Soybean Uganda

Climate change risks and opportunities

Soybeans 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, build resilience in the agriculture sector, improve productivity and farmer incomes, and contribute to climate change mitigation (CIAT & World Bank, 2017). Uganda is the third largest producer of soybeans in Africa, producing about 180,000 Megaonnes in 2010. The average yield of soybeans is about 700kilograms per hectare (Faostat, 2009).

Past trends in temperature

The temperature trend (from 1961-2005) for the first rainy season (March, April, May) show that temperature in the eastern (Mbale, Tororo & Sironko), central and northern soybean growing areas of Uganda has been increasing by about 1°C (Figure 1). During the second rainy season (October, November, December), the temperature has increased by 1°C - 1.2°C over most of the soybean growing areas of the country. The rate of warming has been slightly higher in the second rainy season (OND) as compared to the first season (MAM) by about 0.2°C.

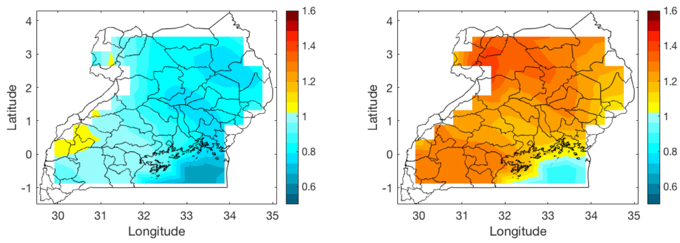

Figure 1. *Temperature trend from 1961-2005 for the first (OND, LEFT) and second rainy season (MAM, RIGHT).* ***NOTE****: During both the second (October, November, December) and first (March, April, May) rainy season temperature has increased by about 1ºC in soybean growing areas of Uganda.*

[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 (CanESM2, EC-EARTH, MPI-ESM-LR, GFDL-ESM2M) 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

Climate change in future[1]

Temperature

During both the second and first rainy season, the model projections for mid-century (2050's) show that temperature in the soybean growing areas of Uganda is expected to increase by more than 2°C (Figure 2). The temperature is expected to rise by about 2.8°C over the eastern (Mbale, Tororo & Sironko), central and northern soybean growing areas of the country especially during the first rainy season (Figure 2). During the second rainy season, the temperature is expected to rise by about 2.0°C-2.4°C. Figure 2 also show that the rate of warming over eastern soybean growing areas of the country is expected to be higher in the first season (MAM) as compared to the second (OND) by about 0.8°C.

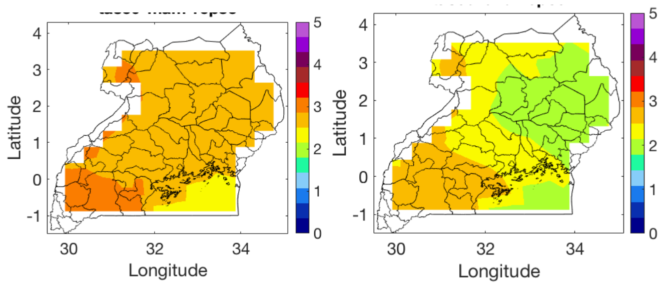

Figure 2*. Projected seasonal mean changes in temperature for 2050s under the RCP8.5 emission scenario (business as usual case scenario), relative to the reference period (1961-2005). During both the second (October, November, December; RIGHT) and first (March, April, May; LEFT) rainy season, temperature is likely to rise by more than 2°C with the highest increase of 3°C over eastern soybean growing areas of Uganda during the first rainy season (MAM).*

Precipitation

The seasonal mean rainfall in the second rainy season (OND) is projected to increase in the eastern, central and northern soybean growing areas of Uganda by as much as 20-30% by mid-century (2050s) under the business as usual scenario (Figure 3). However, the seasonal mean rainfall in the first rainy season (MAM) is expected to decrease by about 10-20% over the eastern and northern soybean areas of the country by 2050s (Figure 3). The central soybean growing areas of the country will continue to get a normal seasonal rainfall.

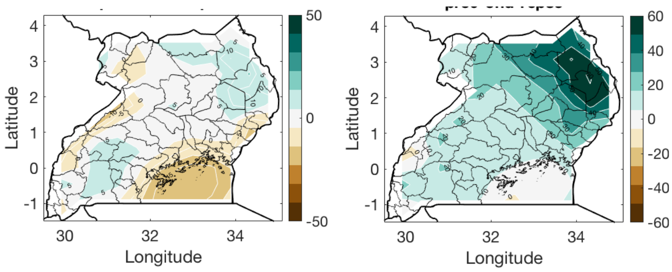

__Figure 3.__ Projected seasonal mean changes in rainfall (in percentage) for mid-century (2050s) under the RCP8.5 emission scenario (business as usual scenario), relative to the reference period (1961-2005). Note: The seasonal mean rainfall in the first rainy season (RIGHT) is projected to increase by about 20-30% over the eastern soybean growing areas of Uganda. However, the seasonal rainfall is expected to decrease by 10-20% over the soybean growing areas of the country (LEFT).

