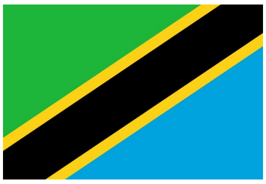
Common Beans Tanzania



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 the first rainy season (March, April, May) show that temperature in the western and south-eastern common bean growing areas of the country has been increasing by about 1°C (Figure 1). During the second rainy season (October, November, December), the temperature has increased by 1°C - 1.3°C over western and south-eastern common beans growing areas of the country.

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

Climate change in future[1]

Temperature

During both the first and second rainy seasons, the model projection for 2030's show that temperature in the western and south-eastern common bean beans growing areas of Tanzania is expected to rise by about 1.4ºC (Figure 2). Figure 2 also 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. The projection model also shows that temperature in the 2050s is expected to rise by about 2.4°C and 2.8°C in the south-east and western common beans growing areas, respectively, in both the first and second rainy seasons. Figure 2 demonstrates a rate of warming in Tanzania, whereby temperature over the western common beans growing areas rises greater than the south-east by about 0.4°C.

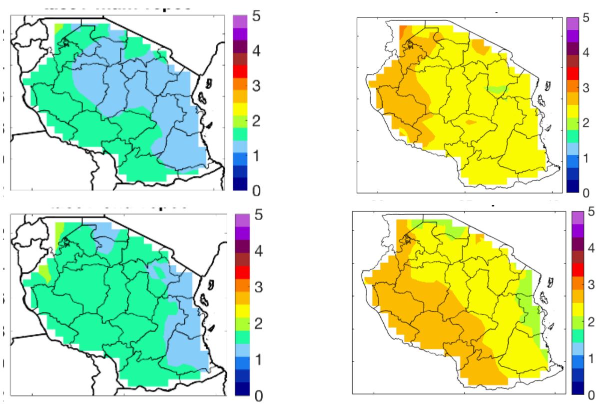


Figure 2*. Projected seasonal mean changes in temperature for 2030s (LEFT COLUMN) and 2050s (RIGHT COLUMN) under the RCP8.5 emission scenario, relative to the reference period (1961-2005).* ***NOTE:*** *In the 2050s, temperature in the western common beans growing areas of Tanzania is likely to rise by about 2.8°C in the second rainy season (OND, BOTTOM RIGHT) and by about 2.4°C in the first (MAM, TOP RIGHT) rainy season.*

Precipitation

The seasonal mean rainfall in both the short and long rainy season is projected to slightly increase in the south-eastern common beans growing areas of Tanzania by about 10% in the 2030s and 2050s (Figure 3). However, the seasonal mean rainfall in both the 2030s and 2050s is expected to slightly decrease by about 5-10% in the western common beans growing areas of the country, especially in OND.

[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.

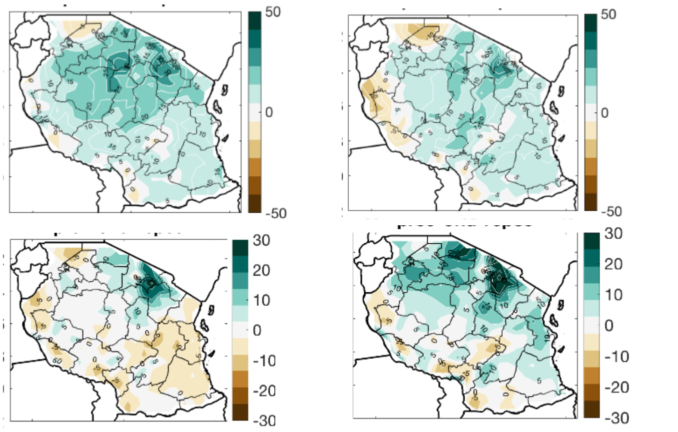


__Figure 3.__ Projected seasonal mean changes in rainfall (in percentage) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). __NOTE__: In both the 2030s and 2050s, the mean rainfall in the second (OND; BOTTOM) and first rainy season (MAM; TOP) is projected to increase in the north-east potato growing areas by 20-30% for the 2050s.

On the other hand, the longest consecutive wet days in the south-east common beans growing areas is expected to slightly decrease by about 2 days (Figure 4). The western common beans growing areas of the country will also experience a significance decrease in the length of the longest wet spell (by about 4 days), especially during the second rainy season.

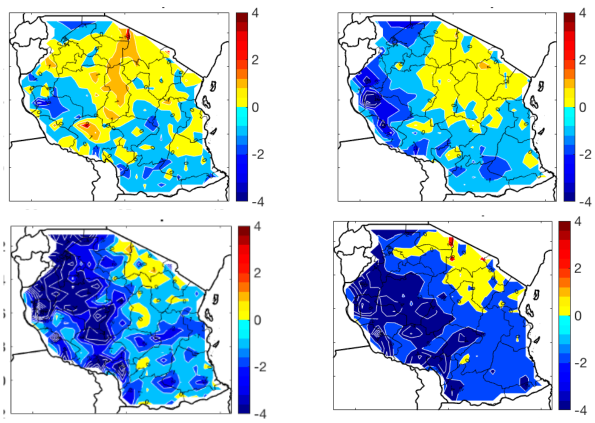


__Figure 4.__ Projected seasonal mean changes in consecutive wet days (__CWD__) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). __NOTE:__ The consecutive wet days are expected to significantly decline (4 days and above) in the west potato growing areas especially during the second rainy season (OND; BOTOM).

