Common Beans Tanzania

Climate change risks and opportunities

Common beans in Tanzania

In Tanzania, 7% of the land under production is used for the cultivation of beans. The average yield of beans (dry) is 888 kilograms per hectare (CIAT & World Bank, 2017). Common beans, despite its relatively low profitability, is considered a key value chain crop because of its inclusiveness, nutritional value, food security contribution and cash-crop importance (60% of the produced volumes are commercialized in the local market), and nitrogen fixation.

Past trends in temperature

The temperature trend (from 1961-2005) for both the short (October, November, December) (OND) and long rain season (March, April, May) (MAM) show that temperature in Tanzania has been increasing for the past few decades by more than 0.5°C (Figure 1). In particular, the temperature trend for the short rainy season has increased by 1°C - 1.3°C over central, north-western, western and south-western parts of the country.

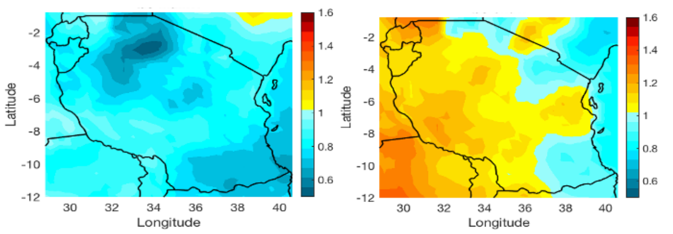

Figure 1. *Temperature trend from 1961-2005 for the long rainy season (MAM, LEFT) and short rainy season (OND, RIGHT).* ***NOTE****: During both the short and long rainy season temperature has increased by more than 0.5ºC in Tanzania*

Climate change in future[1]

Temperature

During both the short and long rainy season, the model projection for mid-century (2050's) shows a temperature rise of about 2.8ºC and 2.5ºC for western and eastern part of Tanzania respectively (Figure 2). Figure 2 highlights a pattern in the rate of warming in Tanzania, where temperature in the western part would rise by about 0.3°C, more than the east. Temperature in the southern highlands and central corridor would increase as well but less compared to the furthest western parts of the country.

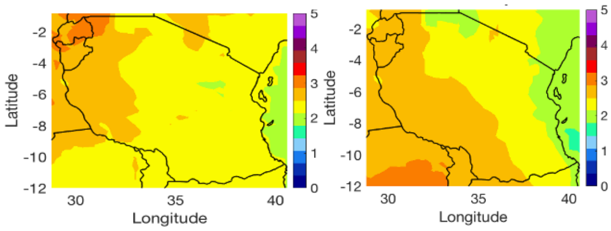

Figure 2*. Projected seasonal mean changes in temperature for 2050s under the RCP8.5 emission scenario (worst case scenario), relative to the reference period (1961-2005).* ***NOTE:*** *During both the short (OND, RIGHT) and long (MAM, LEFT) rainy season, temperature is likely to rise by about 2.8ºC for western Tanzania and 2.5ºC for eastern Tanzania.*

Precipitation

The seasonal mean rainfall in both the short and long rainy season is projected to increase in the northern part of Tanzania by as much as 20-30% for mid-century (Figure 3). In the central, southern and eastern portion of the country, the seasonal mean rainfall is also expected to slightly increase by up to 10%, especially in the long rainy season.

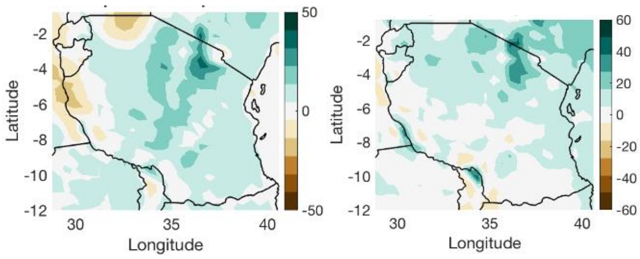

Figure 3. *Projected seasonal mean changes in rainfall (in percentage) for mid-century under the RCP8.5 emission scenario, relative to the reference period (1961-2005).* ***NOTE****: The mean rainfall in both the short (RIGHT) and long rainy season (LEFT) is projected to increase in the northern part of Tanzania by 20-30% for the 2050s and in the central, southern and eastern portion of the country by 10%.*

Similarly, the longest consecutive wet days for the northern part of Tanzania increases by about 1 day (Figure 4). However, the rest of the country will experience a decrease in the length of the longest wet spell.

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[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.

