7.1	-7.1
Vegetables	-10.7	-10.7
Sugarcane	-10.8	1.6
Tobacco	-16.6	-0.6
Cotton and Fibers	-16.6	-0.6
Fruits & Nuts	-10.7	-10.7
Coffee & Tea	-40.0	12.3
Other Crops	-16.6	-0.6
Cattle	-20.0	-10.0
Poultry	-20.0	-10.0

2 The literature reviewed focused on Kenya or East Africa; the limited number of observations did not allow us to assess the impact at different levels of warming.

Agricultural Activities	Yield Variation (%)	
	Low bound	High bound
Other Livestock	-20.0	-10.0
Forestry	-70.0	-5.0
Fishery	-76.0	-56.0

Source: Author's compilation from the review of literature studies.

The BaU and climate change scenarios are introduced in line with the stochastic approach to consider the historical variability of agricultural yields, and the uncertainties inherent in climate change and its effects on agricultural yields. Shocks on agricultural yields are implemented using the Monte Carlo Technique, i.e., random selections of yield variations. Shocks are distributed uniformly using uniform probability with minimum and maximum variations (Tables 3 and 4). Several thousand (9,000) scenarios were implemented. Mean changes and standard deviations (SD) are computed for output variables and discussed in the next section.

3. The Economic Impacts of Climate Change

3.1. Effects on Agriculture

Comparison of the CC scenario with the BaU scenario indicates that climate change shocks substantially reduce agricultural productivity (Table 3). Under the BaU scenario, agricultural productivity increases by an average annual rate of 2.4 percent compared to 2019 levels (between 0.8 percent and 4.0 percent at 95 percent confidence level). Agricultural productivity is severely affected by climate change shocks with a decline of 9.7 percent in average annual productivity compared to 2019 levels (between -8.1 percent and -11.3 percent at 95 percent confidence level). Average annual agricultural productivity therefore falls by 12.1 to 15.3 percentage points in the CC scenario compared to BaU.

The results also indicate that productivity falls across all agricultural activities under the CC scenario compared to BaU (Table 3). **Fisheries** and **forestry** are the activities most affected by climate change shocks. These are followed by **livestock**, then **coffee and tea**, **cereals** (except rice), **oilseeds**, and **vegetables**. On the other hand, **rice**, **fruit and nuts**, and **sugarcane** are less affected by climate change shocks. Changes in agricultural productivity and value-added follow a similar pattern (Table 4).

Table 3: Changes in Kenya's agricultural productivity

	Business-as-Usual		Climate change	
	Mean	SD	Mean	SD
Agriculture	**2.4**	**0.8**	**-9.7**	**0.8**
Maize	1.0	0.7	-9.0	0.9
Rice	4.4	0.8	-0.6	0.9
Other cereals	7.6	1.2	-5.8	1.7
Pulses	2.3	0.8	-4.9	0.0
Oilseeds	-0.9	0.9	-13.5	0.0
Roots	1.6	0.9	-7.1	0.0
Vegetables	3.8	0.7	-10.7	0.0
Sugarcane	1.0	0.5	-4.6	0.4
Tobacco	-1.8	0.5	-8.4	0.5
Cotton and fibers	3.2	1.1	-8.8	0.5
Fruits and nuts	0.6	0.6	-5.6	0.3
Coffee and tea	2.8	0.7	-14.3	1.5
Other crops	0.3	0.4	-8.4	0.5
Cattle and raw milk	7.8	0.9	-15.0	0.3

	Business-as-Usual		Climate change	
	Mean	SD	Mean	SD
Poultry and eggs	3.4	1.0	-14.8	0.3
Other livestock	-0.4	0.5	-15.1	0.3
Forestry	0.9	0.1	-38.4	1.9
Fisheries	-2.3	0.6	-65.8	0.6

Source: Author's estimation.

Table 4: Changes in agricultural value-added in Kenya

	Business-as-Usual		Climate change	
	Mean	SD	Mean	SD
Agriculture	**2.3**	**0.8**	**-10.7**	**1.1**
Maize	0.9	0.6	-7.7	0.7
Rice	3.6	0.6	-4.3	0.7
Other cereals	7.4	1.2	-6.1	1.7
Pulses	2.0	0.6	-5.8	0.1
Oilseeds	-0.5	0.7	-12.1	0.2
Roots	1.4	0.6	-7.3	0.1
Vegetables	2.9	0.5	-9.4	0.1
Sugarcane	1.1	0.3	-6.4	0.3
Tobacco	-4.1	1.1	-10.0	1.0
Cotton and fibers	2.1	0.8	-6.4	0.4
Fruits and nuts	0.8	0.5	-7.1	0.3
Coffee and tea	8.5	1.9	-25.0	3.2
Other crops	-0.4	1.3	-14.0	1.5
Cattle and raw milk	5.3	0.6	-12.6	0.2
Poultry and eggs	2.5	0.7	-12.6	0.2
Other livestock	0.1	0.3	-13.0	0.2
Forestry	1.0	0.1	-31.0	1.6
Fisheries	-1.4	0.4	-50.4	0.6

Source: Author's estimation.

