Sunflower Uganda

Climate Change Risks and Opportunities

Sunflower in Uganda

Uganda's agricultural sector is an important catalyst for economic growth, poverty alleviation, and food security. Nevertheless, the economic losses from the impacts of climate change on the agricultural sector by 2050 are estimated to be about US$1.5 billion (Zinyengere et al., 2016). Climate-smart agriculture practices present an opportunity to reduce such losses because it builds resilience in the agriculture sector, improves productivity and farmer incomes, and contributes to climate change mitigation (CIAT & World Bank, 2017).

Uganda's sunflower sector has made significant contributions to the country's socioeconomic development. Currently about 240,000 Hectares of land is under Sunflower production and continues to increase. Sunflower is mainly processed into three main products namely assorted oils, animal feeds and sunflower seeds and as a snack. Sunflower production is profitable and stands at US$ 45 per acre. Margins are high for millers, i.e., US$ 143 per kg, and sunflower oil traders i.e., US$ 0.3 – 0.7 per kg, while sunflower seed traders only receive a tiny margin of up to US$ 0.05 per kg. The farm-retail price is as high as US$ 0.4 – 0.5 per kg of sunflower seed with farmers only capturing 36 - 46% of the final retail price.

The main actors in the Sunflower value chain include small scale farmers that produce local varieties and sell them to local millers, as well as farmers having contracts with the main oil seed processors. Agents based in producing districts link farmers with processors by providing inputs and collecting the sunflower produce once harvested. These agents can also provide trainings on the use of improved agronomic practices (crop rotation, post harvesting, etc.). Sunflower processors produce cooking oil or cake which is sold for animal feed.

Past trends in Temperature in Sunflower Growing Areas

The temperature trend (from 1961-2005) for the first rainy season (March, April, May (MAM)) show that temperature has been increasing by about 1°C in the sunflower growing areas (Figure 1). During the second rainy season (October, November, December, (OND)), temperature in the sunflower growing areas of the country has been increasing for the past few decades by about 1.2°C -1.4°C (Figure 1).

[1]For this work on climate change projections, dynamically downscaled daily rainfall, maximum, minimum and mean temperature from the Rossby Center (SMHI) regional climate model (RCA4) are used. The regional model (RCA4; Dieterich et al., 2013) was used to downscale four Global Circulation Models (EC-EARTH, MPI-ESM-LR) from the Coupled Model Inter-comparison Project Phase 5 (CMIP5). The regional model was run at a grid resolution of 0.44 x 0.44 over the African domain and all other details about the simulation can be found in Dieterich et al. (2013). The global models (GCMs) projections were forced by the Representative Concentration Pathways (RCPs), which are prescribed greenhouse-gas concentration pathways (emissions trajectory) and subsequent radiative forcing by 2100. In this study, we used RCP4.5 and RCP8.5, which are representatives of mid-and high-level of emission scenarios respectively.

In particular, the temperature trend in the second rainy season has significantly increased by more than 1°C in most sunflower growing areas of the northern parts of the country.

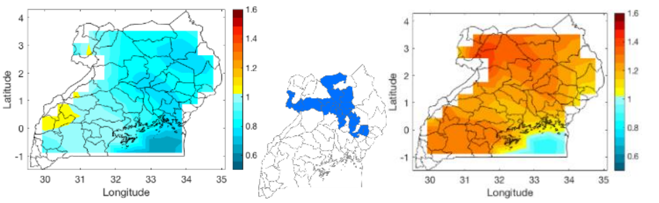

Figure 1. *Temperature trend from 1961-2005 for the first rainy season (MAM, LEFT) and second rainy season (OND, RIGHT) in Uganda.* ***NOTE****: During both the first and second rainy season temperature in the sunflower growing areas of the country (MIDDLE) has increased by* 1°C - 1.2°C.

Climate Change in the Future[1]

Temperature

Temperature in the 2030s is expected to rise by about 1.8°C in first rainy season and 1.4°C to 1.8°C in the second rainy season of sunflower growing areas, (Figure 2). For the 2050s, the temperature in the sunflower growing areas of the country is expected to rise by about 2.8°C and 2.0°C - 2.4°C in the first and second rainy season respectively (Figure 2). Figure 2 shows that the expected rate of warming is higher for the 2050s and in MAM as compared to OND.

