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UNITED REPUBLIC OF TANZANIA

Agriculture Sector Background Note

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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Acknowledgments

The Tanzania Country Climate and Development Report (CCDR) was prepared by a multisectoral World Bank Group team led by Diji Chandrasekharan Behr (Lead Environmental Economist, East Africa Environment Department), and William Battaile (Lead Economist, Macroeconomics, Trade & Investment, Eastern and Southern Africa), under the supervision of Paul Jonathan Martin (Manager, East Africa Environment Department) and Abha Prasad (Manager, Eastern and Southern Africa Macroeconomics, Trade and Investment Department), and the direction of Iain Shuker (Regional Director, Planet vertical, Eastern and Southern Africa).

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Abbreviations and Acronyms

ASDP	Agriculture Sector Development Plan
ASP	aspirational (scenario)
BAU	business-as-usual (scenario)
CCDR	Country Climate Change and Development Report
CO_2e	carbon dioxide equivalent
CSA	climate-smart agriculture
FPCM	fat and protein-corrected milk
GAP	good management practices
GDP	gross domestic product
GHG	greenhouse gas
kg	kilogram
MT	metric tonne
R&D	research and development
ZASDP	Zanzibar Agriculture Sector Development Program

All dollar amounts ($) are US dollars

1. Tanzania's Agriculture Sector is Crucial for National Development, but Highly Vulnerable to the Effects of Climate Change

Agriculture[1] is considered the backbone of the Tanzanian economy. It contributes 26 percent to the national gross domestic product (GDP), 20 percent to exports (~$1.3 billion) and employs about 65 percent of the workforce.[2] The sector has been supplying over 110 percent of the national food requirements over the past decade.

Yet, the sector is poised to bear a disproportionate burden of climate change repercussions, largely due to its inadequate adaptation to offset the impacts of climate change. The National Sample Census of Agriculture (2019/20) reveals major vulnerabilities that expose the sector to the effects of climate change, including:[3]

- Low agricultural productivity, characterized by low yields in crops and livestock products, such as cereal, yields being 40 percent of the world average, beef carcass being only 60 percent of world average.
- Low level of crop irrigation, with only 2.5 percent of irrigable land with crops under irrigation.
- Low level of extension services provided, with only 7 percent of farmers and livestock keepers receiving extension services (down from 67 percent in 2008).
- Low usage of improved inputs, with only 22 percent of planted area planted with improved seeds and 20.2 percent of the planted area applied with fertilizer—and this is under-applied, with farmers using as little as 10 percent of the required amounts.
- Low labour productivity, with 90 percent using hand hoes and machetes as primary farm implements. Only 25 percent use animal tillage and up to 10 percent use mechanized implements.
- Low commercialization of agricultural produce, where only ~20 percent of harvested cereals, pulses, oilseeds and nuts, and roots and tubers are marketed. The rest is used for subsistence.
- Low scalability of production, where 95 percent of farmers are smallholders, producing on less than 2-hectare plots.

Climate change models are predicting rises in temperature and increased precipitation variability. These climate stressors are predicted to have a combination of effects on the agriculture sector (table 1).

Table 1: Effects of climate change stressors on agriculture

Climate change stressor	Effect on agriculture
Decreased rainfall	Drought, irrigation and livestock drinking water shortage, degraded pasturelands
Increased intensity of rainfall	Floods, waterlogging, physical crop damage, erosion, nutrient leeching
Increased duration of heat waves	Heat stress on labor, decreased livestock productivity (lower growth rates, milk/eggs production, reproduction), increased livestock mortality
Rising temperature	Heat stress lowering crop yield
Rising sea level	Saltwater seepage into coastal lands, making them unsuitable for traditional agriculture
Ecological changes	Pests, diseases, increased preharvest losses

1 In this document, agriculture includes both crops and livestock.
2 National Economic Survey 2022; Minister of Agriculture 2023 Budget Speech.
3 NBS Tanzania. 2020. *National Sample Census of Agriculture (NSCA) 2019/20*.

2. The Government has Outlined Some Sector Priorities and Strategies that Aim at Increasing Productivity and Adapting the Sector to Climate Changes

2.1. Nationally determined contribution (NDC)

Tanzania has highlighted its climate commitments under its recently submitted NDC framework. The NDC sets a high-level target of 30–35 percent reduction on national business-as-usual (BAU) emissions by 2030. Specifically, within the agriculture sector, the NDC proposes a string of adaptation measures, including:[4]

- Improving agricultural land, pasture, rangeland and water resources management.
- Increasing productivity sustainably through climate-smart agriculture (CSA) interventions in both crop and livestock.
- Protecting farmers against shocks through crop and livestock insurance.
- Strengthening agricultural (crop and livestock) research and development (R&D).
- Strengthening extension services.
- Promoting livelihood diversification for livestock keepers.

However agriculture is not a prioritized mitigation sector in the NDC. Tanzania's contribution to global emissions is less than 0.2 percent, yet it is anticipated to bear a disproportionate percentage of the impacts of climate change, with the agricultural sector being particularly vulnerable. Consequently, prioritizing adaptation over mitigation within the agricultural sector is perhaps more reasonable under these circumstances. But recent holistic measurements suggest emissions from the broad agrifood sector are as high as 31 percent of global total greenhouse gas (GHG) emissions while only 2.4 percent of total mitigation finance is dedicated to the sector.[5] It is therefore pertinent that the government considers transforming agrifood systems to curb emissions and address the sector's outsized climate footprint. While adaptation initiatives may yield some mitigation co-benefits, the NDC's lack of explicit mitigation directives in the agriculture sector means that no planned activities or budgeting will occur at the sector level. The National Climate Change Response Strategy 2021–26, launched shortly after the NDC submission to aid in its implementation, has prioritized agriculture as a key sector for mitigation efforts.

2.2. Existing government sectoral strategies

The following key agriculture sector policies and strategies will govern the sector's direction over the next few years:

- **National Five-Year Development Plan (2021–26):** A formal tool for implementing Tanzania's development agenda, aimed at increasing production, competitiveness, and standards of living, with agriculture as one of its priority sectors.
- **Agriculture Sector Development Plan (ASDP) II (2017/18–27/28):** A key guiding document for the agriculture sector, this 10-year program guides agricultural investments toward increased productivity, farmer incomes, commercialization, and food security.

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4 URT. 2021. *Nationally Determined Contribution*.

5 Sutton, W R, Lotsch, A and Prasann, A. 2024. Recipe for a Livable Planet: Achieving Net Zero Emissions in the Agrifood System. Washington DC: World Bank. https://hdl.handle.net/10986/41468.

- **Zanzibar Agriculture Sector Development Program (ZASDP, 2019–28)**, which contributes to the Zanzibar Strategy for Growth and Reduction of Poverty III and has similar priority areas to ASDP II.
- **Agriculture Sector Development Strategy II (2015–25).**
- **Agenda 10/30:** A 2030 vision that targets a 10 percent agricultural GDP growth rate by 2030 through investments in public irrigation, extension services, supporting youth and women involvement, commercial block farms, increasing access to finance, and rebranding the sector to encourage private investment.
- **Tanzania Agriculture Master Plan (2024–50)** *currently under development*: A transformation road map for agriculture sector development, guiding the sector up to 2050.
- **Tanzania Livestock Master Plan 2017/18–21/22:** Outlines investments to improve livestock productivity as well as prioritizing value chains to target for increased productivity.
- **Livestock Sector Transformation Plan 2022–27:** Outlines investments for transforming the livestock subsector to achieve ASDP II targets.
- **Ministerial budget speeches:** Produced annually, highlighting past year's performance, and proposing a new budget for the following financial year.
- **National Irrigation Master Plan (2018 to 2035).**
- **Zanzibar Irrigation Master Plan.**
- **National Climate Change Response Strategy 2021–26:** A multisectoral document aiming to mainstream climate change issues in the national development agenda and to implement and monitor the nation's NDC.
- **CSA Programme for Tanzania (2015–25):** Aims to build resilience of the agriculture sector for enhanced food security amidst climate change. The main programmatic areas are improving productivity, building resilience, integrating value chains, R&D and innovations, improving extension services, improving institutional coordination.
- **National Climate-Smart Agriculture Guideline (2017):** A guideline developed to support the implementation of the CSA Agriculture Program (2015–25).
- **Agriculture Climate Resilience Plan (2014):** Proposes strategic adaptation and mitigation actions in the crop subsector, including promoting the uptake of CSA, improving agricultural land and water management, managing impacts of climate-related shocks using risk management tools, and strengthening knowledge and systems for more effective climate action.

Climate change conversations are increasingly happening at a national strategic level. But implementation of proposed adaptation and mitigation interventions is stubbornly slow due to a lack of public funding.[6] In recent years, the agriculture public budget has been less than 3 percent of the national budget, a disproportionately low figure when considering the sector's contribution to the GDP, though the 2022/23 budgets included 155 and 252 percent increased budget commitments in the Ministry of Agriculture and Ministry of Livestock & Fisheries Development, respectively.

6 ASDP II Mid-Term Review. 2023; World Bank. 2022. *Tanzania Agriculture Public Expenditure Review*.

2.3. Identified areas for improvement in government policies and strategies

Existing government policies and strategies are designed to enhance agricultural productivity and climate resilience but several policy gaps have historically hindered the full realization of this vision. These include:

- **Comprehensive climate change scenarios:** The agriculture sector lacks detailed climate change scenarios and coordinated interventions for effective mitigation and adaptation.
- **Food security preparedness and response strategies:** The strategy including the Food Security Early Warning System could increase the capacity of Government and stakeholders to build resilience and response for climate shocks and food insecurity.
- **Crop and livestock insurance:** The adoption and development of crop insurance, livestock insurance could increase farmers' resilience to climate change.
- **Clear alignment under a prioritized investment plan:** The sector currently faces a lack of clear alignment between its myriad strategic documents and its investment plan, budget, and work plan. There is confusion about which document—be it the ASDP, Vision 2030, Livestock Transformation Plan, or Agriculture Master Plan—should guide sector investments, resulting in fragmented and ineffective implementation. Prioritizing and harmonizing these strategic frameworks under a unified investment plan is essential for coherent and efficient sectoral development.
- **Limited agricultural mitigation efforts:** There are insufficient mitigation efforts in agriculture, particularly in the livestock subsector, which is the highest contributor to GHG emissions. Efforts to reduce emissions through intensifying cattle farming, reducing herd size, promoting chicken as a low-impact protein, and improving feed quality are limited.
- **Inadequate budgets for climate resilience:** Budgets for climate resilience measures, such as promotion of CSA techniques, are insufficient, leading to limited adoption.