Drought

The projection of the longest consecutive dry days (CDD) show that dry spells will last longer in the 2030s and 2050s in both the western and south-eastern common beans growing areas of Tanzania (Figure 5). The longest dry spells (~5 days) is expected in the south-eastern common beans growing areas of the country in both the first and second rainy seasons of the 2050s. The projected increase in CDD in the south-eastern and western common beans growing areas of the country in both the 2030s and 2050s for the second and first rainy seasons along with decrease in wet spells (Figure 4) and seasonal rainfall (Figure 3) could lead to high incidence of drought, which would have a significant impact on the common beans yield in the region.

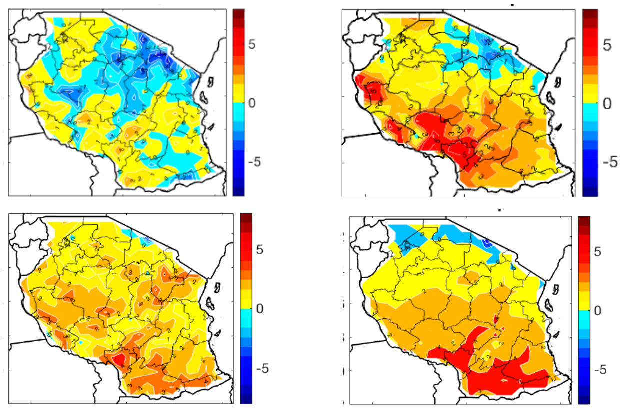


__Figure 5__. Projected seasonal mean changes in consecutive dry days (CDD) for 2030s (LEFT) and 2050s (RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). N__OTE__: Dry spells will last longer (by about 5 days) in the 2030s and 2050s in the south-east common beans growing areas in both the second (BOTTOM) and first (TOP) rainy seasons.

Onset and length of growing spell

The onset, cessation and length of growing spell for the first rainy season (MAM) is estimated for the historical (1961-2005) and the 2030s and 2050s. Results show that onset of the rainfall is expected to be slightly delayed (by about 1-3 days) in both the western and south-eastern common beans growing areas of the country (Figure 6). Similarly, the length of the growing spell in the south-east and western common beans growing of Tanzania is expected to decrease by about 10 days especially in the 2030s (Figure 6).

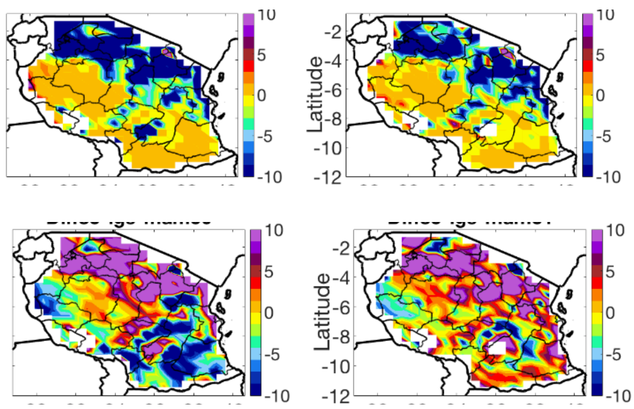


__Figure 6__. Projected seasonal mean changes in onset for 2030s (TOP-LEFT) and 2050s (TOP-RIGHT) and length of growing spell for 2030s (BOTTOM-LEFT) and 2050s (BOTTOM-RIGHT) under the RCP8.5 emission scenario, relative to the reference period (1961-2005). __NOTE__: Onset of the rainfall in the south-east common beans growing areas is expected to be delayed and the length of the growing spell is projected to be short by about ten days especially in the 2030s.

In summary, during both the second (OND) and first (MAM) rainy seasons, the model projections for 2030s and 2050s show that temperature is expected to rise by about 1.4°C to 2.8°C in the *common beans growing areas of Tanzania. A likelihood of more dry spells with an implication of more incidences of agricultural drought is expected over both the south-east and western common beans growing areas of the country*.

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 under the fossil intensive scenario (Thornton et. al., 2009). As shown in Figure 6, other areas mostly in the rainfed highlands are likely to experience yield gains of c ne 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.