The increase in the seasonal mean rainfall in eastern, central and northern soybean growing areas of Uganda during the second rainy period accompanied by an increase in the number of consecutive wet days by about 3-4 days (Figure 4) could lead into enhancement of rainfall in the region. However, the length of the longest wet spell in the soybean growing areas of the country during the first rainy season is expected to decline by more than 3 days. The decline in the longest consecutive wet days coupled with the decrease in seasonal mean rainfall in the first rainy season (by about 10-20%) could lead to lack of rainfall and water scarcity in the soybean growing areas of the country.

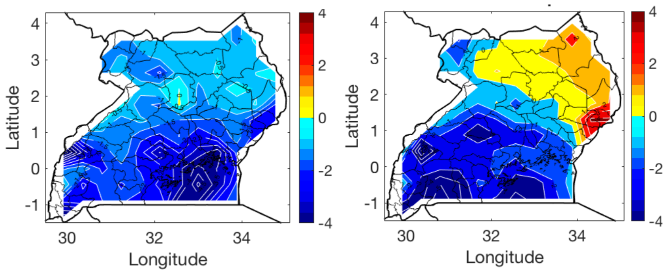

__Figure 4.__ Projected seasonal mean changes in consecutive wet days for mid-century under the RCP8.5 emission scenario, relative to the reference period (1961-2005). For the eastern soybean growing area of Uganda, the longest wet spell during the first rainy season (RIGHT) is likely to increase by about 3-4 days in the 2050s. However, the length of the longest wet spell in the eastern soybean growing areas of the country is expected to decrease by more than 3 days in the first (LEFT) rainy seasons.

Drought

The projection of the longest consecutive dry days (CDD) for the second rainy season show that dry spells are expected to decrease by more than 4 days over the eastern (Mbale, Tororo & Sironko), central and northern soybean growing areas of Uganda (Figure 5). The decline in the dry spell coupled with the increase in the wet spell and seasonal rainfall in the eastern soybean growing areas of Uganda can reinforce the possibility of wet events in the region. On the other hand, during the first rainy season, the consecutive dry days are expected to slightly increase (~1day) over most of the soybean growing areas of the country. The decrease in the longest consecutive wet days coupled with the decrease in seasonal mean rainfall in the first rainy season (up to 10-20%) could lead to shortage of rainfall and water scarcity in the region.

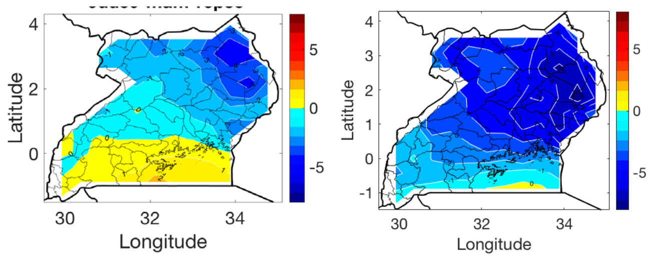

__Figure 5__. Projected seasonal mean changes in consecutive dry days for mid-century (2050s) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). Dry spells are expected to decrease by more than 4 days over eastern soybean growing areas of the country during the second rainy season (RIGHT). A slight decrease (~1day) on the dry spell is expected over the eastern soybean growing areas of Uganda for the first rainy season (LEFT).

In summary, during both the long and short rainy season, the model projections for 2050's show a temperature rise in the soybean growing areas of Uganda. While rainfall is expected to increase in the eastern soybean growing areas of Uganda during the second rainy season, the first rainy season is expected to suffer from a long dry spell and a decrease in seasonal rainfall.

Climate change impact (modelling study)

Climate change is likely to considerably erode existing opportunities for yield increases in soybeans especially during the long rainy seasons. Currently, the average yield of soybean is about 700kg/ha and under current climatic conditions farmers can more than triple this with optimum nutrient management practices and biotic control. However, in the long rainy season in the near future (i.e. 2050s), yields under optimum management conditions are likely to decrease by up to 800kg/ha in Sironko and Tororo and by up to 1000kg/ha in large parts of Mbale. All these areas are also likely to experience yield decreases as a result of climate change in the short rainy season as well. In the short rainy season, the soybean production in Tororo will be affected the most.