3. Overview of the Agriculture Sector Today and under BAU and Aspirational (ASP) Scenarios

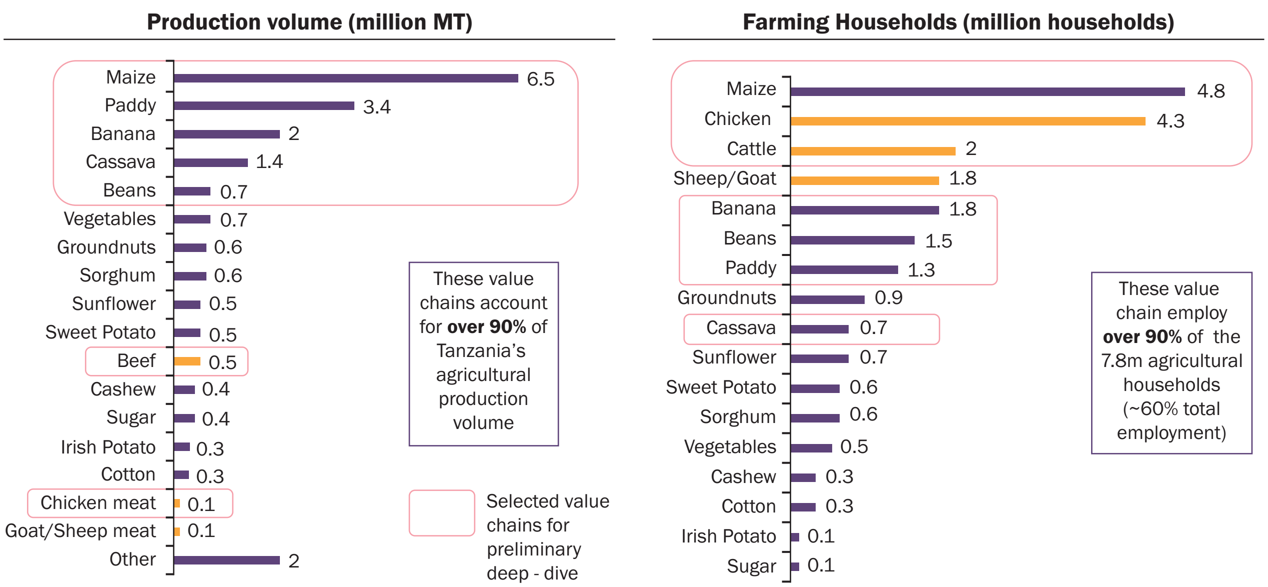
Tanzania is endowed with 64 agroecological zones that enable a variety of value chains to be developed throughout the inhabited lands of Tanzania, excluding forests, national reserves, and other protected areas. The density of production is distributed by specific value chains, depending on the agroecological favorability of individual value chains. This chapter looks at the most important crops and livestock value chains (by production volume and value, employment, and nutritional contributions) in the sector, and selects representative value chains for a deeper dive into how climate change will affect their production in the future (figure 1).

To properly model how climate change will impact the select representative value chains, two economy future scenarios are established (table 2).

Table 2: Scenarios to be modeled

Scenarios	Description
BAU	Looks at historical production trends (2002–22) and extrapolates up to 2050. Limited productivity gains, in line with historical trends and current initiatives. Cropland expansion continues at historical rates, leading to significant stress on arable land and water resources by 2050.
ASP	Proposes strategic interventions to arrive at accelerated agricultural growth from the present up to 2050. Literature was used to establish the effectiveness of interventions in ushering the aspirational accelerated growth. Gradual adoption of intervention was modeled up to 2050. Anticipated productivity gains by 2050 are aligned with those of Africa's leading countries and world averages.

Figure 1: Production and employment of major value chains in Tanzania



3.1. Consumption/nutrition

Although there are limited projections on what a Tanzanian food basket would look like in the future as incomes and dietary options increases, global and local trends[7] suggest a more diverse food basket as the country urbanizes. Reflected in the way Dar es Salaam has a much more diverse food basket than rural regions, urbanization and increased income tends to lead to:

- Increased consumption of rice and wheat product over traditional cereals and roots and tubers—such as maize, sorghum, cassava, and sweet potatoes—partly due to ease of preparation and their perception as symbols of increased social and economic status.[8]
- Increased consumption of cereals over roots, tubers and suckers, with increased consumption of rice associated with higher incomes.
- Decreased dependence on maize as a staple crop relative to other staples.
- Increased consumption of animal-source foods, including meats, eggs, and milk.
- Increased consumption of edible oils in cooked and processed foods.

These consumption trends will see some crops gain more significance than others, and must be considered when projecting for future scenarios.

3.2. Crop subsector

Between 2007/08 and 2019/20, agricultural production grew as a result of expanding the cultivated area from 8.3 to 13.9 million hectares (not much from productivity gains). This expansion of agriculture activities is a major contributor toward GHG emissions: 46 percent of Tanzania's emissions are from land use change and forestry—for example, converting forest land to agricultural land—while primary agriculture accounts for 38 percent.[9] Total usable land available to smallholder farmers in 2020 was 20.77 million hectares (NSCA 2019/20) Of this, 80.5 percent was used for crop and livestock farming, and 877,500 hectares were used as exclusive pasturelands.

Farmers are perceiving the impacts of climate change in Tanzania and are using traditional and locally available technologies to combat the effects of climate change. In a survey of 700 nationally distributed farmers (crop and livestock) and agricultural stakeholders, it was revealed that 60–100 percent of the interviewees perceived the impacts of climate change and had adopted some mechanisms to manage the impact.[10] These include weeding, mulching, intercropping with leguminous crops, crop rotation, ridging, agroforestry, zero-grazing/intensive livestock keeping, manure management for biogas, and improved breeds/seeds usage. This suggests farmers' readiness to adopt appropriate CSA[11] practices and technologies if they are made accessible to them.

The 2019/20 National Sample Census of Agriculture identified that 38 percent of farming households practiced conservational farming (figure 2),[12] with high variance across regions. Some regions had over 60 percent of farmers practicing conservational farming (Kigoma, Kagera, Kilimanjaro) while some had fewer than 20 percent (Songwe, Njombe, Lindi, Dar es Salaam, Pwani, Morogoro). Overall trend is lower adoption in the Coastal and Eastern zones and higher adoption in the Highland zones.

7 USDA. 2015. *Measuring Access to Food in Tanzania: A Food Basket Approach, EIB-135*.

8 FAO. 2015. *Rice Value Chain in Tanzania*.

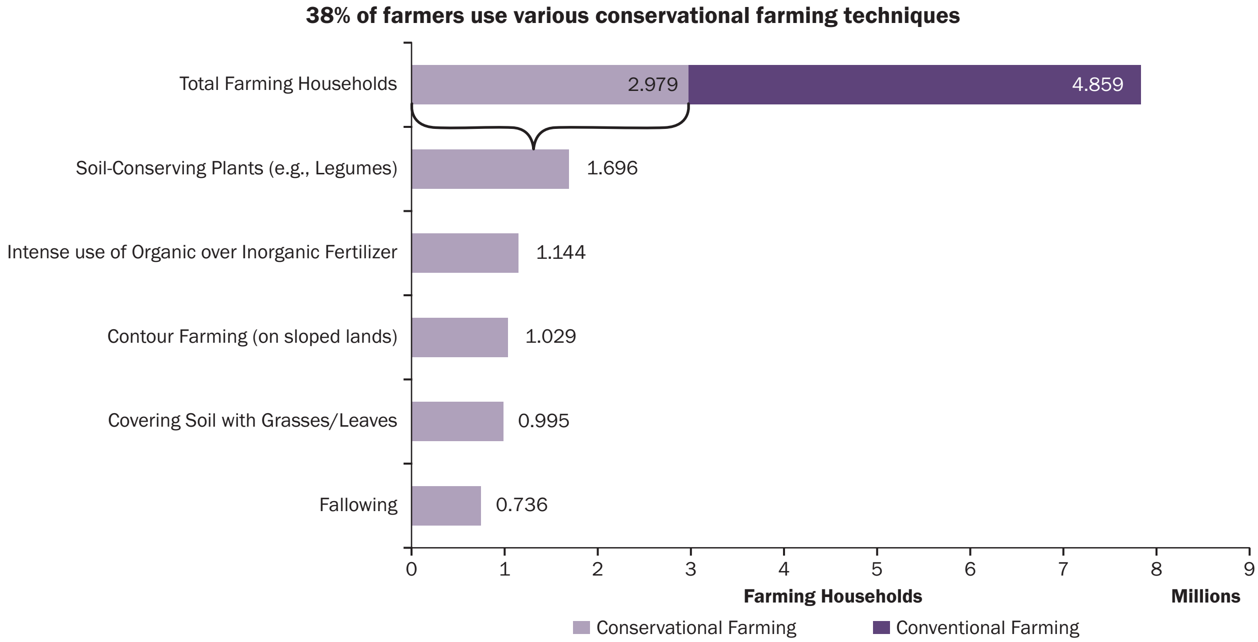
9 World Bank. 2022. *Tanzania Agriculture Public Expenditure Review*.

10 URT. 2017. *National CSA Guidelines*.

11 Defined as practices that sustainably enhance productivity and food security while contributing to climate adaptation and/or mitigation, e.g., using improved seeds, irrigation, soil fertility enhancement, conservational farming, and sustainable pest management.

12 Defined as a farming system that promotes maintenance of a permanent soil cover, minimum soil tillage, and diversification of plant species, as opposed to conventional agriculture that encourage soil tillage, chemical fertilizers and crop protection, and monocropping in order to maximize crop production.

Figure 2: Conservational farming techniques employed by farmers



Farmers have also developed traditional climate-smart practices that have been incorporated into farming culture. A prominent example is the agroforestry system in Kilimanjaro and Kagera, where farmers can do high-density farming and zero-grazing livestock husbandry within existing highland forest terrain with minimum disturbance to the soil and existing natural forests. These practices help with sequestering carbon, managing soil erosion, fertilizing the soil, allowing natural nutrient replenishment, increasing stored soil water, reducing water runoff, and ultimately reducing GHG emissions. Climate-smart practices also improve crop productivity in climate-stressed conditions: under mild drought conditions, conservation agriculture produced maize yields that are 1.8–2.7 times higher than conventional agriculture, owing to higher stored soil water content.[13]

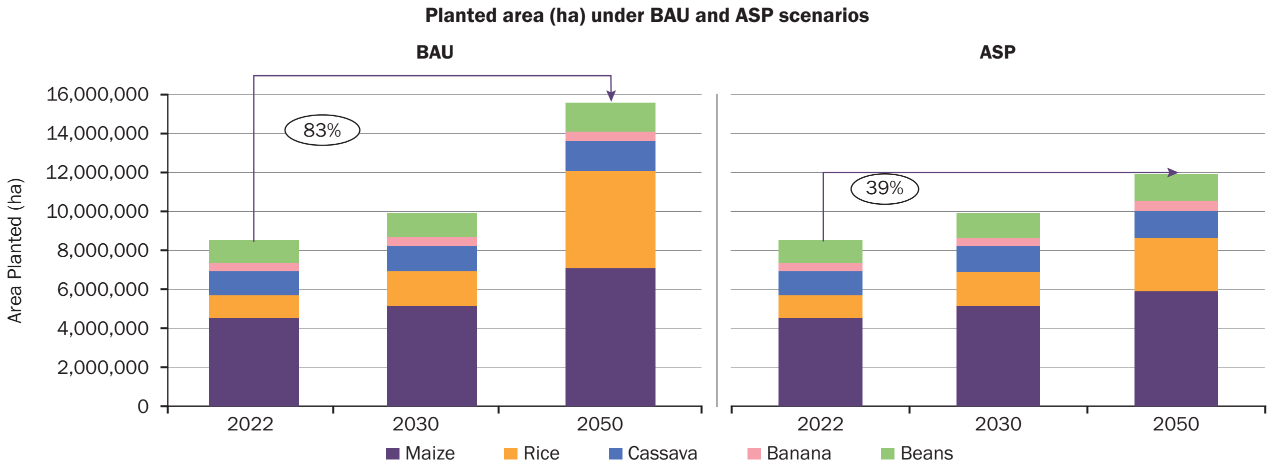
See Appendix A and the accompanying 'Tanzania CCDR Value Chain Modelling' Excel file for a full analysis of crop value chains.

