CRAFT

Climate resilient value chains for improved livelihoods

Potatoes Uganda

Climate Change Risks and Opportunities

Potatoes 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 through building resilience in the agriculture sector, improving productivity and farmer incomes, and contributing to climate change mitigation (CIAT & World Bank, 2017). Potato is an important crop for food and income generation in Uganda, and was recognized in the 2010/11- 2014/15 Development Strategy and Investment Plan (DSIP) as a strategic commodity with the potential to make a remarkable contribution both to increasing rural incomes and livelihoods and to improving food and nutrition security. Despite its potential, sustainable intensification levels remain very low in the potato sub-sector, translating into low average yield. Farmers increase production by expanding the land used to grow potatoes, not by sustainably intensifying their activities. According to FAO statistics, the annual potato output in Uganda is approximately 800,000 metric tons, produced on approximately 112,000 hectares (FAOSTAT, 2014).

Past Trends in Temperature in Potato Growing Areas

The trend of temperature (from 1961-2005) for the first rainy season (March, April, May (MAM)) show that temperature has been increasing by about 1°C in the potato growing areas (Figure 1). During the second rainy season (October, November, December, (OND), temperature in the potato growing areas of the country has been increasing by about 1.2°C -1.4°C in the past few decades (Figure 1). In particular, the temperature trend in the second rainy season has increased significantly by about 1.3°C to 1.4°C in Nebbi district and the South-western potato growing areas of Uganda.

[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.

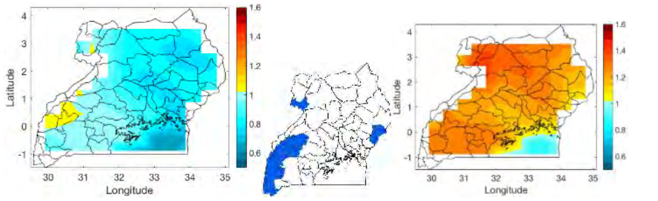


Figure 1. *Temperature trend from 1961-2005 for the first rainy season (MAM, LEFT) and second rainy season (OND, RIGHT) in Uganda.* ***NOTE****: During both the second and first rainy seasons, temperature in the potato growing areas of the country (MIDDLE) increased by* 1°C - 1.4°C.

Climate Change in Future[1]

Temperature

During the first rainy season, temperature in the 2030s is expected to rise by about 1.8°C in Nebbi and Mbale districts and by about 2°C in the South-western potato growing areas. In the second rainy season, temperature in Mbale, Nebbi and the South-western districts in the potato growing areas is expected to rise by 1.4°C, 1.8°C and 2.0°C respectively by the 2030s (Figure 2). For the 2050s, the temperature in the potato growing areas of the country is expected to rise by about 2.8°C to 3.0°C and 2.0°C - 2.8°C in the first and second rainy season, respectively (Figure 2). Figure 2 shows that the expected rate of warming is higher for MAM as compared to OND in most of the potato growing areas, and the highest temperature increment (+3.0°C) is expected around Kabale district by 2050s.

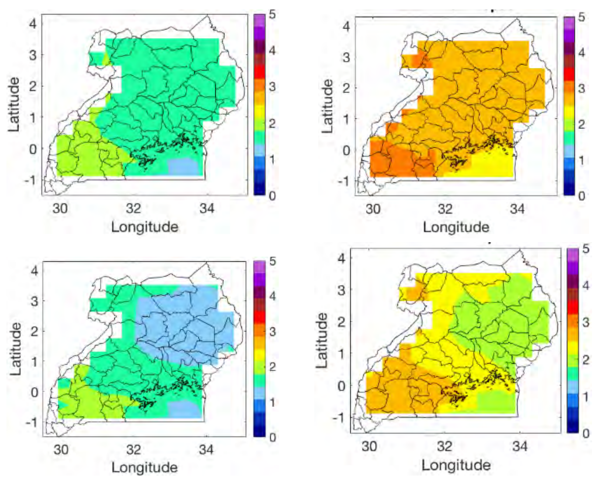


Figure 2*. Projected seasonal mean changes in temperature for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario (worst case scenario), relative to the reference period (1961-2005).* ***NOTE:*** *In the 2050s, temperature in the potato growing areas is likely to rise by about 2.8°C -* 3.0°C *and 2.0°C – 2.8°C in the first (MAM; TOP RIGHT) and second (OND; BOTTOM RIGHT) season, respectively.*