3.2. Effects on Non-agricultural Sectors

Declines in agricultural value-added affect the rest of the economy through the backward and forward linkages of the agricultural sector with non-agricultural sectors. In Kenya, the backward linkages measured by the industry and services input intensity (i.e., ratio of input costs to value-added) of the agricultural sector were 17.0 percent and 4.7 percent respectively in 2019. Forward linkages which are measured by the shares of total demand for agricultural products by the industry and services sectors were 18.1 percent and 3.5 percent respectively in 2019. Due to the higher levels of backward and forward linkages for industry compared to the service sector, industry value-added declines more than services value-added under the CC scenario (4.0 percent vs. 3.1 percent respectively).

Several non-agricultural industries are adversely impacted by climate change shocks in the agricultural sector through direct exposure (via forward and backward linkages) with the agricultural sector, or by indirect exposure through declining overall economic performance (Figure 1).

- The wood and paper products industry is severely hit by climate change shocks (Figure 6) because of the high dependency on forestry products (32 percent of total input costs).
- The chemical and petroleum product industry is also hit by climate change shocks because of the high dependency on agricultural products (47 percent of total input costs) and the high share of agriculture demand in total industry demand (39 percent).

- Construction value-added also declines substantially because of its dependency on forestry products (13 percent of total input costs).
- The beverage and tobacco industry is also among those negatively impacted by climate change shocks on agricultural yields because of the industry's dependence on other cereals whose productivity and output would decline under the CC scenario.
- The accommodation and food services industry is also affected as agricultural products represent 38 percent of total input costs for the industry.
- Although the food processing industry displays the strongest connection with the agricultural sector (71 percent of total input costs), the industry's value-added is less affected by the climate change shocks on agricultural yields (3.6 percent).
- Water supply and sewage services are among the most affected industries because of the backward linkages with the agricultural sector, i.e., demand from the agricultural sector represents 36 percent of total demand for the services.
- Public administration, education, and health and social work are also hit by the climate change shocks on agricultural yields compared to the BaU scenario because of their linkages to the agricultural and food industries (agriculture and food products represent between 12 percent and 29 percent of their total input costs). Moreover, the economy's underperformance and the related impacts on government revenues and expenditures (fiscal policy effects) also have additional negative impacts.

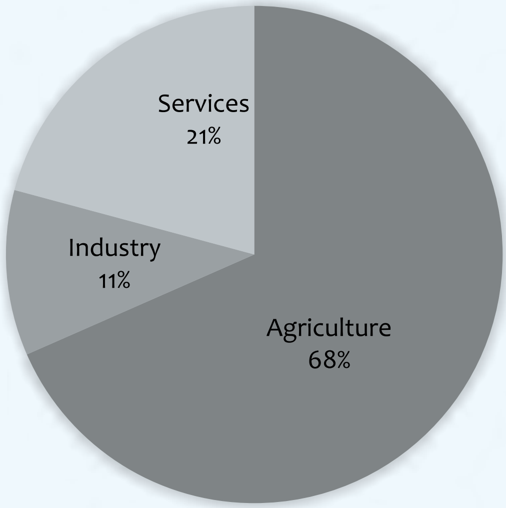
Figure 1: Changes in value-added for the industry and service sector in Kenya, CC against BaU scenario (%)

Source: Author's estimation.

3.3. Effects on the National Economy

Climate change impacts on agricultural yields reduce Kenya's economic output (measured in terms of GDP) by 8.3 percent compared to the BaU scenario. Contraction of the agricultural sector is primarily responsible for the shrinking GDP, contributing up to 68 percent to this decline (Figure 2). The industry and service sectors also contribute significantly to the GDP decline i.e., 11 percent and 21 percent respectively. The share of agriculture, industry and services in the Kenyan economy were estimated at 37 percent, 18 percent, and 45 percent in 2019.

Figure 2: Sector contribution to GDP decline, under CC scenario



Source: Author's estimation.