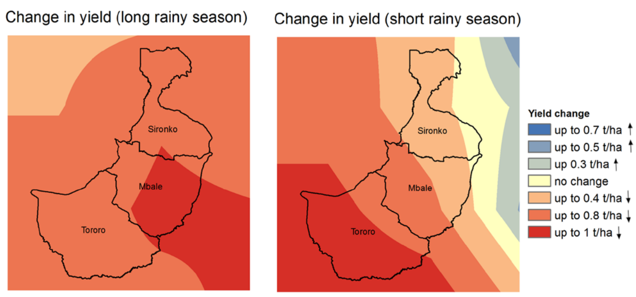

Figure 6*. Change in soybean yield under RCP 8.5 (2050s) compared to current climatic conditions. Yields were simulated under optimum nutrient management conditions and biotic control (Duku, forthcoming)*

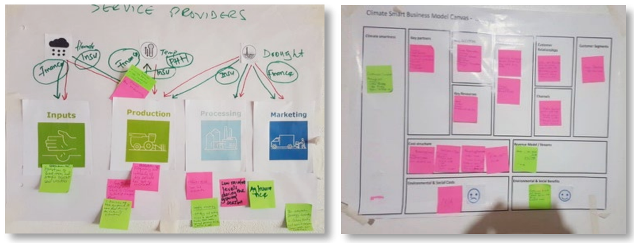

Photo 1 and 2. *Results of discussion on impact of climate change on business (LEFT) and (RIGHT) Exploring climate smart business ideas using business canvass model (Source: CRA workshop soybeans, 24-25 April 2019*

Stakeholders' perceptions of climate change and its impact on soybeans (field survey results)

A field survey on climate change and its impact amongst different stakeholders in the soybeans value chain in northern Uganda was carried out in April 2019. The survey showed 41% of the stakeholders reported a delayed start to the long rainy season compared to ten years ago. Majority of the respondents, however, consider the start of the long rainy season to have become more unpredictable. Over 75 % of all male and female farmers reported a decrease in soybean productivity. In addition to drought, changes in start of the rainy season etc., respondents attributed the reported decrease in productivity to the impact of climate change on the incidence of pests and diseases.

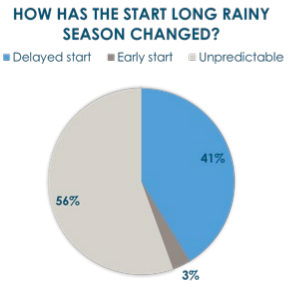

Figure7. *Stakeholders' perception of changes in the start of the long rainy season due to climate change (Source: Climate change field survey, April 2019, forthcoming)*

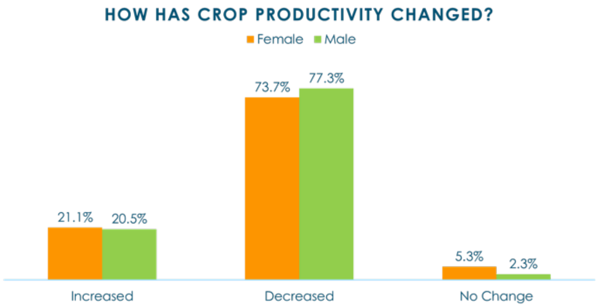

Figure 8. *Smallholder farmers' perception of changes in soybean productivity due to climate change (Source: Climate change field survey, April 2019, forthcoming)*

Climate Risk Assessment workshop (24 - 25 April, 2019)

The Climate Risk Assessment workshop brought together 37 participants representing the different stakeholders of the soybeans value chain. The majority of the participants were male and female smallholder farmers. Stepwise they shared and discussed experiences with climate change, its impact on their business and the effectiveness of current coping strategies (Photo 1)

Based on insights into climate change projections and participants' adaptive capacity, different adaptive strategies were discussed to anticipate and prepare for future conditions.

Adaptation strategies (examples)

- Solar driers
- Drought-tolerant seeds
- Agroforestry
- Irrigation
- Storage cocoons

Adaptation strategies with potential benefit for the entire value chain were further explored from a business perspective. Climate smart business ideas were discussed to address high climate related risks and to improve the viability of the value chain.

Climate smart business ideas addressing high-medium climate change risks (examples)

- Affordable and accessible drought tolerant seeds
- Soil sampling / clinic
- Provision of quality PHH technology

References:

1. 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.
2. Duku, C. (forthcoming). *Impact of climate change on soybeans in Uganda.*
3. FAOSTAT, 2018. *FAOSTAT Database*. Food and Agriculture Organization of the United Nations, Rome, Italy.
4. SNV (forthcoming) Climate change field survey on soybeans, Uganda, April 2019.

5. 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

This document was developed by Confidence Duku, Annemarie Groot, Monserrat Budding-Polo (Wageningen Environmental Research) with contributions from: Teferi Demissie (CCAFS), George Oroma (SNV), the Uganda SNV team, Agriterra, and RaboBank. It highlights activities and examples of results of a climate risk assessment for the soybeans value chain implemented in the period January - April, 2019. The assessment was carried out in the context of the **Climate Resilient Agribusiness For Tomorrow (CRAFT**) project.

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 Climate Change Agriculture and Food Security Programme (CCAFS), Agriterra, and Rabo Partnerships in Kenya, Tanzania and Uganda

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