Precipitation

The seasonal mean rainfall in the first rainy season is projected to decrease in Nebbi and the South-western potato growing areas though a slight increase (by about 10%) is expected in Mbale district. However, the seasonal mean rainfall in the second rainy season is expected to increase (by about 20-40%) in the eastern potato growing areas of the country (e.g. Mbale and Kapchorwa districts) especially in the 2050s (Figure 3). The seasonal mean rainfall in the second rainy season is also expected to increase slightly (by about 10%) in the potato growing areas around Nebbi and in the South-western districts (e.g. Kabale) especially in the 2050s.

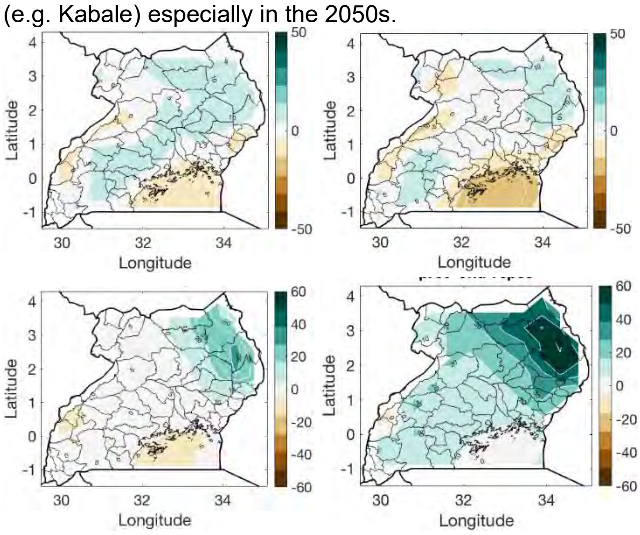
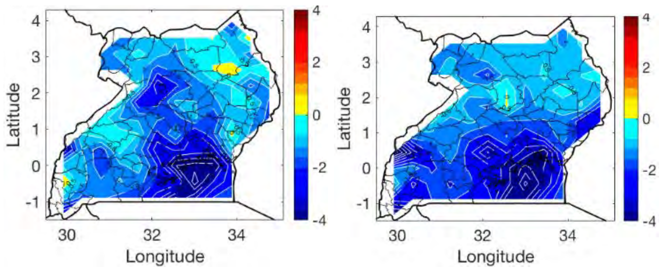


Figure 3. *Projected seasonal mean changes in rainfall (in percentage) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario relative to the reference period (1961-2005). NOTE: In the 2050s (RIGHT), the seasonal mean rainfall in the eastern potato growing areas around Mbale is projected to increase (20-40%) in the second rainy season (OND, BOTTOM RIGHT). The seasonal rain is expected to decline in Nebbi and South-western potato growing areas during the first rainy season (TOP-LEFT and TOP RIGHT).*

Similarly, the longest consecutive wet days in the potato 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 eastern potato growing areas of the country (Mbale and Kapchorwa) is projected to increase (by about 2-3 days) in the second rainy season.



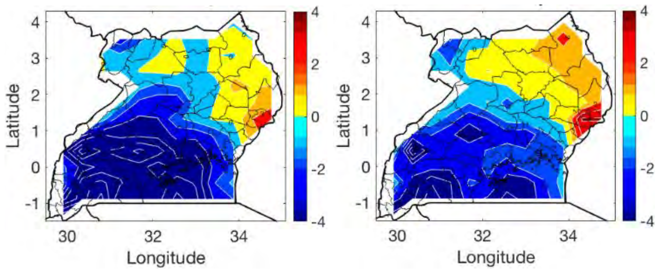


Figure 4. *Projected seasonal mean changes in consecutive wet days (CWD) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). **NOTE:** The consecutive wet days is expected to decline in the western and South-western potato growing areas in both the first (TOP-LEFT and TOP-RIGHT) and second (BOTTOM-LEFT and BOTTOM-RIGHT) rainy seasons. However, the length of the longest wet spells is expected to increase in the eastern potato growing areas in the second rainy season.*

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 eastern potato growing areas (Mbale and Kapchorwa) by the 2030s and 2050s (Figure 5). However, dry spells are expected to increase slightly (by about 1 day) in the South-western potato growing areas of the country especially in the first rainy season and in the 2030s of the second rainy season. The projected increase in the dry spell (Figure 5) coupled with the expected decrease in the seasonal mean rainfall (Figure 3) accompanied by an decrease in the number of consecutive wet days (Figure 4) in the South-western potato growing areas of Uganda for the first rainy season could translate into drought or lack of sufficient rainfall in the region.