3.4. Effects on Employment and Factor Rewards

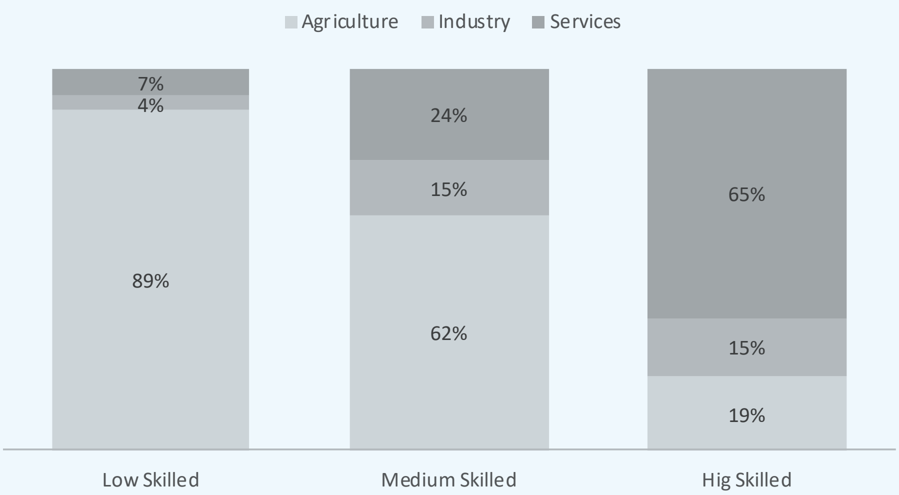
Comparison of the CC and the BaU scenarios revealed that climate change shocks on agricultural yields would hit high-skilled laborers more severely than their low-skilled and medium-skilled counterparts in terms of changes in employment numbers and earnings (Table 5). As low- and medium-skilled employment earnings are generated predominantly in the agricultural sector (Figure 3), in the long-run, the increased employment of these categories of workers would compensate for the large productivity declines in agricultural activities severely affected by climate shocks, such as fisheries and forestry. The returns to agricultural land and other forms of capital also decline significantly.

Table 5: Changes in employment numbers and Earnings by category in Kenya, CC compared to BaU scenarios (%)

	Numbers	Earnings
Labor, Low-skill	-5.4	0.3
Labor, Medium-skill	-4.6	-0.6
Labor, High-skill	-4.6	-2.5
Agricultural Land		-13.1
Other Capital		-6.9

Source: Author's estimation.

Figure 3: Employment earnings by labor category and economic sector in Kenya



Source: Author's estimation.

3.5. Effects on Inequality and Poverty

Both income inequality and poverty levels increase under the climate change (CC) scenario in comparison to BaU. Income inequality, measured by the Gini Index, rises slightly by 0.2 percent under the CC scenario compared to BaU (Table 6). The number of the poor, i.e., individuals with annual consumption expenditures less than the national poverty line of KShs. 71,951 for urban areas and KShs. 39,033 for rural areas, increases by 3.3 percent under the CC scenario compared to BaU. This represents an additional 1,412,259 individuals remaining or falling into poverty in the CC scenario compared to BaU.

The number of the extreme poor, i.e., individuals with annual consumption expenditures less than the food poverty line of KShs. 30,613 for urban areas and KShs. 23,440 for rural areas, increases by 6.4 percent under the CC scenario compared to BaU. This represents an additional 884,761 individuals unable to afford the cost of the minimum food basket.[3]

Table 6: Change in poverty and hunger, CC compared to BaU scenarios

	Percentage (%)	Number of Individuals
Gini Index	0.2	-
National Poverty	3.3	1,412,259
Extreme Poverty	6.6	884,761

Source: Author's estimation.

4. The Contribution of Climate Change Adaptation Strategies

Four adaptation strategies are tested. These are: (i) Soil and water conservation (reduced tillage, terracing, ridging, bunds, and mulching), (ii) Use of improved varieties, (iii) Irrigation, and (iv) Use of organic and inorganic fertilizers. Empirical evidence on the impacts of these adaptation strategies on crop yields has been obtained from existing research results and is presented here:

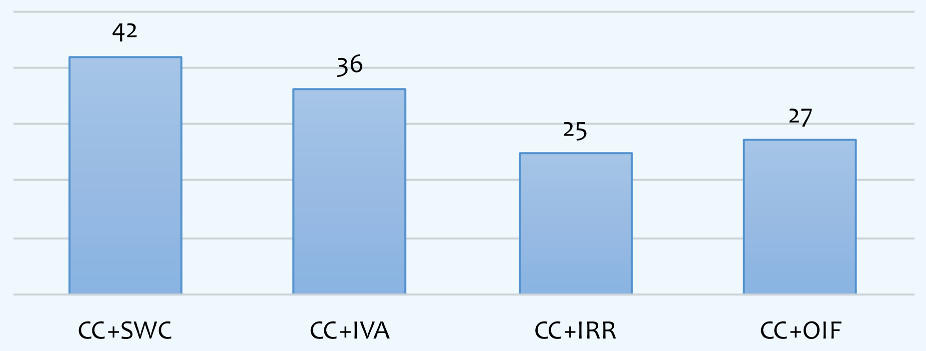
- *Soil and water conservation*
    - Increased crop yields by 23 percent in **Ethiopia** (Pender & Gebremedhin, 2006).
    - Increased crop yields by 45 percent in **Ethiopia** (IMF, 2020).
    - Increased maize yields between 75 percent and 94 percent in **Kenya** (Okeyo et al., 2014).
- *Improved varieties*
    - Increased crop yields by 25 percent in **sub-Saharan Africa** (Waha et al., 2013).
    - Increased crop yields by 120 percent in **Ethiopia** (IMF, 2020).
    - Increased maize yields between 1 percent and 9 percent in **Eastern Africa** (Fischer, 2009).
- *Irrigation*
    - Increased crop yields by 120 percent in **Ethiopia** (IMF, 2020).
    - Increased crop yields by 38 percent in **Southern Africa** (Mabhaudhi et al., 2018)
- *Organic and inorganic fertilizers*
    - Increased crop yields by 60 percent to 80 percent in **Ethiopia** (IMF, 2020).

We then assessed the share of cultivated areas that should be covered by each adaptation option to compensate for the economic output losses (measured in terms of GDP) caused by climate change shocks in agriculture. The results are presented in Figure 4.

Compared to 2019 levels, the share of cultivated areas placed under irrigation would have to rise by 25 percent, while that enriched with organic and inorganic fertilizers would have to rise by 27 percent. Similarly, the share of cultivated areas with improved varieties would have to rise by 36 percent while that under soil and water conservation measures would have to rise by 42 percent (Figure 4). This implies that the area under soil and water conservation, for instance, would have to increase by 42 percent to compensate for the economic losses caused by climate change.

3 The minimum food basket contains food items required to meet the minimum food energy requirement.

Figure 4: Percentage of cultivated area to cover under various adaptation options (%)



Source: Author's estimation.
Note: CC: Climate Change; SWC: Soil and Water Conservation; IVA: Improved Varieties; IRR: Irrigation; OIF: Organic and Inorganic Fertilizer.

5. Summary and Conclusion

This assessment of the economic impacts of climate change has clearly shown the urgent need for implementation of adaptation strategies. Should Kenya continue with business-as-usual, climate change will reduce the country's economic output (measured in terms of GDP) by 8.3 percent. The agricultural sector is primarily responsible for the GDP decline, contributing 68 percent to the economic contraction. Similarly, because of climate change, the number of extremely poor people in Kenya will increase by 6.4 percent. This represents an additional 884,761 individuals unable to afford the cost of the minimum food basket. However, the extensive promotion and implementation of soil and water conservation, irrigation, improved crop varieties, and organic and inorganic fertilizers will help combat the adverse impacts of climate change. To better protect the country from the adverse effects of climate change, areas under soil and water conservation, irrigation, improved crop variety and fertilizers will have to increase by 42 percent, 36 percent, 25 percent, and 27 percent respectively.

Based on these findings, this study recommends the following: i) mainstreaming adaptation practices in the agricultural sector will require improved prediction capabilities and a better knowledge of climate suitability for crops. Improved predictions will help determine – with a level of certainty – how the climate will change in the short-term and assist in planning cropping activities. This will also help in the identification of suitable places to grow specific crops based on climate. These combined measures would enhance climate change adaptation efforts instead of only relying on traditional knowledge of the crop calendar; ii) promotion of climate smart practices such as soil and water conservation practices, irrigation, and improved agricultural technologies to stem productivity declines in the agricultural sector and shield the economy from climate induced crises.