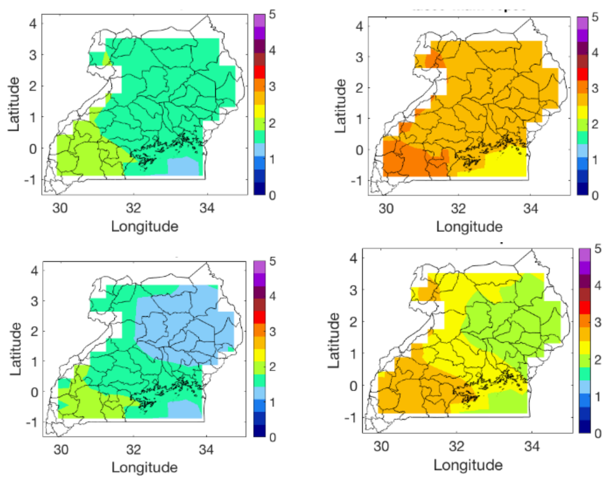

Figure 2*. Projected seasonal mean changes in temperature for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario (worst case scenario), relative to the reference period (1961-2005).* ***NOTE:*** *In the 2050s, temperature in the sunflower growing areas of the country is likely to rise by about 2.8°C in the first (MAM; TOP RIGHT) and 2.0°C – 2.4°C in the second (OND; BOTTOM RIGHT) seasons.*

Precipitation

The seasonal mean rainfall in the first rainy season is projected to decrease in the sunflower growing areas of Uganda in both the 2030s and 2050s though a slight increase (5-10%) is expected in the northern growing regions by 2030s. However, the seasonal mean rainfall in the second rainy season is expected to increase (by about 20-40%) in the sunflower growing areas of the country especially in the 2050s (Figure 3).

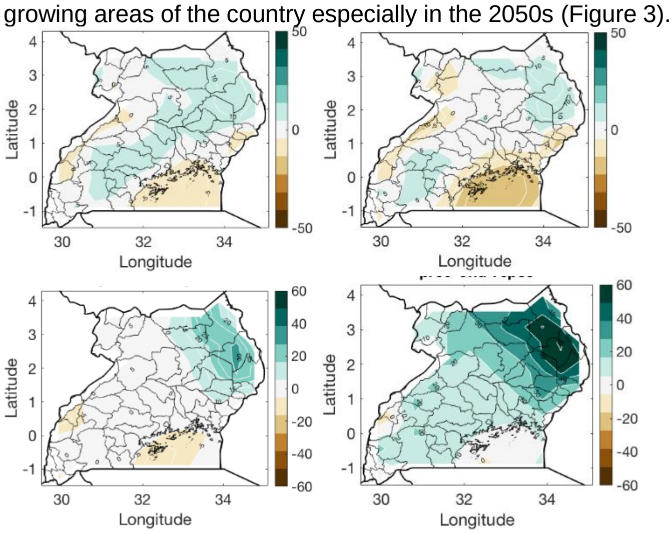

Figure 3. *Projected seasonal mean changes in rainfall (in percentage) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario relative to the reference period (1961-2005). NOTE: In the 2050s (RIGHT), the seasonal mean rainfall in the sunflower growing areas is projected to increase in the second rainy season (OND, BOTTOM RIGHT). However, the seasonal mean rainfall is expected to decline during the first rainy season (MAM; TOP RIGHT).*

Similarly, the longest consecutive wet days in the sunflower growing areas of Uganda is expected to decrease in both the 2030s and 2050s during the first rainy season (Figure 4). However, the length of the longest wet spells in the sunflower growing areas of the country is projected to increase slightly in the second rainy season especially in the 2050s.