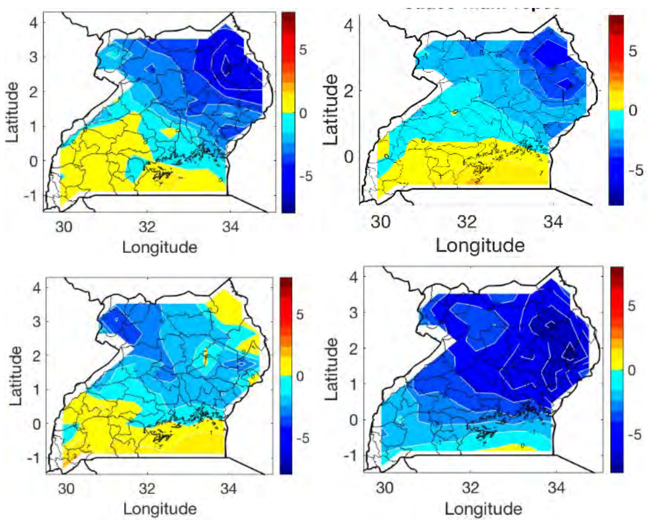


Figure 5*. Projected seasonal mean changes in consecutive dry days (CDD) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). **NOTE**: Dry spells are expected to increase (by about 1 day) in the South-western potato growing areas especially in the first rainy season of the 2030s (TOP-LEFT) and 2050s (TOP-RIGHT). Dry spell spells are expected to decline in the eastern potato growing areas.*

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 the onset of the first rainy season is expected to be delayed (by about 3-4 days) in Nebbi and the South-western potato growing areas. On the other hand, early onset of the rainfall (3-6 days) is expected in the eastern potato growing areas of the country (Figure 6). The length of the growing spell in Nebbi, the South-western, as well as in the eastern potato growing areas is projected to increase by up to 5-10 days (Figure 6) extending the season to June and subsequent months.

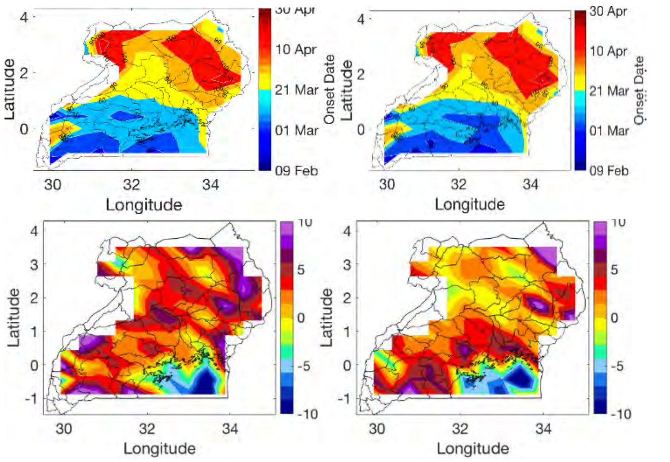


Figure 6*. Projected seasonal mean of onset for 2030s (TOP-LEFT) and 2050s (TOP-RIGHT) and length of growing spell for 2030s (BOTTOM-LEFT) and 2050s (BOTTOM-RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). **NOTE**: Late onset of rainfall is expected in Nebbi and the South-western potato growing areas for both the 2030s (TOP-LEFT) and 2050s (TOP-RIGH). The eastern potato growing areas however will experience early onset of rainfall. The length of the growing spell is however projected to be longer by up to 5-10 days in the potato growing areas of the country.*

In summary, during both the second (OND) and first (MAM) rainy seasons, temperature for the 2030s is expected to rise by 1.4°C to 2.0°C in the potato growing areas of eastern, Nebbi and South-western Uganda. In the 2050s, temperature in the potato growing areas of the country is projected to increase by more than 2°C in both the second and first rainy seasons. Temperature in the South-western potato growing areas of the country is expected to increase by about 3.0°C in the first rainy season.