References

1. Adhikari, U., A.P. Nejadhashemi, and S.A. Woznicki. 2015. "Climate change and eastern Africa: a review of impact on major crops". In *Food and Energy Security*, 4(2): 110-132.
2. Brooks, K., S. Islam, K. Wiebe, C. Arndt, F. Hartley, and R. Robertson. 2019. "Climate and jobs for rural young people". IFAD Research Series 49. Rome: IFAD.
3. Bourguignon, F., and S. Amedeo. 2006. "Microsimulation as a Tool for Evaluating Redistribution Policies." *Journal of Economic Inequality* 4 (1): 77–106.
4. Cockburn, J., L. Savard, and L. Tiberti. 2014. "Macro-Micro Models". In The Handbook of Microsimulation Modelling, edited by C. O'Donoghue, 251-274. Leeds: Emerald Group Publishing Limited.
5. Craparo, A. C. W., P.J. Van Asten, P. Läderach, L.T. Jassogne, and S.W. Grab. 2015. Coffea arabica yields decline in Tanzania due to climate change: Global implications. In *Agricultural and Forest Meteorology*, 207: 1-10.
6. Decaluwé, B., A. Lemelin, V. Robichaud, and H. Maisonnave. 2013. pep -1- t the PEP standard single-country, recursive dynamic CGE model. (Université Laval, Ed.) (Vol. 0). Québec (Canada): Partnership for Economic Policy.
7. Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.F. Soussana, J. Schmidhuber, and F.N. Tubiello. 2007. "Food, fibre and forest products". *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, 273-313. Cambridge: Cambridge University Press.
8. Hérault, N. 2010. "Sequential linking of computable general equilibrium and microsimulation models: a comparison of behavioural and reweighting techniques". *International Journal of Microsimulation*, 3(1): 35-42.
9. Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate change 2007: the physical science basis: summary for policymakers*. Geneva: IPCC.
10. John, E., P. Bunting, A. Hardy, O. Roberts, R. Giliba, and D.S. Silayo. 2020. "Modelling the impact of climate change on Tanzanian forests". *Diversity and Distributions*, 26(12): 1663-1686.
11. Läderach, P., A. Eitzinger, O. Ovalle, and S.E. Carmona Rahn. 2012. *Brief: Future Climate Scenarios for Tanzania's Arabica Coffee Growing Areas*. Cali: Centro Internacional de Agricultura Tropical.
12. Lobell, D. B., and C.B. Field. 2007. "Global scale climate–crop yield relationships and the impacts of recent warming". *Environmental research letters*, 2 (1): 014002.
13. Lobell, D. B., M.B. Burke, C. Tebaldi, M.D. Mastrandrea, W.P. Falcon, and R.L. Naylor. 2008. "Prioritizing climate change adaptation needs for food security in 2030". *Science*, 319 (5863): 607-610.
14. Ministry of Environment and Mineral Resources (MEMR), Kenya. 2018. *National Climate Change Action Plan (NCCAP) 2013-2017*. Nairobi: Ministry of Environment and Mineral Resources, Kenya.
15. Ministry of Devolution and Planning, Republic of Kenya (MoDP). 2017. *Ending Drought Emergencies in Kenya: Progress Report for 2017*. Nairobi: Ministry of Devolution and Planning, Republic of Kenya.
16. Ministry of Environment and Forestry, Republic of Kenya (MoEF). 2018. *National Climate Change Action Plan (NCCAP) 2018-2022 Volume 1: Towards Low Carbon Climate Resilient Development*. Nairobi: Ministry of Environment and Forestry, Republic of Kenya.
17. Ministry of Environment and Forestry, Republic of Kenya (MoEF). 2021. *National Climate Change Action Plan (NCCAP) 2018-2022: Second Implementation Status Report for the FY 2019/2020*. Nairobi: Ministry of Environment and Mineral Resources, Republic of Kenya.
18. Mulwa, R., 2022. "Status and Implementation of the National Adaptation Plan (NAP) 2015-2030 for Kenya." Review Report. Kigali: AKADEMIYA2063.
19. National Drought Management Authority (NDMA). 2015. *Common Programme Framework for Ending Drought Emergencies*. Nairobi: Republic of Kenya.
20. National Drought Management Authority (NDMA). 2018. *Ending Drought Emergencies in Kenya: Progress Report for 2018*. Nairobi: Republic of Kenya.
21. National Drought Management Authority (NDMA). 2020. *EDE/DRMC-SP5 Final Narrative report March 2017-September 2020*. Nairobi: European Union and Republic of Kenya.
22. National Drought Management Authority (NDMA). 2021. *Ending Drought Emergencies in Kenya: Progress Report for 2019 and 2020*. Nairobi: Republic of Kenya.
23. National Drought Management Authority (NDMA). 2021. *Ending Drought Emergencies in Kenya: Progress Report for 2019 and 2020*. Nairobi: NDMA and Vision 2030.
24. Nelson, G. C., M.W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, ... and D. Lee. 2009. *Climate change: Impact on agriculture and costs of adaptation (Vol. 21)*. Washington DC: International Food Policy Research Institute (IFPRI).

25. Merttens et al. 2017. *Evaluation of the Kenya Hunger Safety Net Programme Phase 2: Impact evaluation final report*. Oxford: Oxford Policy Management.