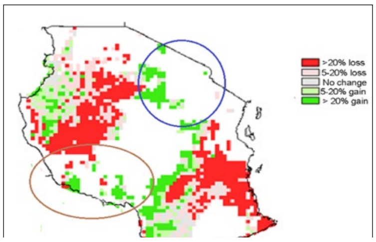


Figure 6*. Rain fed highlands that will experience yield gains of over 20% by 2050 (Thornton et.al. 2009)*

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. The survey showed similarities in perceptions but also large differences. 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. The majority of all stakeholders reported that climate change had a negative impact on the production of common beans (Figure 8).

However, smallholders' perceptions of changes in the end of the long rainy seasons and changes in start and end of the short rainy season varied significantly (Figure 9). 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.

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

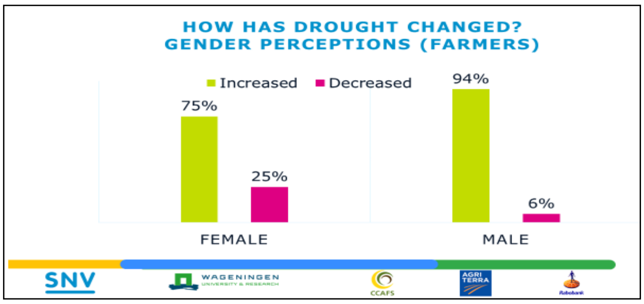
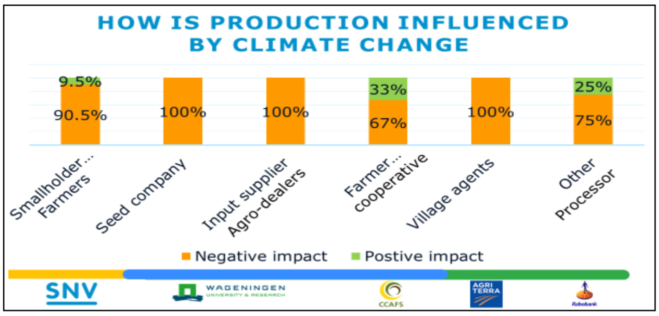


Figure 8. Stakeholders' perception of changes in production due to climate change (Source: Climate change field survey)



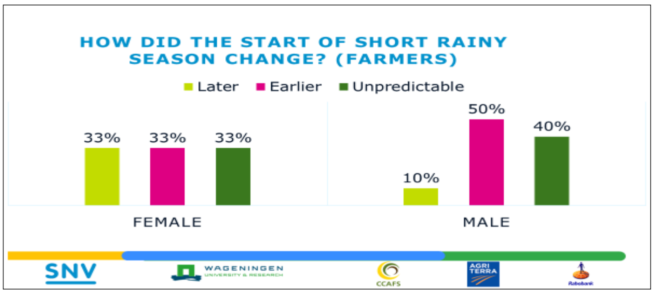
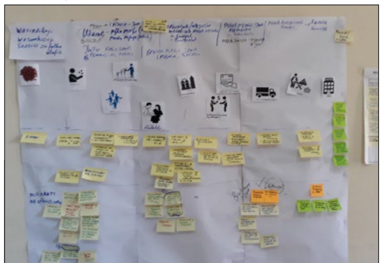
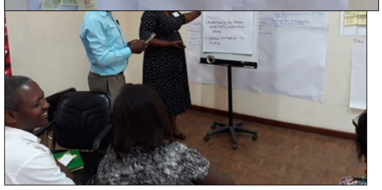


Figure 9*. Smallholder farmers' perception of changes in the start of the short rainy season (Source: Climate change field survey)*

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. Climate smart business ideas have been





explored to address high climate related risks and to improve the viability of the value chain.

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)

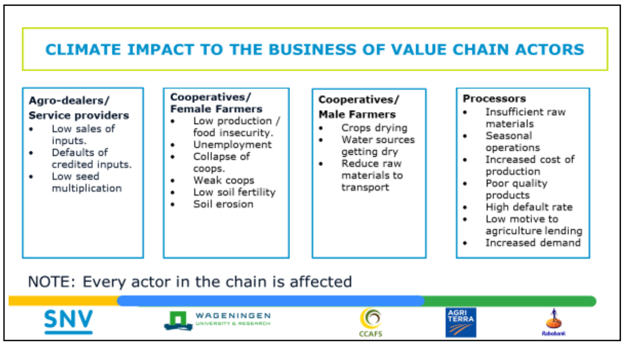


Figure 10. *Results of discussion on impact of climate change on business (Source: CRA workshop common beans, 18-19 April 2019)*

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

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. 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.
3. Climate change field survey on common beans value chain, Tanzania, April 2019 (forthcoming).

Acknowledgement

This document was developed by Annemarie Groot and Confidence Duku (Wageningen Environmental Research) with contributions from: Teferi Demissie (CCAFS), Godfrey Kabuka (SNV), Emanuel Nkenja (SNV), Kasian Ninga (SNV), Raymond Lyimo (Agriterra), Pierre Schonenberg (Rabo Partnerships B.V), April, 2019. Editing Brian Harding. It highlights activities and examples of results of a climate risk assessment for the common beans 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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