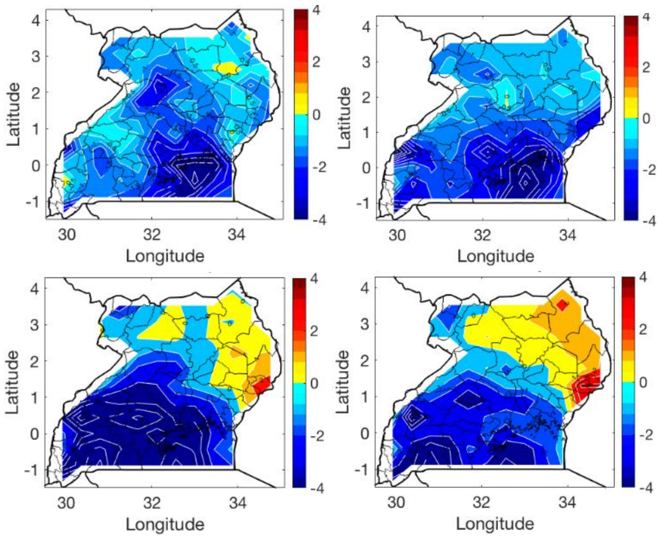

Figure 4. *Projected seasonal mean changes in consecutive wet days (CWD) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005).* ***NOTE:*** *The consecutive wet days are expected to decline in the sunflower growing areas in the first rainy season for both the 2030s (TOP - LEFT) and 2050s (TOP - RIGHT).*

Drought

The projection of the longest consecutive dry days (CDD) for both the second and first rains show that dry spells are expected to decline (by 2-5 days) in the sunflower growing areas by the 2030s and 2050s (Figure 5). The projected decline in the dry spell (Figure 5) coupled with the expected increase in the seasonal mean rainfall (Figure 3) accompanied by an increase in the number of consecutive wet days (Figure 4) in the sunflower growing areas for the second rainy season could translate into enhanced extreme rainfall in the region.

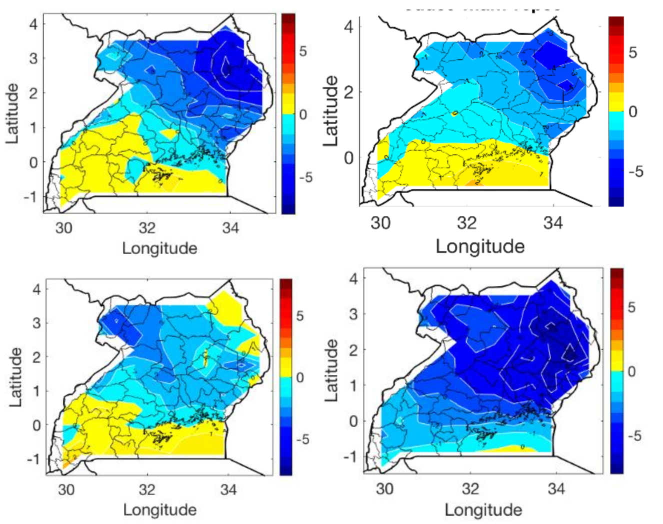

Figure 5*. Projected seasonal mean changes in consecutive dry days (CDD) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005).* ***NOTE****: Dry spells are expected to decline (2-5 days) in the sunflower growing areas especially in the second rainy season by the 2050s (BOTTOM-RIGHT).*

Onset and Length of Growing Spell

The onset, cessation and length of the growing spell for the first rainy season (MAM) is estimated for the historical period (1961-2005) and the 2030s and 2050s. Results (Figure 6) show that early onset (by about 2-5 days) of rainfall is expected in the first rainy season in the northern and central sunflower growing areas of the country. However, the seasonal rain is expected to be delayed (by about 4-8 days) in the north-western sunflower growing areas of Uganda. On the other hand, the length of the growing spell in the sunflower growing areas is projected to increase by about 4-8 days (Figure 6) extending the season to June and subsequent months.