26. Parry, J-E. 2016. *Review of current and planned adaptation action in Kenya*. CARIAA Working Paper no. 16. Ottawa and London: International Development Research Centre and UKAID.

27. Round, J. 2003. "Social accounting matrices and SAM-based multiplier analysis". *The impact of economic policies on poverty and income distribution: Evaluation techniques and tools*, 14: 261-276.

28. Rowhani, P., D.B. Lobell, M. Linderman, and N. Ramankutty. 2011. "Climate variability and crop production in Tanzania". *Agricultural and forest meteorology*, 151(4): 449-460.

29. Silas, M. O., M.A. Kishe, S.S. Mgeleka, B.N. Kuboja, B.P. Ngatunga, and P. Matiku. 2022. "The octopus fishing closures positively impact human wellbeing and management success; case of Tanzania". *Ocean and Coastal Management*, 217(106022): 71-9.

30. Thomas, T., and M. Rosegrant. 2015. "Climate change impact on key crops in Africa: Using crop models and general equilibrium models to bound the prediction". In *Climate change and food systems: global assessments and implications for food security and trade*, edited by A. Elbehri. Rome: Food Agriculture Organization of the United Nations (FAO).

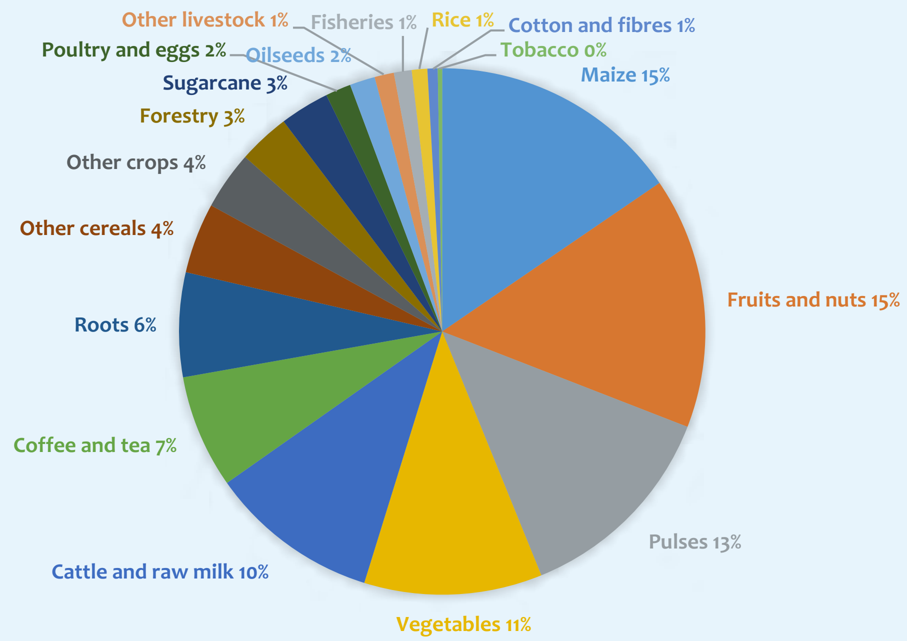
31. Thornton, P. K., P.G. Jones, G. Alagarswamy, and J. Andresen. 2009. "Spatial variation of crop yield response to climate change in East Africa". *Global environmental change*, 19(1): 54-65.

32. Thurlow, J. 2021. *2019 Social Accounting Matrix for Kenya: A Nexus Project SAM*. Data Paper. Washington DC: International Food Policy Research Institute (IFPRI). 10.2499/p15738coll2.134819

33. Waithaka, M., G.C. Nelson, T.S. Thomas, and M. Kyotalimye, eds. 2013. *East African agriculture and climate change: A comprehensive analysis*. Washington DC: International Food Policy Research Institute. http://dx.doi.org/10.2499/9780896292055

Annexes: Additional Graph and Tables

Annex A.1: Contribution of agricultural activities to agricultural value-added in Kenya, 2019