3.2.1. Impact of climate change on the crop subsector

Historically, increased crop production has been largely due to the growth of agricultural land (typically at the expense of forested areas). Historical trends suggest that cropland area for five major crops (maize, rice, cassava, banana, and beans) will grow by 83 percent by 2050 under the BAU scenario (figure 3). This trend may be extrapolated to other major crops as well, and cropland expansion is projected to continue until available arable land is exhausted. But the ASP scenario proposes a more modest 39 percent increase in cropland for these five crops by 2050, and no further cropland expansion beyond 2050 (figure 3).

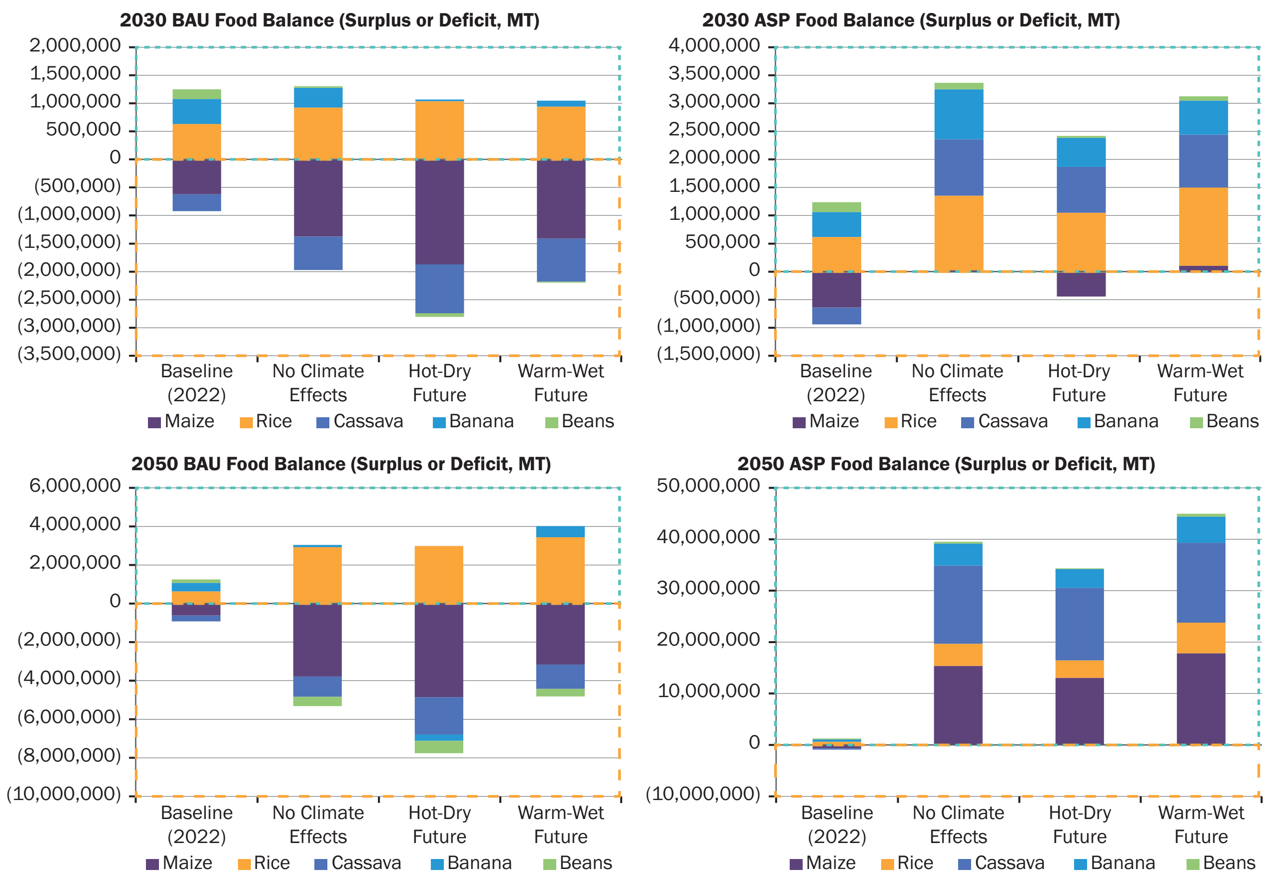
13 Cairns, J E, Hellin, J, Sonder, K, et al. 2013. "Adapting Maize Production to Climate Change in Sub-Saharan Africa." *Food Security* 5, 345–360. https://doi.org/10.1007/s12571-013-0256-x.

Figure 3: Projected cropland area growth under two economy futures scenarios



Climate change will significantly affect BAU yields, leading to serious food imbalances with domestic use[14] exceeding production. Whereas maize, beans and cassava will be in deficit by 2030, the deficit will increase 2–3 times by 2050. Rice remains in surplus through to midcentury and bananas are in surplus save for the extreme hot/dry future in 2050 (figure 4). Maize and cassava are highly vulnerable under BAU and will have deficit production through midcentury.

Figure 4: Projected food balance in 2030 and 2050, under two scenarios



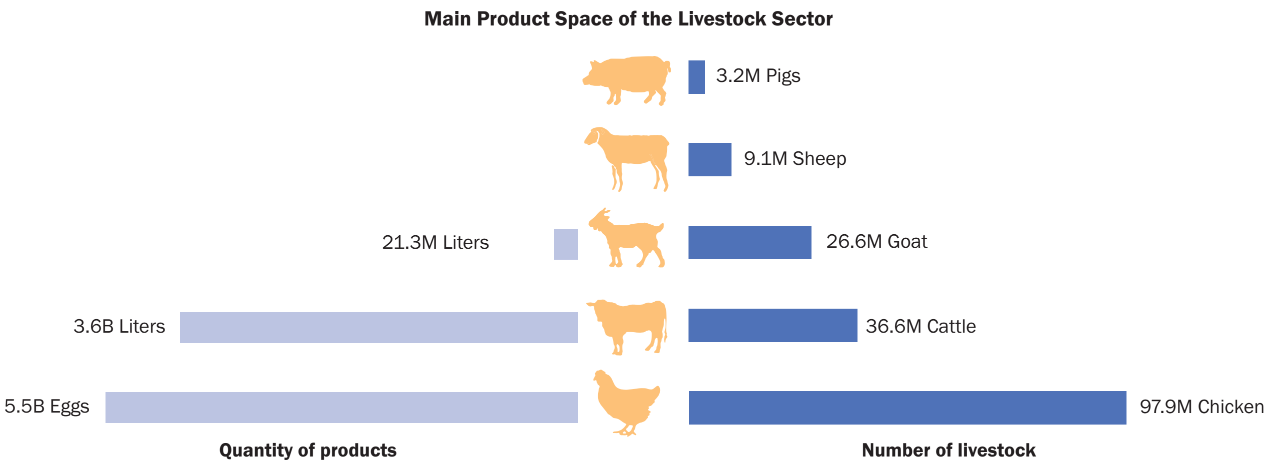
14 *Domestic use* signifies all domestic uses, including food, feed, seed, losses, processing, industrial use, etc. It considers holistic national crop requirements beyond food use.

Under the ASP scenarios, specific interventions are required to ensure that the sector produces surplus food across all value chains by 2050, positioning Tanzania as a regional breadbasket. These interventions include sustained investments aimed at increasing productivity through various means. Key measures involve enhancing smallholder access to improved seeds and fertilizers, improving soil health, and expanding irrigation and water management systems. Additionally, providing proximity extension services and promoting digitalization will be crucial. Strengthening market linkages and encouraging private sector investments are also essential components to achieve the ASP ambitious goal.

3.3. Livestock subsector

The livestock subsector contributes significantly to Tanzania's GDP (7 percent), employment (up to 50 percent of the population are involved in the sector). As well as supporting livelihoods, it is a crucial nutritional source.

Figure 5: Livestock product space



Source: Ministry of Livestock budget speech 2023.

Tanzania has a sizeable livestock population (figure 5), including Africa's second largest cattle population. Despite a large livestock population, the livestock have low productivity, with small carcass weights, low reproduction, low milk and egg production, and so on. The sector's growth has been driven by an increase in livestock numbers, not productivity improvements. The large herd size leads to increased competition for limited natural resources such as water and food for feed, and frequent clashes with crop farmers competing for farming versus grazing land use. The large herds are increasing pressure on land beyond the natural land carrying capacity, significantly stressing pasturelands. Climate change will only exacerbate the problem.

The livestock subsector is a major contributor to methane emissions in Tanzania, contributing 14.5 percent of all anthropogenic GHG emissions,[15] with cattle contributing 65 percent of this. Enteric fermentation from livestock, which primarily produces methane as a byproduct, accounts for over 60 percent of all agriculture sector emissions in Tanzania. Given that methane is 80 times more potent at warming the planet than carbon dioxide, Tanzania's mitigation efforts must prioritize the livestock subsector to achieve significant emissions reductions. Considering the sector's importance to the GDP, nutrition, and livelihoods, and the likelihood of extensive negative impacts from climate change, deliberate adaptation interventions are urgently needed to build resilience and minimize adverse effects on the economy, nutrition, and livelihoods. It is worth highlighting that while animal-source proteins are essential

15 FAO. 2019. *Five Practical Actions Towards Low-Carbon Livestock*.

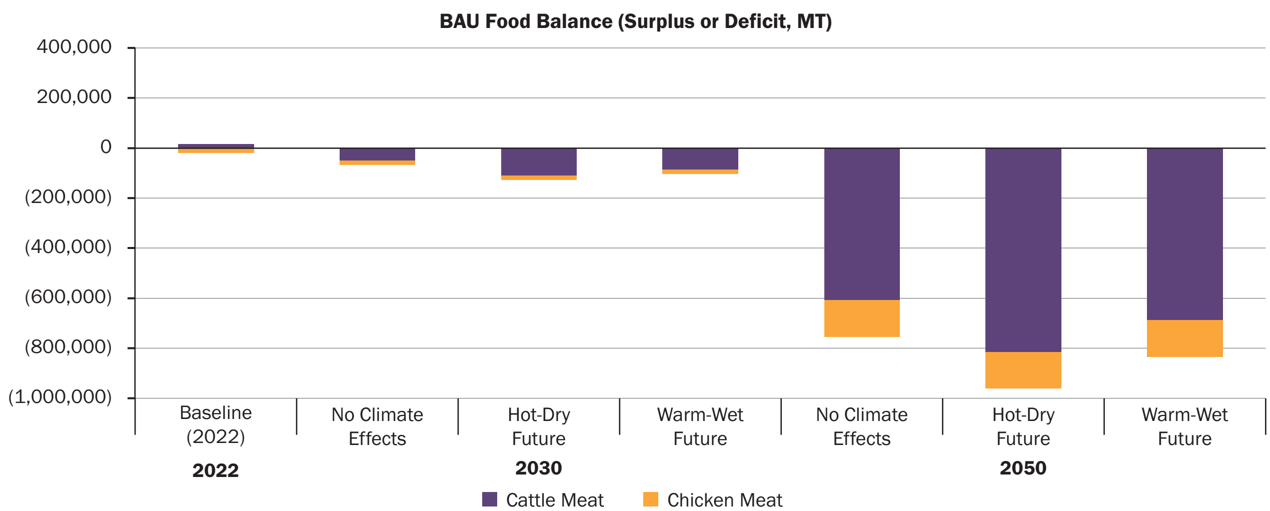
for nutrition, its consumption in Tanzania is well below the minimum recommended amount. Mitigation and adaptation efforts should therefore concurrently contribute to increasing the affordable supply and consumption of animal-source proteins. As witnessed globally, increase in incomes and urbanization drive increased consumption of animal-source foods, such as meats, milk, cheese, and eggs. Wealthier more urbanized countries consume more protein per capita and derive a larger share of it from animal-source foods. As urbanization and per capita income grows, Tanzanians are expected to consume more animal-source proteins than before. Tanzania must urgently establish a balance of meeting its current and future animal-source food needs while adapting to climate change and mitigating further GHG emissions that threaten the very sector itself.