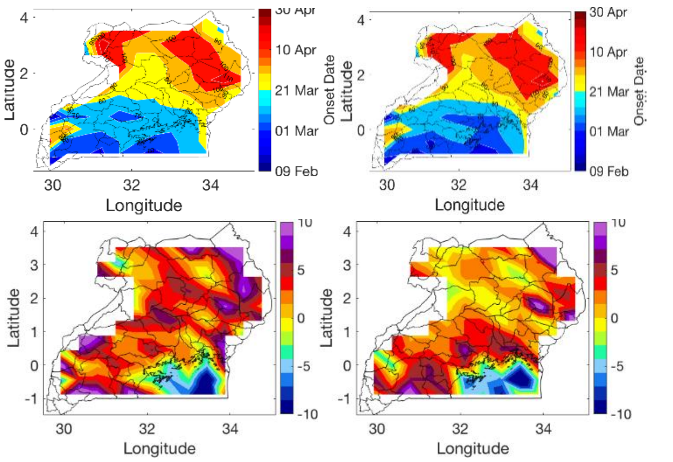

***Figure 6**. Projected seasonal mean of onset for 2030s (TOP-LEFT) and 2050s (TOP-RIGHT) and length of growing spell for 2030s (BOTTOM-LEFT) and 2050s (BOTTOM-RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). **NOTE**: Early onset of rainfall is expected in the northern and central sunflower growing areas of Uganda in both the 2030s (TOP-LEFT) and 2050s (TOP-RIGHT). Delay of the onset of the seasonal rainfall is expected in the north-western sunflower growing area of the country. The length of the growing spell is projected to be longer by about 4-8 days in most of the sunflower growing areas of the country.*

In summary, during both the second (OND) and first (MAM) rainy seasons, the model projections for both the 2030s and 2050s show that temperature is expected to rise by 1.0°C to 2.8°C in the sunflower growing areas.

A likelihood of more wet spells with an implication of more incidences of extreme rainfall (e.g. floods) is expected over the sunflower growing areas of the country during the second rainy season.

Climate Change Impact (Modelling Study)

In Uganda, climate change is likely to boost sunflower production. In the coming decades, sunflower yield is expected to increase during the OND season and under all climate change scenarios (Figure 7). The northern region is likely to benefit the most, where yields are expected to increase by up to 300kg/ha in large areas. Major increases are likely in the RCP4.5 scenario than in the RCP8.5 scenario. With improved agronomic practices such as a combination of soil testing and fertilizer application, pest, disease and weed control, farmers in Uganda can even get far more (about 50% more) yield than what they get now.

The major factor for the expected increases in sunflower yield in the future will be due to increasing rainfall during the OND season. These effects were captured and expressed using the Water Requirement Satisfaction Index (WRSI), which is an indicator of crop performance based on the availability of water to the crop during the growing season (Figure 8). The WRSI results for sunflower show that increasingly more water (rainfall and soil moisture) will be available to meet sunflower crop water requirements during the OND season resulting in the aforementioned yield gains.

