CLIMATE CHANGE AND AFRICAN AGRICULTURE: CHALLENGES AND OPPORTUNITIES

FOCUS AREA

Climate change impacts on the productivity of the agricultural sector through processes such as weather uncertainty, environmental changes and pest or disease distributions, land degradation, land grabbing, heat and migration. A number of solutions can be tested and scaled to reduce climate change impacts. These solutions include diversification of livelihood options, early warning systems and use of ICT to provide climate services, smart and sustainable crop and livestock management strategies/practices, alternative renewable energy sources such as solar and wind, preventive measures that reduce the chances of developing heat stress, and overarching regional adaptation governance strategy to tackle borderless climate risk.

CHALLENGES

In Africa, climate change is negatively affecting agricultural productivity which inhibits rural development. This happens in several ways:

- Weather uncertainty: Climate change is characterised among others by increasing variability that leads to larger uncertainties about future weather (e.g. daily or seasonal rainfall, temperature, etc.) either in the short, medium or long term. These uncertainties lead to inefficient allocation of production resources with direct negative impacts on productivity.

- Environmental changes and pest or disease distributions: Climate change induced environmental changes impact all the production systems, including live-

stock, both directly (e.g., through extreme weather events, lack of grazing or water during droughts, and heat stress), as well as indirectly through changing disease distributions (e.g., altered habitat suitable for disease vectors, such as the midges that carry Bluetongue virus or African Horse Sickness). All this reduces the productivity of livestock and crops.

- Land degradation: Land is a key production asset in smallholder farming systems. Climate change-induced land degradation (e.g. desertification, wind and water erosion, deterioration in vegetation cover, soil salinization, etc.) is one of the leading factors in productivity losses.

- Land grabbing: The increasing investments in biofuels production in many developing countries as a way to address climate change leads to the conversion of croplands to commercial production of biofuel crops. This negatively impacts local food crop productivity of smallholder farms.

- Heat impacts: In Africa, agriculture relies mainly on outdoor farm workers and employs a large proportion of the workforce. Outdoor farm workers are vulnerable to the temperature rises resulting from climate change. They are at risk of heat stress that further affects health, productivity, and rural development.

- Migration: While migration has the potential to be a source of income through remittances, it also affects productivity negatively in the agricultural sector. The migrants are typically the youth and their departure from rural areas implies a reduction of labour availability.

- Food insecurity and conflict rising: As a result of climate variability/change, failure in crop and animal production is expected, which leads to rising conflict in relation to natural resources.

In sum, climate change, agriculture and rural development are closely interrelated. In Africa, climate change negatively impacts productivity through multiple processes. The situation is particularly alarming and needs urgent action in smallholder farming systems where adaptation capacities are limited.

FACTS AND FIGURES

Agriculture is a key economic sector in African countries, contributing approximately 15% to total Gross Domestic Product (OECD/FAO 2016; World Bank, 2019) and employing more than half of the labour force in many countries (FAO 2020). Future climate scenarios suggest mixed patterns (increases or decreases) for rainfall across the continent, but clear increases in temperature (Schleussner et al., 2018; Serdeczny et al., 2017). Statistics from selected countries suggest the following:

- In Benin, rainfall is projected to show mixed-patterns depending on the agro-ecological zones and the climate models while temperature will increase by about 2.3°C in 2050 (TCN Benin, 2019).

- In South Africa, climate will probably change as follows: in 2050, the average temperatures will rise 3°C as compared to 1986–2005, whereas, the average rainfall will be reduced by 10% (Smith et al. ,2014).

- In Ghana, average annual temperatures are estimated to increase between 0.8°C and 5.4°C for the years 2020 and 2080 respectively. Within the same period average annual rainfall total is estimated to decline by between 1.1%, and 20.5% (MESTI, 2010)

- In Zambia, the mean annual temperature is projected to increase by a further 1.2 to 3.4oC by the 2060 (MONDP et al., 2016).

These projections are associated with higher uncertainties about weather, environmental changes (e.g. more extreme events such as droughts, floods; shifting of agro-ecological zones, etc.) and high pests/diseases occurrence. These changes alter numerous processes and result in productivity losses. Many parts of Africa already experience weather conditions that challenge productivity. For example, many countries record temperatures that exceed heat stress thresholds of poultry, small and large ruminant animals, leading to reduced production and increased vulnerability to disease and death.

Climate change is also one of the drivers of soil salinization due to increases in evapotranspiration and temperature, and decreases in salt leaching from rainfall. In South Africa, for instance, salt affected soils comprise almost 32% of the country's surface area (FAO, 2015). This percentage is predicted to increase to 42% in 2050 due to the impacts of climate change (FAO, 2015).