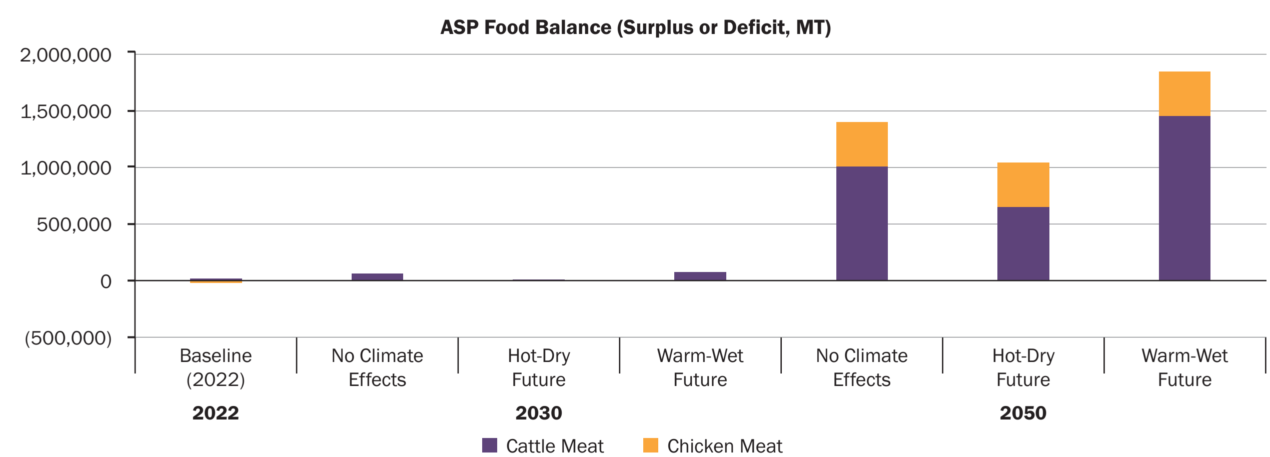
See Appendix B and the accompanying 'Tanzania CCDR Value Chain Modelling' Excel file for a full analysis of livestock value chains.

2.3.1. Impact of climate change on the livestock subsector

Without targeted interventions (investments and policy actions), the livestock subsector will have significant deficits in the coming decades. Under BAU, chicken and cattle meat will have a deficit of 800,000–1,000,000 metric tonne (MT) by 2050, but under the ASP scenario, interventions in improving genetics and management of livestock will see Tanzania as a net exporter of meats (figure 6).

Figure 6: Food balance for representative livestock products, under two scenarios





4. Policy Actions and Investments Needs in Agriculture for Adaptation and Mitigation

4.1. Sustainable intensification for increased productivity and resilience through sustainable agriculture systems

4.1.1. Crop production and systems

Improved seeds are required to address the low and stagnant crop yields. Most planted area is planted with recycled seeds that have a diminishing genetic potential; only 20 percent of planted area uses improved seeds. Poor seed quality is the primary limiting factor to improving crop productivity and must be urgently addressed. Public investment in seed systems has one of the highest benefit-cost ratios of any public investment, returning 17 times more value to farmers than what the government invested.[16] Seed systems development has largely been led by the government. But strategic liberalization of the seed sector, as well as creating a conducive environment for the private sector to thrive, may lead to increased accessibility, affordability, and greater adoption of improved seeds.

Due to the already low agricultural yield levels in Tanzania, improving crop breeding alone will not suffice to adequately address the scale required for both increasing current yield levels and mitigating future yield losses associated with climate change and heightened climate variability.

Improved soil health management will enable crops to realize their yield genetic potential. Integrated soil fertility management aims to manage soil health while conserving the soil and minimizing nutrient loss. This is done by directly applying soil nutrients in the form of fertilizer (inorganic) or manure (organic) and by promoting natural fertilization and conservation of the soil through climate-smart practices such as mulching, composting, and other organic matter cover, intercropping with legumes, crop rotation, and minimum tillage. Integrated soil fertility management allows for sustainable management of soil health over a long period and encourages minimum use of artificial inputs by minimizing nutrient loss and encouraging natural refertilization of the soil. As part of integrated soil fertility management, appropriate amounts of fertilizer should be applied to enable crops to realize their cultivar's genetic yield potential. Tanzania has one of the lowest fertilizer application rates in the world: 19 kilograms (kg) per hectare (ha) compared to the world average of over 100 kg/ha and a continental target of 50 kg/ha.[17] This is in part due to farmer's low access and inability to afford fertilizer. Fertilizer subsidies that were championed by the government have not holistically considered soil health and fertility management—for example, fertilizers are used without considering soil needs, soil pH, crops planted, and monitoring and evaluation of their effectiveness is limited. The government needs to work with development partners and the private sector to explore nondistortive mechanisms to increase the accessibility and affordability of fertilizers to farmers to enable widescale adoption and usage. Such mechanisms should incentivize holistic soil health management, promote climate-smart practices, and encourage behavioral change toward better soil health management. The government can also redirect its focus from merely subsidizing chemical fertilizers to a more integrated and sustainable approach that rewards farmers for climate-smart practices that promote long-term soil health and water efficiency, thereby enhancing climate resilience.

Irrigation through public infrastructure development and farmer-led irrigation development will increase productivity and shield yields from climatic variability. Irrigation also enables sustainable intensification where more crops can be planted in smaller areas, limiting the clearing of forests for cropland. Tanzania has a high irrigation potential. Of its 44 million hectares of arable land, 29.4 million hectares are suitable for

16 World Bank. 2022. *Tanzania Agriculture Public Expenditure Review*.
17 FAOSTAT. Tanzania Fertilizer Regulatory Authority.

irrigation; of these, 2.3 million have high potential, 4.8 million have medium potential, and 22.3 million have low potential.[18] The government has embarked on an ambitious public irrigation infrastructure development program, having increased the 2023 irrigation budget allocation to $157 million, a 770 percent increase compared to the 2022 figure. Whereas less than 300,000 hectares were under irrigation in 2020,[19] the country currently boasts public irrigation infrastructure covering 727,000 hectares with new infrastructure under development to cover an additional 256,000 hectares as per the 2024/25 agricultural budget. It is estimated that every dollar spent by the government on irrigation yields up to 16 times the value in farmers' increase income.[20] For the current increased investments in public irrigation to yield expected returns, the ministry of Agriculture will have to address the factors that led to historical low utilization of public irrigation infrastructure, including poor maintenance, weak operational capacity, and low farmer contributions toward operations, maintenance, and management.[21]

Improve operation, management and maintenance could lead to increase productivity in Tanzania. The agriculture sector is responsible for 80–90 percent of freshwater withdrawals. But given the low efficiency of agricultural water usage (as low as 15 percent compared to modern efficiencies of over 90 percent),[22] the high withdraw rate has little to show for in terms of increased agriculture output. Establishing efficient irrigation systems can translate withdrawn water to increased agricultural output. Microirrigation systems, such as drip irrigation systems and hand pipes, can be low-cost farmer-led initiatives that increase irrigation efficiency. Government policy should encourage such farmer-led initiatives and support farmers and the private sector to make such technologies accessible and affordable. This may include waiving of taxes on irrigation, water harvesting, and water storing technologies for smallholder farmers and supporting a results-based financing for private sector actors promoting adoption of such technologies to the farmers.

Promoting good management practices (GAP) and CSA practices will sustainably enhance crop productivity. Some adopted practices include using improved seeds, irrigation, crop spacing, minimum tillage, integrated pest management, water harvesting, intercropping with legumes, mulching and agroforestry. Additional research is required to create a package of GAPs and CSA practices most appropriately suited for different agroecological zones in Tanzania. The research also needs to identify new CSA/GAPs that are climate appropriate, such as new planting schedules to optimize the use of shorter rains using early maturing crop cultivars. These practices need to be mass-disseminated using technology and the extension network throughout the country.

4.1.2. Livestock production and systems

Improving genetics by introducing improved breeds, crossbreeding, and artificial insemination will increase productivity in the livestock subsector. Tanzania cattle yields an average carcass weight of 139 kg, less than half that of African leaders Egypt, South Africa, Namibia, and Zimbabwe, averaging 273–325 kg. Indigenous cattle on average produces less than 5 liters/day,[23] far less than 30 liters/day potential of dairy cattle. Similarly, Indigenous chicken yield far fewer eggs and take longer to build weight compared to layer and broiler breeds. The primary distinguishing factor is animal genetics. Most of the Indigenous cattle, sheep, goat, and chicken populations have been severely inbred and have lost their genetic vigor; even stellar husbandry and quality feed will only yield limited results due to inferior genetic potential. Improving breeds is therefore a top priority for the livestock subsector before any other intervention can bear tangible benefits. Improved genetics in the livestock subsector is a primary adaptive line of defense against climate-related productivity shocks. The government needs to pursue a policy that supports government and private sector investments in introducing new breeds, crossbreeding, and disseminating artificial inseminations

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18 URT. 2018. *National Irrigation Masterplan*.

19 NBS Tanzania. 2020. *National Sample Census of Agriculture (NSCA) 2019/20*.

20 World Bank. 2022. *Tanzania Agriculture Public Expenditure Review*.

21 World Bank Group. 2022. *Resilient, Inclusive, Sustainable, and Efficient (RISE) Irrigated Agriculture in Tanzania*.

22 2030 Water Resources Group. 2014. *Tanzania: Hydro-Economic Review – An Initial Analysis*.