A likelihood of more wet spells with an implication of more incidences of extreme rainfall (e.g. floods) is expected over the eastern potato growing areas (Mbale and Kapchorwa) especially during the second rainy season. However, an increase in dry spell and a decrease in seasonal rainfall with a possibility of frequent drought is anticipated in the South-western potato growing areas of the country especially during the first rainy season.

Climate Change Impact (Modelling Study)

Potato production in Uganda is mainly concentrated in South-western, Elgon (Mbale and Kapchorwa) and West Nile (Nebbi) regions. Currently, average production of farmers is about 8tons/ha. **In the coming decades, climate change is likely to result in reduction in potato yields during the MAM season, which is the major growing season. The impacts on potato yields are likely to worsen with time.** In the south-western region, large areas that currently produce a maximum of 10 t/ha are expected to have yield losses between 2 and 4t/ha under the business-as-usual climate scenario (RCP8.5) scenario depending the time period (Figure 7). In the Elgon region, a maximum of 4 t/ha can be produced currently and yield losses of between 1 and 2 t/ha are likely. In the West Nile region, the impact will be relatively minimal. Current yields in this region are about 4 t/ha and yield losses of up to 1 t/ha are expected. Yield losses are also expected under the more optimistic scenario in terms of mitigation interventions i.e. RCP4.5. However, the magnitude of yield losses is likely to be lower than under RCP8.5.

Currently, opportunities exist to double potato yields in all the regions through the use of improved agronomic practices such as soil testing, fertilizer application, pests, diseases and weed control. However, in the coming decades, climate change is likely to considerably erode existing opportunities for yield increases during the MAM season.

The major factor for the expected decrease in potato yield in the future will be due to unreliability of rainfall and rising temperature. Farmers in Uganda have already been experiencing rising temperatures and erratic rainfall during the MAM season, which is the major rainy season (CRA workshop). In the coming decades, this is expected to worsen under both the business-as-usual climate change scenario (RCP8.5) and the more optimistic scenario (RCP4.5)

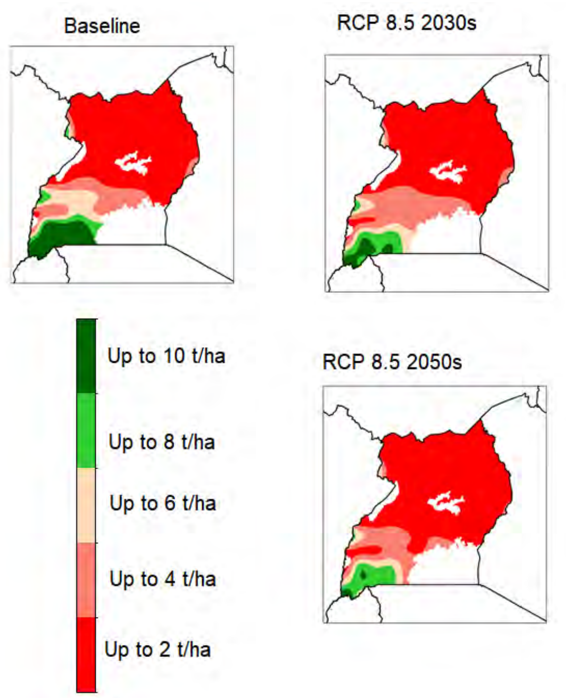


Figure 7. *Modelled potato yields under current and future climates (RCP8.5)*

Climate Risk Assessment Workshop

The CRAFT project conducted a Climate assessment process for the Potato chain in on November 14th and 15th in Kabale attended by 36 participants (Male-27; Female-9). The most important climate risks highlighted during the workshop included: prolonged droughts; too much rain; unpredictable seasons 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

"I grew up on my fathers' farm and I recall that we experienced droughts once in a very long time (like once in 10 years) and these would occur again after a similar period of time. But these days, droughts are frequent and it occurs any time. I remember that we had to remove our clothes to cross 'kiruruma' swamp since the water was beyond the waistline. Today we walk across the same swamp with our shoes on; the water has disappeared," Charles K. Byarugaba a 63 year old potato farmer from Kabale district, Kamuganguzi Sub county, Katenga parish

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 - use of weather forecasts for timely planting	- lack of appropriate climate, 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, - value addition to prolong potato shelf life, - climate information services and soil testing services.

References

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Project Information

The Climate Resilient Agribusiness for Tomorrow (CRAFT) project (2018 - 2022), 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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