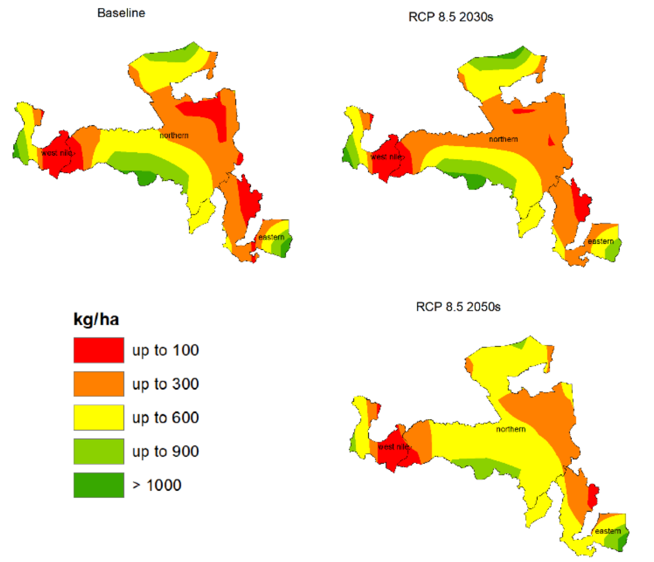

***Figure 7.** Modelled sunflower yields under current and future climates (RCP8.5)*

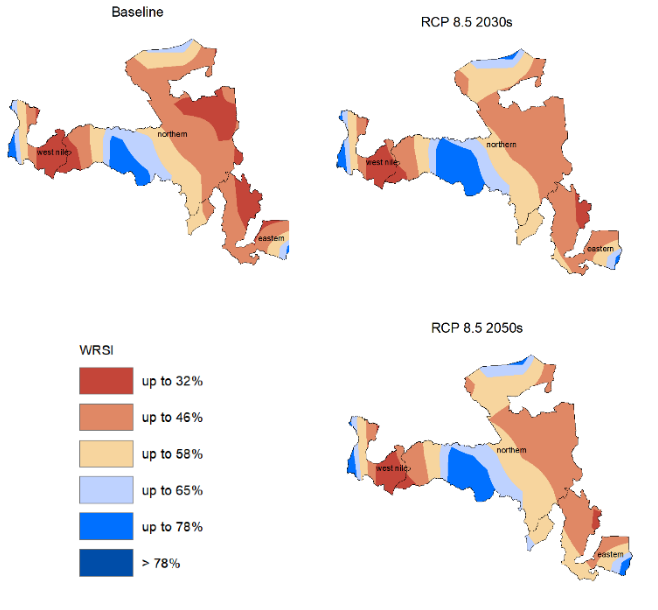

***Figure 8.** Water availability (WRSI) for sunflower production during the OND season under current and future climates (RCP8.5)*

Climate Risk Assessment Workshop

The CRAFT project conducted a Climate assessment workshop for the Sunflower value chain in November 18th and 19th in Lira attended by 27 participants (Male-19; Female-8). The most important climate risks highlighted during the workshop included: prolonged droughts; too much rain; unpredictable seasonality among others

Climate Related Risks

With insight on how the climate is likely to change in future as well as in the effectiveness of current coping strategies, actors discussed the most important climate risks in relation to other risks affecting their business.

> *"In the past, we easily predicted the onset and secession of the rains. We observed signs from the emergence of certain bird species; and used sounds of various birds and animals. Ducks would make swimming gestures and cattle (especially calves) would run in excitement with erect tails pointing to the sky. We seem to have destroyed our surrounding too much that these bird and animal species have disappeared. We are now stuck in a dilemma as to when rains shall come and not sure when rains will end". Tom O. Lalobo, a 71 year old sunflower farmer from Nwoya district; Koc Goma sub-county; Chorom Parish; Lamin Latoo village.*

Adaptation Strategies (Examples)

To better deal with climate change in future, adaption strategies were identified and discussed in terms of factors hindering the uptake and/or implementation of adaptation strategies and what could be done to support adoption.

Adaption strategies (examples)	Factors hindering uptake or implementation of adaptation strategies (examples)	What can be done? Potential Business cases
- use of drought tolerant/resistant varieties, - appropriate climate information for timely planting, - use of early maturing varieties, - soil/water conservation and conservation farming	- lack of weather information, - lack of affordable sources of finance to invest in climate smart infrastructure, - insufficient sources of improved seed, - unreliable input sources.	- supplementary water for production (irrigation), - agro-input supply, - seed supply, - climate information services and soil testing services, - vegetable oil processing

References:

- CIAT & World Bank, 2017. Climate-Smart Agriculture in Uganda. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT); World Bank, Washington, D.C.
- Zinyengere, N., Crespo, O., Hachigonta, S. and Tadross, M., 2015. Crop model usefulness in drylands of southern Africa: an application of DSSAT. South African Journal of Plant and Soil, 32(2), pp.95-104.

Acknowledgement

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Project Information

The Climate Resilient Agribusiness for Tomorrow (CRAFT) project (2018 - 2023), funded by the Ministry of Foreign Affairs of the Netherlands, will increase the availability of climate smart foods for the growing population in Kenya, Tanzania and Uganda. The CRAFT project is implemented by SNV (lead) in partnership with Wageningen University and Research (WUR), CGIAR's Research Program on Climate Change, Agriculture and Food Security (CCAFS), Agriterra, and Rabo Partnerships in Kenya, Tanzania and Uganda

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