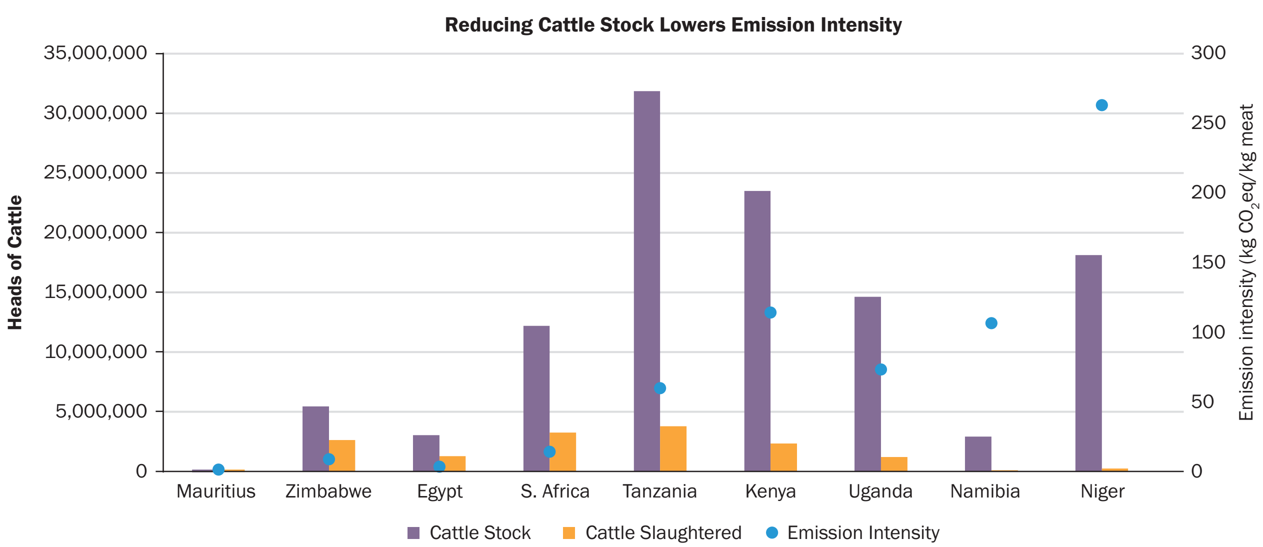
23 Tanzania Dairy Sector Analysis. 2019.

services to the masses at subsidized costs. This may involve offering tax incentives to breeders, subsidies to farmers, and results-based incentives to the private sector.

Related to improving genetics, the sector must intensify production, thereby reducing the GHG (especially methane) emission intensity. Due to low animal productivity, livestock keepers hoard large herds to maximize income. This leads to high emissions per unit of product produced and competition over limited resources from a large herd (feed, grazing land, medicine, and water), and therefore further suppression of yield on individual animals. Improved animal productivity and intensive animal husbandry will lead to livestock keepers raising more productive herds that are more profitable. With improved productivity and profitability per animal, practices such as herd hoarding, where livestock keepers maintain large herds as a prestigious asset base (albeit not very productive) will become less desirable over commercial livestock keeping.

Improving livestock productivity reduces GHG emission intensity. In Africa, countries with intensive and more commercial beef cattle systems produce significantly less carbon dioxide equivalent (CO_2e) than those keeping larger 'prestige' animal stocks—that is, slaughtering only small portions of the national animal stock. In figure 7, there is a clear correlation between maintaining a large cattle stock and the intensity of GHG emissions per kilogram of meat produced. Even though Namibia and Niger have better beef cattle breeds, with a carcass yield twice that of Tanzania, their cattle hoarding practices (slaughtering less than 3 percent of national stock) makes them significantly more intense GHG emitters than their less productive counterparts. Intensive and efficient livestock systems has enabled South Africa—with one-third the cattle stock—to produce twice as much beef meat as Tanzania, yielding a low emission intensity of 14 $kgCO_2e/kg$ of meat produced compared to Tanzania's 60 $kgCO_2e/kg$. This trend is consistent with other highly productive African peers such as Zimbabwe and Egypt whose emissions are 9 and 3 $kgCO_2e/kg$ of meat produced.

Figure 7: Reducing cattle stock lowers emission intensity



The dairy subsector shows similar results: increasing productivity per animal lowers emission intensity. Countries with low dairy productivity (less than 2,000 kg of fat and protein-corrected milk (FPCM) per cow per year) emit 5–25 $kgCO_2e/kg$ of FPCM produced whereas more productive countries (with cows producing 2,000–10,000 kg of FPCM per cow per year emit as low as 2 $kgCO_2e/kg$ of FPCM produced; a full order of magnitude lower in terms of emissions.[24]

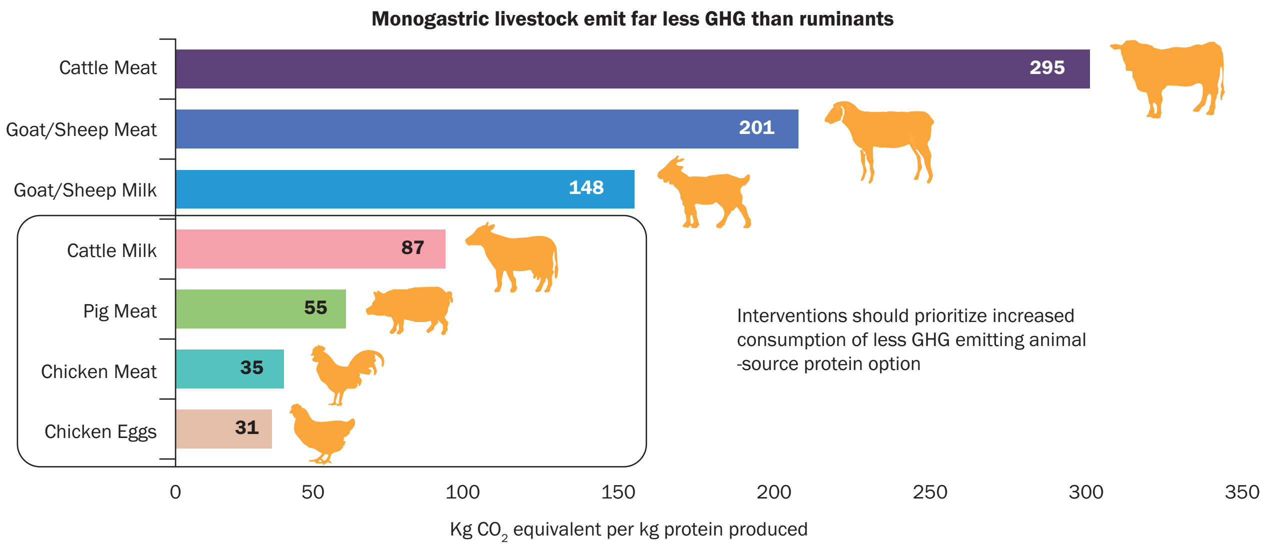
24 FAO. 2019. *Five Practical Actions Towards Low-Carbon Livestock*. https://www.fao.org/3/ca7089en/ca7089en.pdf.

Sustainable pastureland and water management is crucial to guarantee the availability of feed and water for grazing animals. There are currently 3,384,485 hectares of designated pastureland in Tanzania,[25] but these are largely undeveloped. The government, private sector and farmers need to work together to develop these pasturelands and ensure their sustainability. Various methods for managing pastureland and water resources include strategies such as cultivating grasses and perennial fodders, implementing in-situ fodder conservation techniques like fodder banks, supplementing feed with concentrates and crop residues, regulating stocking rates, practicing rotational grazing, reducing livestock numbers through improved genetics, and employing water harvesting and storage through small-scale dams and pits.

4.1.3. Nutrition-sensitive agriculture

Stimulating dietary shifts toward less GHG-emitting livestock will mitigate future GHG emissions. Even as animal-sourced protein intake increases with increased per capita income, consumption should be steered toward proteins with lower carbon footprint per kilogram (figure 8).

Figure 8: Average GHG emissions for different protein sources (CO_2e/kg)



Source: FAO, Five Practical Actions Towards Low-Carbon Livestock. 2019. Accessed on https://www.fao.org/3/ca7089en/ca7089en.pdf.

With a strong correlation between incomes and consumption of animal-source food products, the government should pursue policies that make greener animal products (chicken meat, chicken eggs, cattle milk) more affordable and accessible to the mass population. This may entail interventions such as preferential imports and local production of improved breeds, tax incentives on feed ingredients, and R&D investments in increasing productivity. It is worth noting, however, that existing cultural and dietary preferences may limit dietary shifts in the short term: for example, the preference for the free-range Indigenous chicken (with deeper flavors for stew) over the highly productive broiler bird (with a comparatively shallower flavor profile).

4.1.4. Weather and climate services, early warning, and response

Enhanced early climate warning information service enable farmers to make informed decisions, adapt to changing environmental conditions, and build resilience to the impacts of climate change on agriculture. Early climate warning systems can play a crucial role in helping Tanzanian farmers adapt to the effects of climate change. Timely Information about upcoming weather patterns, such as changes in

25 Ministry of Livestock and Fisheries Development budget speech 2023.

temperature, rainfall, and extreme weather events like droughts and floods, enable farmers to anticipate and prepare for potential risks to their crops and livestock. Farmers can therefore take proactive measures to mitigate risks and minimize potential damage to their crops and livestock. For example, they can adjust planting schedules, implement soil conservation techniques, or secure livestock sheds ahead of extreme weather events. Early warnings also enable farmers to make informed decisions about crop and livestock management practices. For instance, they can adjust irrigation schedules, select drought-resistant crop varieties, or adjust feeding regimes for livestock during periods of drought or excessive rainfall. Lastly, early warning systems enable farmers to allocate their limited resources more efficiently, such as investing in drought-resistant crops or investing in water storage and irrigation infrastructure to cope with changing rainfall patterns.

4.2. Demand-driven research and innovations systems for locally adapted inputs, technologies to improve adaptation capacity and mitigation of climate change

Significant investment in R&D for 'climate-proof' seeds would be needed to develop crop varieties that maximize yield potential in each agroecological zone in Tanzania under a climatic variable future. The R&D would need to investigate and optimize traits that would boost crop performance in a warmer future under increased precipitation variability. Some traits include yield potential, early maturation, disease tolerance, and heat/drought tolerance. A simulation done on maize in the semiarid Singida region in Tanzania revealed that using well-adapted improved varieties stood the greatest chance to offset yield losses from climate change over the coming decades whereas other adaptation methods —such as irrigation, mulching, and increased fertilizer usage—did little to offset the yield losses caused by prolonged high temperatures. It further revealed that temperature was the biggest driver to yield losses for semiarid areas in the future and that the most promising adaptation mechanism was using suitable heat-tolerant improved seeds.[26]

Research is also required to develop tailored CSA packages for each agroecological zone and have the information disseminated through innovative delivery models discussed under section 4.3.