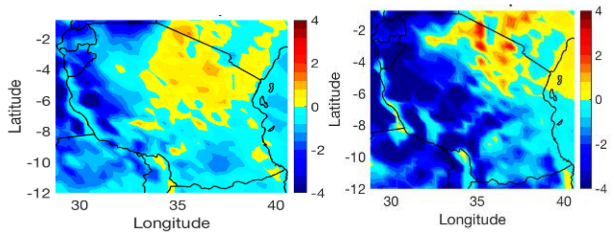

Figure 4. Projected seasonal mean changes in consecutive wet days for mid-century under the RCP8.5 emission scenario, relative to the reference period (1961-2005). NOTE: Except for the northern part of the country (which CWD slightly increases by 1 day for both the short (RIGHT) and long (LEFT) rainy season), the length of the longest wet spell is expected to significantly decrease by about 2 - 3 days in most parts of Tanzania by 2050s.

In the northern part of the country, the increase in the seasonal mean rainfall accompanied by an increase in the number of consecutive wet days could imply enhanced extreme rainfall.

Drought

The projection of the longest consecutive dry days (CDD) show that dry spells will last longer for mid and end of the century for most of Tanzania with much longer dry spells projected (by about 5 days) over central, western and southern parts of the country (Figure 5). However, the CDD decreases (by about 1 day) in the northern and north-eastern part of the country under this scenario. The projected increase in CDD in most parts of the country along with decrease in wet spells (Figure 4) and seasonal rainfall could lead to high incidences of drought, which would have a significant impact on rain-fed agriculture, including bean production.

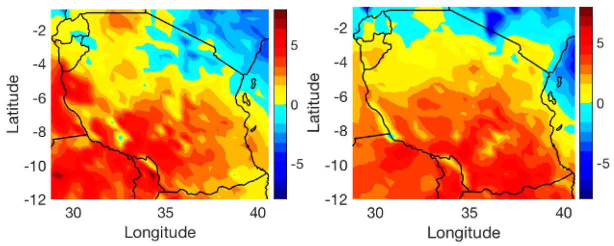

Figure 5. Projected seasonal mean changes in consecutive dry days for mid-century under the RCP8.5 emission scenario, Left: RCPs 8.5 2050s – MAM consecutive dry days. Right: RCPs 8.5 2050s – OND consecutive dry days NOTE: Dry spells will last longer for the 2050s for most of Tanzania with much longer dry spells projected to increase by 5 days over southern and south-western part of the country

In summary, during both the short (OND) and long (MAM) rainy seasons, the model projections for 2050s show that temperature is expected to rise in all parts of Tanzania ranging from 2.0°C to 2.8°C. A likelihood of more dry spells with more incidences of agricultural drought is expected over most parts of Tanzania by 2050s.

Climate change impact (literature review)

In Tanzania about 50% of common bean cultivation area (mostly in areas with elevation below 1000m) will experience greater than 20% yield reduction by 2050 for RCP 8.5 (Thornton et. al., 2009). As shown in Figure 6, other areas mostly in the rainfed highlands are likely to experience yield gains of over 20% by 2050 (Thornton et. al., 2009). A substantial part of the heterogeneity in yield response can be explained in terms of temperature effects.

At higher elevations, temperature-driven yield increases will occur up to an average threshold of between 20°C–22°C. Beyond this temperature, yields will tend to decline.

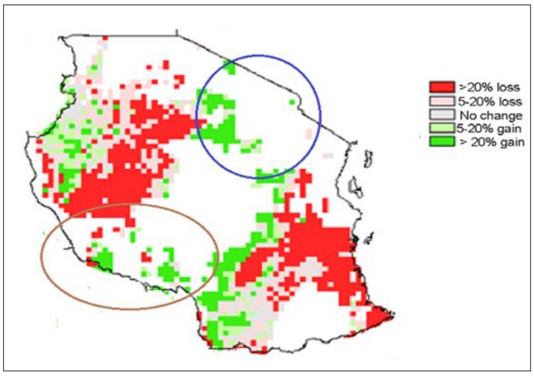

***Figure 6**. Rain fed highlands that will experience yield gains of over 20% by 2050 (Thornton et.al. 2009)*

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

A field survey on climate change and its impact amongst different stakeholders in the common beans value chain in northern Tanzania (Arusha, Manyara and Kilimanjaro) and southwest Tanzania (Mbeya, Songwe and Katavi regions) was carried out in April 2019. Almost all smallholder farmers (male, female) perceived an increase in extreme temperature, a large majority reported that droughts had increased (Figure 7) and perceived a delay in the start of the long rainy season.