Annex A.2: Evidence of climate change impacts on maize yields in Kenya

Region/ Country	Range of Yield Variation (%)		Journal/publisher		Authors	Climate Change Scenario (Var. Temperature and Precipitation)
East Africa	5.0	-5.0	Science	American Association for the Advancement of Science	Lobell D. B., Burke M. B., Tebaldi C., Mastrandrea M. D., Falcon W. P., and Naylor R. L., (2008)	0.5°C to 2°C and -10% to +5%
East Africa	6.3	-1.7	Book	FAO	Thomas, T. & Rosegrant, M. (2015)	1.1°C to 1.9°C and +26 mm to +184 mm
East Africa	-5.0	-20.0	Global Environmental Change	Elsevier Science	Thornton, P. K., Jones, P. G., Alagarswamy, G., & Andresen, J. (2009)	1.0°C to 1.8°C and 1.6°C to 2.8°C
Ethiopia	-5.0	-25.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013)	1.0°C to 3.5°C and +100 mm to +300mm
Ethiopia	-7.0	-12.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	1.4°C to 5.5°C and 10% to +15%
Kenya	-6.0	-11.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 15% to +20%
Rwanda	-6.0	-10.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	3°C to 4°C and 10% to +15%
Tanzania	-5.0	-25.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013)	1.0°C to 3.5°C and +100 mm to +300mm
Tanzania	-6.0	-12.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 5% to +15%
Tanzania	-3.6	-13.0	Agricultural and Forest Meteorology	Elsevier Science	Rowhani, P., Lobell, D. B., Linderman, M., & Ramankutty, N. (2011)	+2°C and +20%
Uganda	-7.0	-11.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 5% to +15%
Zambia	-7.0	-13.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	1.4°C to 5.5°C and 0% to +5%

Annex A.3: Evidence of climate change impacts on coffee and tea yields in East Africa

Region/ Country	Range of Yield Variation (%)		Journal/Publisher		Authors	Climate Change Scenario (Var. Temperature and Precipitation)
East Africa		-40.0	Food and Energy security	Wiley Online Library	Adhikari, U., Nejadhashemi, A. P., & Woznicki, S. A. (2015)	1.4°C to 5.5°C and -2% to +20%
Tanzania	-30.0	-20.0	Report	Centro Internacional de Agricultura Tropical	Läderach, P., Eitzinger, A., Ovalle, O., Carmona Rahn, S.E., 2012.	2°C to 4°C and +48 mm
Tanzania	-12.3	12.3	Agricultural and Forest Meteorology	Elsevier Science	Craparo, A. C. W., Van Asten, P. J. A., Läderach, P., Jassogne, L. T. P., & Grab, S. W. (2015)	1.0°C increase

Annex A.4: Evidence of climate change impacts on rice yields in East Africa

Region	Range of Yield Variation (%)		Journal/Publisher	Authors	Climate Change Scenario (Var. Temperature and Precipitation)
East Africa	-16.0	-4.0	Book	Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.-F. Soussana, J. Schmidhuber and F.N. Tubiello, 2007	1°C to 3°C
East Africa	-3.0	-1.0	Environ. Res. Lett.	Lobell , D. B. , and C. B. Field . 2007	1°C and -40% to 20%
East Africa		3.0	IFPRI Research Monograph	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	1.3°C to 1.5°C and 0 to 4.7%
East Africa		-15.0	IFPRI report	Nelson, G. C., M.W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, C. Ringler, S. Msangi, A. Palazzo, M. Batka, M. Magalhaes, R. Valmonte-Santos, M. Ewing, and D. Lee. 2009.	0.5°C to 8°C and 2% to 10%
East Africa	-5.0	15.0	Science	Lobell D. B., Burke M. B., Tebaldi C., Mastrandrea M. D., Falcon W. P., and Naylor R. L., (2008)	0.5°C to 2°C and -10% to +5%
East Africa (rainfed)	2.2	6.7	Book + FAO	Thomas, T. & Rosegrant, M. (2015)	1.1°C to 1.9°C and +26 mm to +184 mm
East Africa (irri-gated)	-19.7	-10.4	Book + FAO	Thomas, T. & Rosegrant, M. (2015)	1.1°C to 1.9°C and +26 mm to +184 mm
East Africa (irri-gated)		-21.0	Global Change Biology	Van Oort, P. A. J., & Zwart, S. J. (2017)	Base temperature 14°C and optimum temperature 31°C…

Annex A.5: Evidence of climate change impacts on agricultural yields in East Africa

Agricultural Activity	Region	Range of Yield Variation (%)		Journal/Publisher		Authors	Climate Change Scenario (Var. Temperature and Precipitation)
Fruits and Vegetables	SSA		-10.7	Rural Development Report	IFAD	Brooks K., Dunston S., Wiebe K., Arndt C., Hartley F., and Robertson R. (2019)	1.4°C to 4.5°C and 0.7% to 4.7%
Pulses	SSA		-4.9	Rural Development Report	IFAD	Brooks K., Dunston S., Wiebe K., Arndt C., Hartley F., and Robertson R. (2019)	1.4°C to 4.5°C and 0.7% to 4.7%
Livestock	SSA	-10.0	-20.0	Environmental science & policy	Wiley Online Library	Jones, P. G., & Thornton, P. K. (2009)	1.0°C to 4.0°C
Roots & Tubers	SSA		-7.1	Rural Development Report	IFAD	Brooks K., Dunston S., Wiebe K., Arndt C., Hartley F., and Robertson R. (2019)	1.4°C to 4.5°C and 0.7% to 4.7%
Oilseeds	SSA		-13.5	Rural Development Report	IFAD	Brooks K., Dunston S., Wiebe K., Arndt C., Hartley F., and Robertson R. (2019)	1.4°C to 4.5°C and 0.7% to 4.7%
Sugarcane	East Africa	-10.8	1.6	Science	American Association for the Advancement of Science	Lobell D. B., Burke M. B., Tebaldi C., Mastrandrea M. D., Falcon W. P., and Naylor R. L., (2008)	0.5°C to 2°C and -10% to +5%