With respect to land grabbing, the government of Ghana, for instance, pledged a 45% reduction of emission by 2030 (Republic of Ghana, 2015) and this has triggered over 950,131 ha of land grabs converted into biofuel plantations (Ahmed et al., 2017). The apparent potential of biofuels encouraged smallholders to shift


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labour and land from food crop farming to engage in biofuel crops thereby affecting food crop productivity and food security (Gasparatos et al., 2015).
Although there is a need of more evidence, the projected mean annual temperature increases are acknowledged to make farmers more vulnerable to suffering from heat-related illnesses such as heat stress, heat stroke, heat exhaustion, heat cramps, heat rashes and dehydration.
Regarding migration, internal climate migration in Africa grew from 12.5 million in 2000 to 19.4 million in 2017 (UNCTAD, 2018). It is estimated that by 2050, the projected total number of potential climate migrants could be as high as 85.7 million in Africa (World Bank, 2020).

SOLUTION

A range of solutions and measures can be tested and scaled to reduce the risk of negative climate change impacts on productivity in the agricultural sector in Africa. These include:

- Diversification of livelihood options through sustainable developments: In most African countries, the rural inhabitants heavily relied on natural resources for their living (agriculture). Thus, diversification of livelihood options is crucial to broaden the opportunities under harsh conditions and to decrease the negative impacts on natural resources.
- Development of early warning systems and use of ICT to provide climate services: Early warning systems have the potential to build resilience to climate variability and climate change. The high penetration rate of ICTs in general and particularly of mobile phones in many African countries is a huge opportunity to provide climate services to smallholder farmers.
- Development and adoption of smart and sustainable crop and livestock management strategies/practices: This solution requires management choices that improve crop/livestock health and productivity. These may include smart agricultural practices; improved or adapted seeds breeds or species; adequate soil and water management strategies; techniques to enhance cooling (e.g., provision of shade, water or ventilation for livestock).

- Development and adoption of alternative renewable energy along with appropriate regulation frameworks: Adoption of alternative renewable energy sources such as solar are imperative to reducing demand and competition for land between smallholder farmers and biofuel plantations. This solu-

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tion also involves establishing land restrictions for biofuels relative to food crop land.

- Development and adoption of preventive measures that can be undertaken to reduce the chances of developing heat stress: These include wearing loose-fitting light clothing, drinking more water, reducing movement, seeking shade, evaporative cooling, using sunscreens, installation of wells for hydration and altering schedules to allow high intensity work in cooler temperatures.

- Development of a regional adaptation governance strategy to tackle borderless climate risk and associated mobilities across SSA: This involves the need for over-arching regional adaptation governance strategy to respond to increasing climate change and associated mobilities.

Climate change impacts in the agricultural sector in Africa is a 'wicked' problem that requires holistic / integrated solutions. In this respect, no one single solution will be sufficient on its own. The over-arching strategies need to encompass integrated approaches to adaptation, involving inputs from climate scientists (who understand the likely hazards), experts in crop and livestock agriculture (who understand the impacts to farm production), social scientists (who understand the impacts to farmers, their livelihoods, family structures, migration options), health experts (who understand the changes in disease distributions and impacts on mental health), and others. Adaptation for improved resilience of African farmers must look beyond crop management alone, and requires a holistic approach that also considers animal health, management practices, species and breed selection, and genetic selection for disease resistance. The different adaptation options need to be considered and tested, and promising options can be implemented or recommended at scale.

HOW CAN THE CLIMAPAFRICA PROGRAM CONTRIBUTE TO ADRESS THE CHALLENGE?

To prevent negative effects of climate change on agriculture in SSA, intra-Africa, interdisciplinary collaboration will be needed to develop workable adaptation strategies.
The DAAD climapAfrica program enables African researchers to test and generate high-quality evidence on all the above-mentioned solutions. For example, in Benin, Rosaine is conducting a study on smallholder farmers' preferences for different climate service platforms. Frederick's research explores the challenges and opportunities for transnational adaptation governance in response to increasing climate mobilities in West Africa. Michelle will be synthesizing the results of a broad range of research, to generate Africa-relevant messages about adaptation options for livestock farmers.

Most importantly, the close collaboration facilitated by DAAD climapAfrica program enables DAAD postdoctoral fellows and alumni to share knowledge, work more efficiently and effectively by means of various outreach activities based around agricultural development in Africa. In addition, this collaboration facilitates collegial relationships between these African scientists. These relationships promote problem-solving, creating a continuous cycle of knowledge generation that can expedite new and creative solutions, and lead to better team performance and overall productivity.

The thematic working groups are composed of postdoctoral fellows and African alumni of German funding initiatives with expertise in the field of climate research. **LINK to climapAfrica working group: Climate change Agriculture and Rural development**

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LINK to profiles of all climapAfrica postdocs fellows of this working group

LINK to profiles of all climapAfrica alumni experts of this working group

PHOTOS AND GRAPHICS
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