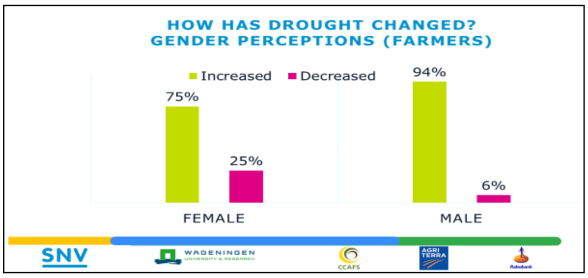

***Figure 7**. Smallholder farmers' perception of changes in drought due to climate change (Source: Climate change field survey)*

The majority of all stakeholders reported that climate change had a negative impact on the production of common beans (Figure 8).

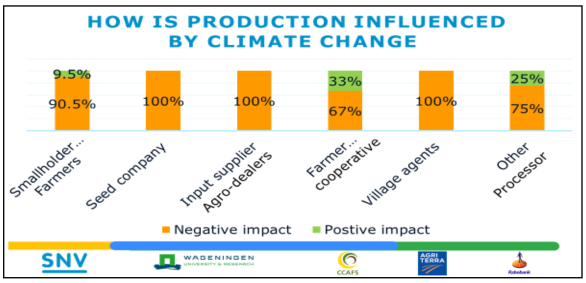

***Figure 8.** Stakeholders' perception of changes in production due to climate change - Climate change field survey (SNV, forthcoming*

Stakeholders reported the following high/medium climate related risks: an increase in length and/or frequency of dry spells, more often *extreme* temperature, an increase in temperature and a delay in the start or end of long rainy season.

Climate Risk Assessment workshop (18 -19 April, 2019)

The Climate Risk Assessment workshop brought together 26 participants representing the different stakeholders (Farmers Groups, Cooperatives representatives, Processors, Input suppliers, Traders and Financial Institutions) of the common beans value chain. The majority of the participants were male and female smallholder farmers. They shared and discussed experiences with climate change, its impact on their business and the effectiveness of current adaptation strategies (Figure 9, Photo 1 and 2).

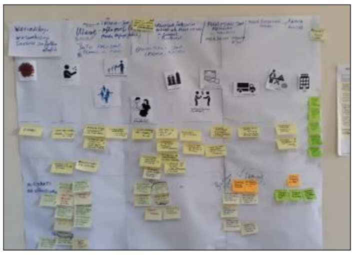

***Photo 1 and 2**. Discussing climate change, impact on business, coping strategies and their effectiveness (processor, bank, traders) and exploring climate smart business ideas addressing drought risks (Source: CRA workshop common beans, 18-19 April 2019)*

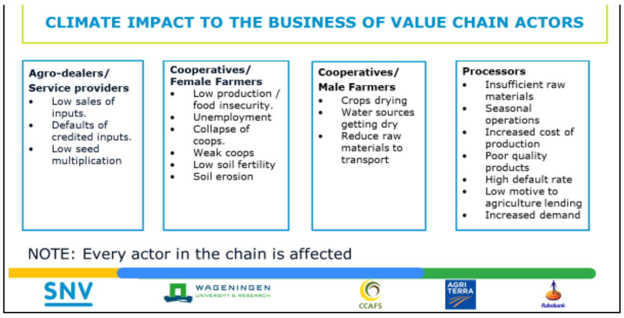

***Figure 9.** Results of discussion on impact of climate change on business (Source: CRA workshop common beans, 18-19 April 2019)*

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)

- Improved seed multiplication and distribution; early maturing seeds
- Crop clinics and mechanization centre
- Conservation agriculture practices (e.g. zero tillage, mulching)
- Irrigation
- Planting trees

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)

- Farmer (mobile) clinic selling improved seeds, equipment and advisory services
- Improved seeds sold by seed company to farmers, farmer cooperatives and agro-dealers
- Contract farming (processor – producers), processor as owner of business idea

References:

1. CIAT & World Bank. 2017. Climate-Smart Agriculture in Tanzania. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT); World Bank, Washington, D.C. 25 p.
2. SNV (forthcoming) Climate change field survey on common beans value chain, Tanzania, April 2019.
3. Thornton, Philip & van de Steeg, Jeannette & Notenbaert, An & Herrero, Mario. (2009). The Impacts of Climate Change on Livestock and Livestock Systems in Developing Countries: A Review of What We Know and What We Need to Know. *Agricultural Systems*. 101. 113-127.

Acknowledgement

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

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