Annex A.6: Evidence of climate change impacts on other cereal (sorghum) yields in East Africa

Region/Country	Range of Yield Variation (%)		Journal/Publisher		Authors	Climate Change Scenario (Var. Temperature and Precipitation)
East and Central Africa	-25.0	5.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	1.3°C to 1.5°C and 0 to 4.7%
East Africa	-15.5	-0.5	Book	FAO	Thomas, T. & Rosegrant, M. (2015)	1.1°C to 1.9°C and +26 mm to +184 mm
Ethiopia	-33.0	-18.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	1.4°C to 5.5°C and 10% to +15%
DRC	-25.0	5.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	-1°C to 3.5°C and -400mm to +400mm
Tanzania	5.0	25.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	0.5°C to 3.5°C and 50 to 200 mm
Kenya	5.0	25.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	1°C to 3.5°C and 100 to 300 mm
Kenya	-29.0	-16.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 15% to +20%
Sudan	5.0	25.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	1.5°C to 2.5°C and -50 to 200mm
Malawi	-34.0	-17.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	3°C to 4°C and 0 to 5%
Rwanda	-25.0	-15.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 4°C and -5% to 10%
Tanzania	-30.0	-16.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 5% to +15%
Tanzania	-8.9	-7.2	Agricultural and Forest Meteorology	Elsevier Science	Rowhani, P., Lobell, D. B., Linderman, M., & Ramankutty, N. (2011)	1°C to 2°C and 20%
Uganda	-30.0	-17.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	2°C to 3°C and 5% to +15%
Zambia	-35.0	-19.0	Food and Energy Security	Wiley Online Library	Adhikari U., Nejadhashemi A. P., & Woznicki S. A., (2015)	1.4°C to 5.5°C and 0% to +5%

Annex A.7: Evidence of climate change impacts on forestry yields in East Africa

Region/ Country	Range of Yield Variation (%)		Journal/Publisher		Authors	Climate Change Scenario (Var. Temperature and Precipitation)
Tanzania		-70.0	Diversity and distribution	Wiley Online Library	John, E., Bunting, P., Hardy, A., Roberts, O., Giliba, R., & Silayo, D. S. (2020)	4.3 ± 0.7 o C and 766.08mm to 1139.84m
Southern Africa	-41.0	-51.0	IPCC Report	IPCC	IPCC (Intergovernmental Panel on Climate Change), 2007	1°C to 2.1°C
East Africa		-5.0	IFPRI Research Monograph	IFPRI	Waithaka, M.; Nelson, G. C.; Thomas, T. S. and Kyotalimye, M., (2013).	1.1°C to 1.9°C and +26 mm to +184 mm
Kenya	-76.0	-63.0	Ocean & Coastal Management	Elsevier Science	Wilson, R. J., Sailley, S. F., Jacobs, Z. L., Kamau, J., Mgeleka, S., Okemwa, G. M., Omukoto, J. O., Osuka, K. E., Samoilys, M., Sauer, W., Silas, M. O., Sululu, J. S., & Roberts, M. J. (2021)	+5°C

AKADEMIYA2063 is supported financially by the United States Agency for International Development (USAID), the Bill and Melinda Gates Foundation (BMGF), the German Federal Ministry for Economic Cooperation and Development (BMZ), the African Development Bank (AfDB), the UK's Foreign, Commonwealth & Development Office (FCDO), the Global Center on Adaptation (GCA), and the Food and Agriculture Organization of the United Nations (FAO). The views expressed in this publication do not necessarily reflect those of the funders.

AKADEMIYA2063 | Kicukiro/Niboye KK 341 St 22 | 1855 Kigali-Rwanda

+250 788 318 315 | +221 33 869 28 81

kigali-contact@akademiya2063.org | dakar-contact@akademiya2063.org

www.akademiya2063.org

@AKADEMIYA2063