R&D for livestock breed most suited for different agroecological zones in Tanzania will produce breeds that are more adapted to a climatically variable future. A hotter future requires animal breeds that are better adapted to hotter climates. Breeds of the future need to exhibit desirable traits that enable them to remain highly productive in a hotter future. Importing some high-yielding breeds from temperate regions may be counter-productive as they may struggle with high heat stress and disease intolerance. Cross breeding hardy and adaptable Indigenous breeds with high-yielding exotic ones will lead to sustainable improvement in yield, and therefore adaptability to climate change. Early trials of crossing European-origin Taurus cattle, such as Sussex, a breed with high growth rates and heat tolerance, and Indian-origin Indicus cattle, such as Boran, Brahman, which has adaptable traits such as twitching skin to control pests, and disease resistance, have proved to yield positive results of 200–250 kg carcass weight in Tanzania's hotter agroecological zones.[27] Given the high upfront cost and technical know-how of breeding to maximize productivity and adaptability, it is essential that the government works with pioneering private sector breeders to accelerate the R&D efforts. This may be done through mechanisms such as sharing resources and knowledge, collaborating in field trials, providing breeders access to government ranches, disseminating promising genetics, and monitoring and evaluating the performance of breeds in different agroecological zones.

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26 Volk, J, Gornott, C, Sieber, S, et al. 2021. "Can Tanzania's Adaptation Measures Prevent Future Maize Yield Decline? A Simulation Study from Singida Region." Regional Environmental Change 21: 94. https://doi.org/10.1007/s10113-021-01812-z. The improved variety Situka is an open pollinated variety with early maturity, tolerance to low nitrogen levels, and a 4-6MT/ha yield potential. It was compared against H612 cultivar, a popular single-cross hybrid used in Tanzania over multiple decades.

27 Interview with Mbogo Ranches, a pioneering beef cattle breeder in Tanzania.

4.3. Enhance professionalization of farmers and proximity service delivery

Boosting extension services through innovative delivery models would help professionalize farmers and enable them to maximize their potential and build resilience against climate shocks. Extension services are the cornerstone of effecting change in agricultural systems. Every public dollar spent on extension services yields nine times the value in farmers' income gain.[28] But in 2020, only 7 percent (537,701 households) of the farming population received extension support from extension workers, a steep decline from 67 percent in 2008.[29] Of livestock keepers, only 9.1 percent (250,768 households) receive extension services. This partly explains the slow adoption of various agricultural technologies and know-how that would have transformed smallholder agriculture. There is a gap of about 5000 crop extension workers and about 8,000 livestock extension workers, and about a 65 percent funding gap in the government's extension program.[30] But there is no articulated plan to practically close this gap, so the extension service gap is likely to widen in the coming decades. The government has made some progress in increasing the coverage area of these officers by giving them vehicles (typically motorcycles).

The ministries of agriculture and livestock can further expand the use of digitalization to scale technologies and extension services. In 2023/24, the Ministry of Agriculture distributed over 4,000 tablets to extension officers for on-the-field agricultural data collection. Such digital devices can be used for, among other things, rapid dissemination of new knowledge, such as new crop management practices and early warnings, upskilling officers, and monitoring and evaluation to boost the effectiveness of extension services. A digital information-sharing platform could also be used for direct information sharing with farmers.[31] Incorporating traditional extension services with digital technologies will increase farmer access to agricultural advisory services and will lower the cost of administering the service, opening opportunities to commercialize such services, and making them more sustainable.

Lastly, the government can incentivize third-party players to partially share the extension burden. Private sector parties, large farmers, and nongovernmental organizations could be sensitized to offer some form of extension services that aligns with their mission—for example, meat processors could work with livestock keepers to boost carcass weight, crop plantations could establish out-grower schemes and train farmers to meet required quality and quantities. Farmer-led extension and farmer-field schools could also help address the low scale of existing extension service model, with lead farmers employed to act as model farmers and centers of knowledge dissemination at the village level in partnership with existing public extension workers.

4.4. Improve access to finance, risk mitigation services, value chain competitiveness and market access.

Improving access to financial services can support farmers to adopt improved inputs and mitigate risks resulting from climatic variability. In the 2019/20 season, only 3.8 percent of agricultural households received credit for agricultural activities, and this was used primarily for hiring labor and purchasing improved inputs (seed and fertilizer). The credit was largely from informal (unregulated) sources: 25.9 percent from family/friends/relatives, 22.3 percent from cooperatives, 16.9 percent from private individuals, and 13.2 percent from savings and credit cooperative societies, potentially offering uncompetitive interest rates to farmers. Very little credit was channeled through formal financial institutions. A total of 294,000 smallholder households took TZS 200.7 billion in agricultural credit and repaid TZS 284 billion, demonstrating a willingness to pay market-rate interests to access formal agricultural credit. Increasing innovative credit to farmers (bundled with a financial literacy package, insurance, climate-smart inputs, and so on) can

28 World Bank. 2022. *Tanzania Agriculture Public Expenditure Review*.

29 NBS Tanzania. 2020. *National Sample Census of Agriculture*, 2019/20.

30 URT. Agriculture Master Plan (currently under development).

31 The government's e-extension platform M-Kilimo (launched in 2019) is a promising attempt, but adoption is very low. Further analysis is needed to understand how the platform can be enhanced for wider adoption.

increase adoption of improved inputs, and therefore agricultural productivity. Improved access to finance will allow farmers to access inputs and technologies and hence increase productivity. Currently, smallholder agricultural yields are a low in part due to poor adoption of improved technologies. This is driven by and large by farmers' low ability to afford and access such technologies. Consider that only about 20 percent of planted area is applied with fertilizer and improved seeds. Farmer access to finance can be greatly enhanced with digital technologies such as unsecured lending products offered by mobile network operators in partnership with banking financial institution.[32] Customizing these offerings to farmers' needs and income cycles would increase their adoption among farmers.

Crop and livestock insurance will protect producers and help them recover from shock events, therefore boost their confidence to invest commercially in agriculture. Even with best-in-class adaptation, some vulnerable populations will experience irrecoverable damage from climate change. It is therefore crucial to develop products and schemes that protect these vulnerable populations against climate-related shocks such as the total wipeout of their crop from extreme weather events. These may be in the form social safety nets (typically provided by the public sector, nongovernmental or religious organizations) or insurance cover (offered by the private sector, potentially subsidized by the government). Indexed crop insurance (such as weather-indexed and area-yield indexed insurance) pays out automatically during drought, flood, pest, and other extreme events. Weather indexing significantly lowers the cost of servicing low-income small-scale farmers (who have a high acquisition cost relative to the price they pay) since there is no need for traditional services associated with insurance (such as in-person claim assessments). Whereas several companies—including the National Insurance Corporation, UAP Insurance, and Strategis Insurance—offer agricultural insurance products, uptake among farmers remains low due to factors including awareness, literacy, poor product design, prior experience with risk events, land ownership, and socioeconomic factors.[33] Coordinated efforts between the ministries, insurance providers, and the insurance regulator will be required to address the low farmer uptake.

Digital delivery of agricultural insurance—such as BIMA PIMA, a digital crop insurance product offered by Acre Africa—can further lower costs to both insurers and farmers, boosting insurance penetration to the climate-vulnerable populations. Increasing penetration of insurance opens access to credit and other financial offerings, increasing a farmer's overall resilience to climate change.

4.4.1. Climate-smart market infrastructure development

Over 95 percent of farmers in Tanzania are subsistence, farming on less than 2-hectare plots and market only about 20 percent of the food they produce.[34] More than 80 percent of farmers cite low market prices as the main challenge to marketing their produce. Less than 10 percent cite market access (distance to market, availability and affordability of transport, availability of buyers) as the main challenge. There is, therefore, a need to develop robust market price information dissemination tools, enhance primary markets to enable direct trade with farmers (diverting middlemen margins back to farmers), build buyer-seller linkage platforms and productive alliances (such as online trading platforms and commodity exchanges), establish forward-buying contracts between farmers and offtakers, and remove distortions to market prices through export bans, cess taxes, and so on. Improving agriculture logistics through cold chains, aggregation centers including storage facilities, milk collection centers, animal markets, fresh food wholesale markets and other marketing infrastructure will increase the income of farmers, stimulate agroprocessing and maximize the value of agricultural commodities.

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32 Vodacom offers Mpawa and Songesha products, Tigo offers Nivushe, and Airtel offers Timiza, all in partnership with banking financial institutions.

33 Machangu-Motcho,J. 2023. *Factors for Crop Insurance Uptake among Smallholder Maize Farmers: A Case Study of Njombe Region in Tanzania*. REPOA, Dar es Salaam.

34 NBS Tanzania. 2020. *National Sample Census of Agriculture NSCA 2019/20*. A notable outlier is the fruits and vegetable subsector, where farmers market about 60% of produce. This may be due to the high perishability of fruits and vegetables, short growing cycles (e.g., leafy greens), and high productivity relative to what farmers can consume within the produce's shelf life, which all cause farmers to secure markets for produce immediately after harvest.

Enabling the environment for the private sector to invest across the value chain including primary production, value addition and services will contribute massively to job creation for youth and women. Initiatives to encourage farm-level value addition will increase the agricultural value that remains in farmers pockets. This may include making available the know-how and simple innovations that enable primary processing by farmers. Examples include simple shelling machines, simple oil press machines, cleaning and sorting machines, and simple milling machines that can be used in villages.

Specific productivity-boosting interventions mentioned under the crop and livestock subsectors will increase the overall income farmers receive in commercializing their produce, increasing the commercialization of agricultural products.

4.4.2. Alternative employment and livelihood development

The interventions driving Tanzania's aspirational growth will see the services sector overtake agriculture as the leading employer by 2050. Anticipated increments in labor productivity will also see the agricultural sector lose labor at a faster rate than historically. Historical trends have shown a steady decline in agricultural employment from 82 percent of the population in 2000 down to below 65 percent in 2020/21. Similarly, the industrial sector has grown from employing less than 3 percent up to 8 percent, and the service sector from 15 percent up to almost 30 percent in the same 20-year period.[35] Tanzania's agricultural transformation journey will see the sector transition from agriculture expansion and commercialization to agriculture-driven industrialization, and later toward a structural transformation where services and industry will overtake agriculture's dominance in the economy. The transition will usher labor diversion away from agriculture into services, industries and extractives. The government needs to put in place appropriate plans and policies to enable a sustainable workforce transition. The government may need to consider social welfare and alternative livelihood programs for populations that are left behind in this great workforce shift away from agriculture.

4.5. Strengthen sector governance, institutional capacity building, enabling environment for private sector investments

To enable the above recommendations to be implemented, there is a need to strengthen the capacity of various actors including the public sector at central and decentralized levels, and the private sector. The need to improve coordination and adopt results- and performance-based sector governance with increased stakeholder accountability is critical to sustainable food system resilience. To strengthen sector governance and building institutional capacity, Tanzania can:

- Mainstream climate change in different strategies and thematic policy documents.
- Build the capacity of the agriculture and livestock ministries, local government authorities, and related government bodies to design, deploy, monitor, and evaluate CSA policies, programs, and packages.
- Strengthen the respective research and development departments to carry out climate-conscious R&D for 'climate-proof' seeds and breeds, by building capacity in bodies responsible for:
    - Seed systems—including the government seed certifier Tanzania Seed Certification Institute, the government seed producer Agricultural Seed Agency, and agricultural research institutes such as the Tanzania Agricultural Research Institute—to develop 'climate-proof' seeds for different agroecological zones.

35 URT. 2021. *Integrated Labour Force Survey 2020/21.*

- Animal breeding and genetics—such as the National Artificial Insemination Center, government ranches, ministry R&D departments—to carry out climate-conscious R&D to produce breeds that are productive and resilient.

- Strengthen extension services departments to be aware of the effects of climate change, understand adaptation and mitigation practices, and develop CSA/GAP packages for different agroecological zones, to build their capacity to use digital tools and innovations to scale access to extension.
- Build the capacity of the irrigation department and the National Irrigation Commission to diagnose the low performance of existing public irrigation infrastructure and rethink their approach toward public irrigation, improving efficiency.
- Strengthen sector coordination to ensure improved seeds/genetics, innovations, and technologies produced by R&D departments are effectively disseminated and deployed to farmers throughout the country.

The private sector also has capacity building needs. Financial institutions do not lend to farmers due to a high perceived risk of the sector. These institutions need to build capacity to develop agriculture-appropriate products and lend to farmers, while improving farmers' financial literacy will enable them to manage loans for productive uses. The private sector also needs a conducive environment to enable increased:

- Investment in producing improved inputs (seeds, breeds, fertilizer, feed, and so on).
- Distribution of water saving, water storing, and microirrigation equipment.
- Lending to the agricultural sector, enabling farmers to use high-quality inputs for high productivity.
- Offtake and processing of agricultural produce, thereby create a strong market pull.

5. Investment 'Costing'

Table 3 estimates the cost in dollars of the above proposed interventions and present in two periods: 2024–30 and 2031–50.

Table 3: Indicative investment needs for the development of the crops and livestock subsectors Tanzania Country Climate Change and Development Report

Investment	2024–30 ($)	2031–50 ($)
Sustainable intensification for increased productivity and resilience through sustainable agriculture systems		
Crop production and systems	4,020,031,423	8,415,732,358
Animal resources and production systems	635,654,039	478,681,838
Nutrition-sensitive agriculture	4,917,324	8,085,842
Weather and climate services, early warning, and response	4,917,324	8,085,842
Demand-driven research and innovations systems for locally adapted inputs, technologies to improve adaptation capacity and mitigate climate change	264,446,768	2,057,677,523
Enhance professionalization of farmers and proximity service delivery	460,366,442	946,160,887
Improve access to finance, risk mitigation services, value chain competitiveness and market access	1,162,965,869	259,391,193
Strengthen sector governance, institutional capacity building, enabling environment for private sector investment	9,834,649	16,171,684
Total	**6,563,133,838**	**12,189,987,166**

Appendix A: Crop Value Chain Deep Dive

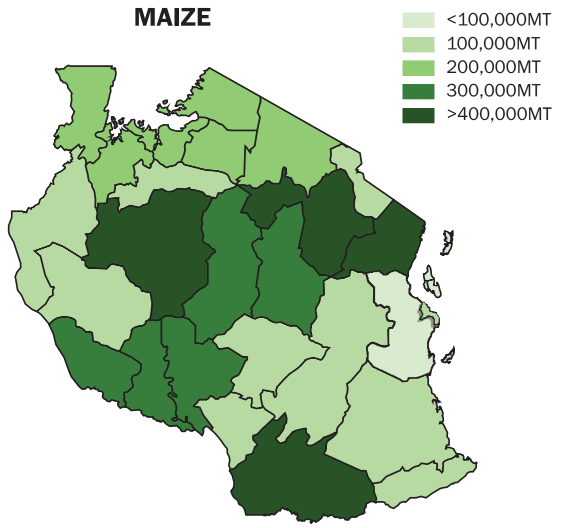
Per capita utilization is total domestic supply (production + import – exports + stock variation) divided by population. M = million; Mha = million hectares; MT = metric tonne.

<table>
<tr><td>Maize</td><td>Area: 4.9 Mha planted

Production: 6.5 M MT

Irrigation: 55,000ha (1.1%)

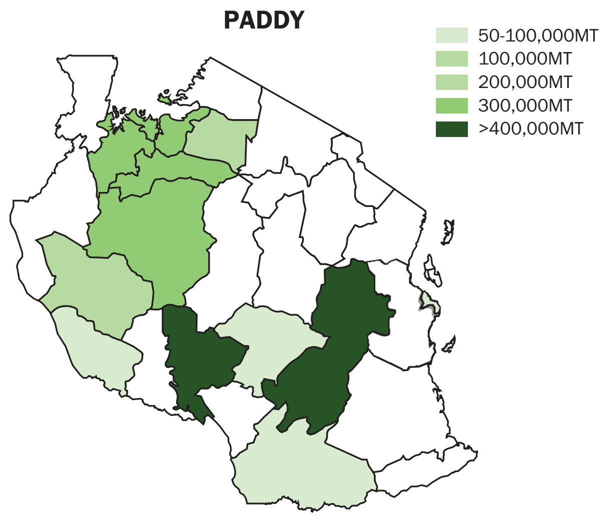
Yield: 1.5MT/ha

Location: distributed throughout the country with central and southern highland regions contributing to half of production.</td><td>
</td></tr>
<tr><td>Paddy</td><td>Area: 1Mha harvested

Production: 2.9M MT

Irrigation:~87,000ha (5.1%)

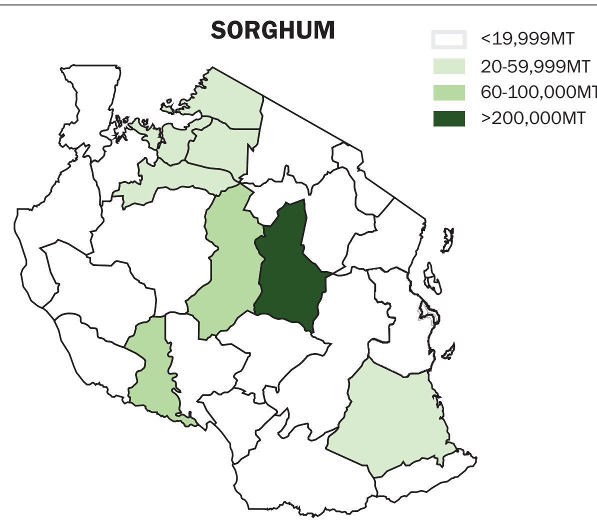
Yield: 2.8MT/ha

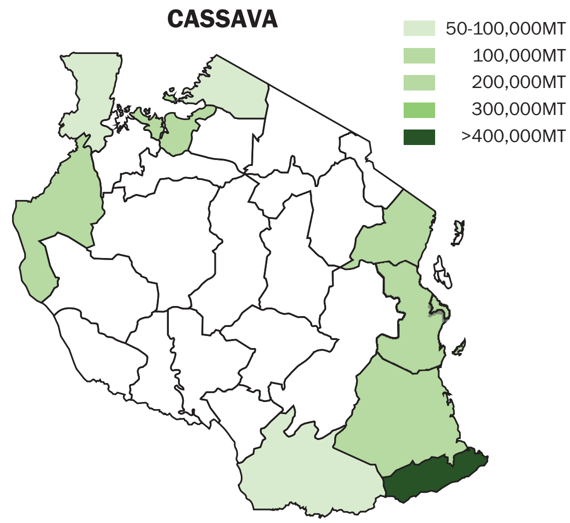
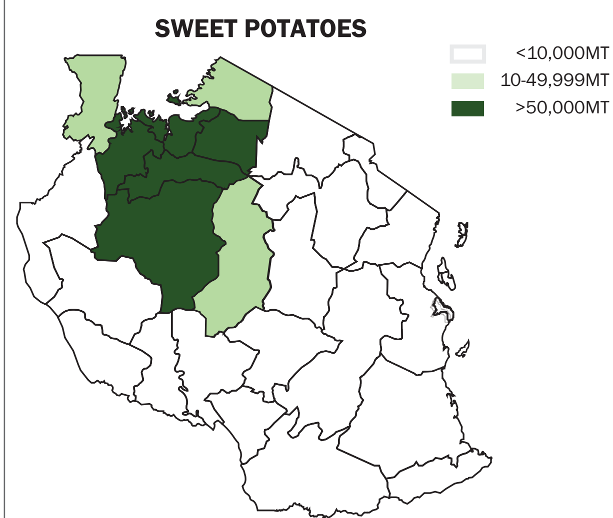
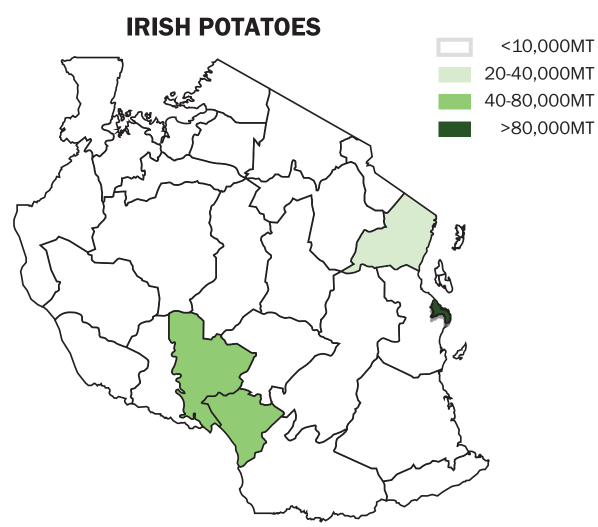
Location: 90% of production is within regions with more developed public irrigation schemes. Morogoro is the largest producer (17%).</td><td>
</td></tr>
<tr><td>Sorghum</td><td>Area: 0.5Mha

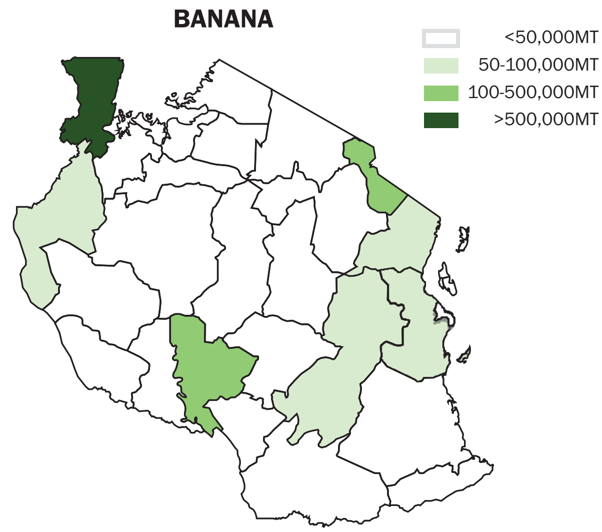
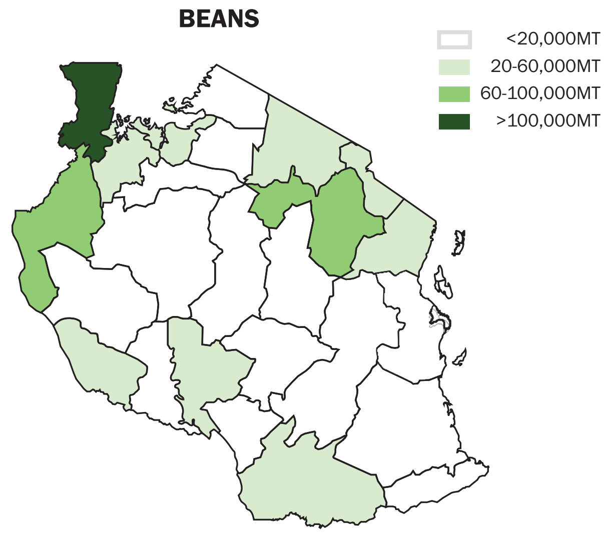
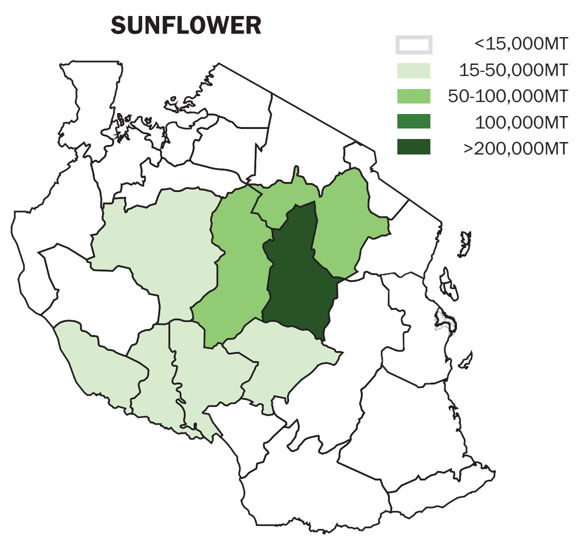
Production:0.65M MT

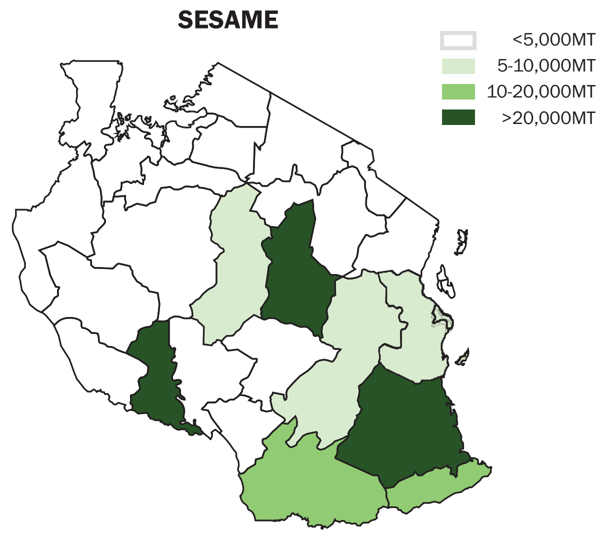
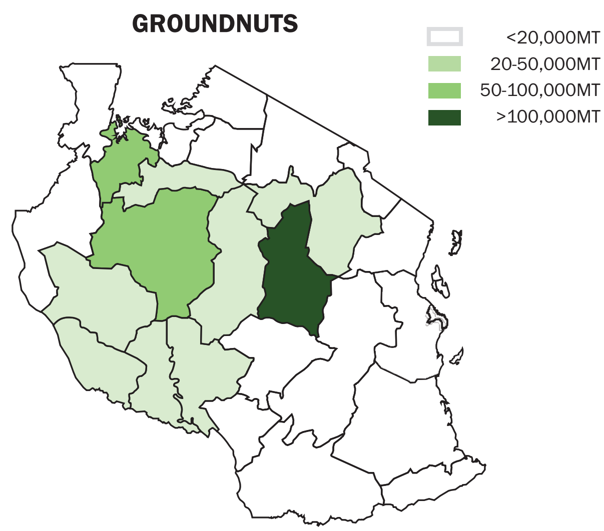
Irrigation: <1%

Yield: 1.3MT/ha

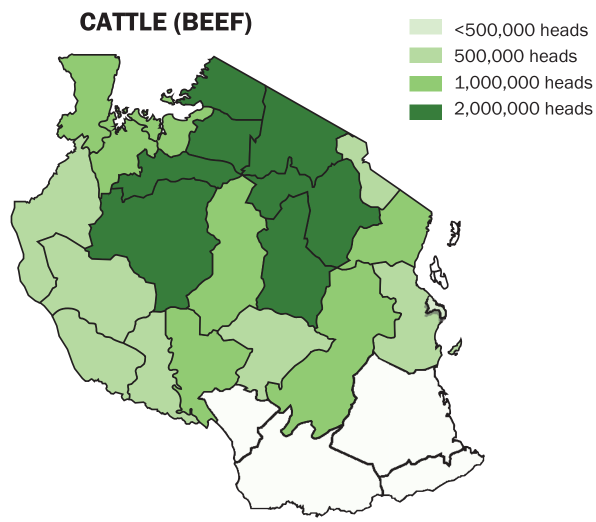
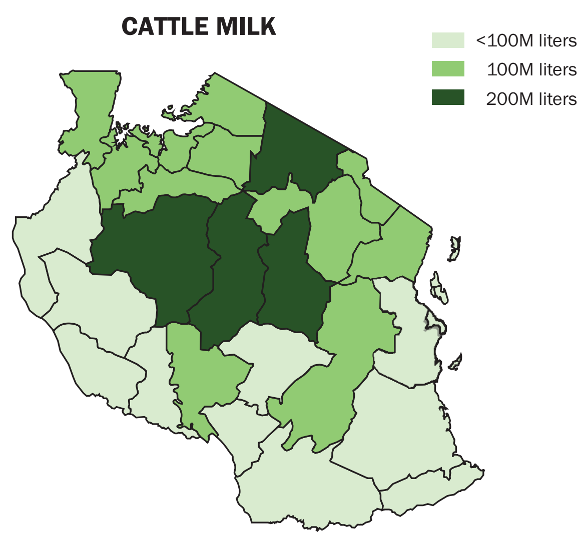
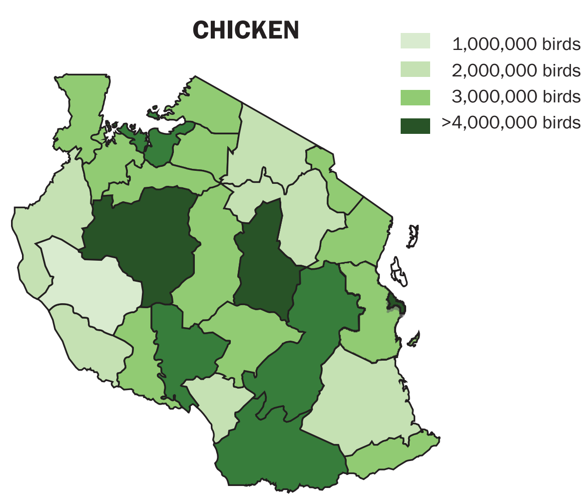
Location: 2/3 of production in Dodoma, Songwe, and Singida. Its tolerance to drought makes is suitable for the semiarid central regions.</td><td>
</td></tr>
</table>

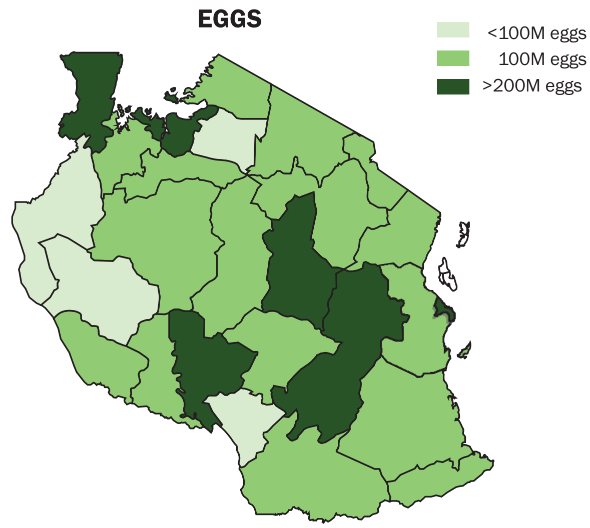
Cassava	Area:1Mha Production: 6.4M MT Irrigation: <1% Yield: ~7MT/ha Location: Semiarid areas, famine reserve crop that are drought tolerant and available when cereals fail. Mtwara 25%, Pwani 12.4%, Kigoma 10%. Coastal regions produce over 50%.	
Sweet Potato	Area: 0.3Mha Production: 0.5M MT Irrigation: <1% Yield: 2.1MT/ha Location: Concentrated in Lake and Western zones (80% of production). Good drought tolerance.	
Irish Potato	Area: 0.06Mha Production: 0.3M MT Irrigation: 7% Yield: 6MT/ha, highest 10.5MT/ha in Dar Location: Dar produces 38%. 80% of production is concentrated in Dar, Mbeya, and Njombe regions.	

Banana	Area: 0.35Mha Production: 3.5M MT Farmers: 1,761,560 households Irrigation: 31,000ha (9%) Yield: 10MT/ha Location: Kagera produces 50%. Production is concentrated in the highlands.	
Beans	Area: 826,685ha Production: 661,699MT Farmers: 1,525,868 households Irrigation: 30,000ha (4%) Yield: 0.9MT/ha. Highest 1.6MT/ha in Kaskazini Unguja. Location: Kagera 20.3%, Manyara 11%, Kigoma 9.4%. Beans are the most common pulse and amajor protein source for farmers, so production is distributed throughout the country.	
Sunflower	Area: 529,394ha Production: 504,422MT Farmers: 661,520 households Irrigation: <1% Yield: 1MT/ha, highest 1.8MT/ha in Kagera Location: Dodoma (40.3%), Singida and Manyara produce 65%.	

Sesame	Area: 443,068ha Production: 128,842MT Farmers: 425,019 households Irrigation: <1% Yield: 0.3MT/ha, highest 1.4MT/ha in Mara Location: Lindi, Dodoma, and Songwe produce 60%.	
Groundnut	Area: 528,373ha Production: 621,697MT Farmers: 931,792 households Irrigation:<1% Yield: 1.3MT/ha, highest 2.6MT/ha in Pwani Location: Dodoma, Tabora, Geita produce 50%. Production is concentrated in central and western zones.	

Appendix B: Livestock Value Chain Deep Dive

Cattle (Beef)	# livestock: 33,928,391 # households: 1,971,550 Yield: 139 kg carcass weight Location: Major production in is central, northern and lake zones due to available rangelands. Growth rate # head: 4.1% compound annual growth rate (2003–20).	
Cattle (Dairy)	Production: 3,112,940,000 liters # households: Yield: liters/cow/day: 3 (Indigenous), 9 (improved/dairy) Location: Major production is in central, northern and lake zones due to available rangelands. Growth rate # head: 4.1% CAGR (2003–20).	
Poultry (Chicken)	# livestock: 33,928,391 # households: 1,971,550 Location: Dar is the biggest producer (12.4%) and consumer. Distributed throughout the country. Growth rate # head: 4.9% CAGR (2003–20) – driven by adoption of improved breeds at a 2003–20 CAGR of 20.2% for broilers, 17.9% for layers. Indigenous chicken grew much slower at 1.9%.	

Eggs	Production: 4,375,888,580 eggs Yield Location: Distributed throughout the country.	

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