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Tanzania Agriculture Public Expenditure Review

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AGR

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Acronyms and Abbreviations

ACRP	Agricultural Climate Resilience Plan
AfDB	African Development Bank
ASA	Agriculture Seed Agency
ASDP	Agricultural Sector Development Programme
ASLMs	Agriculture Sector Lead Ministries
BOT	Bank of Tanzania
CAADP	Comprehensive African Agriculture Development Programme
CAG	Controller and Auditor General
CIAT	International Center for Tropical Agriculture
CIF	Cost Insurance and Freight
COFOG	Classification of Functions of Government
CSAP	Climate Smart Agriculture Plan
EAC	East African Community
EAP	East Asia and the Pacific
FAO	Food and Agriculture Organization
FOB	Free on Board
FTE	Full Time Equivalent
FYDP III	Five Year Development Programme III
GDP	Gross Domestic Product
GoT	Government of Tanzania
ICT	Information Communication Technology
IPCC	Inter Government Panel for Climate Change
JSR	Joint Sector Review
LAC	Latin America and Caribbean
LGA	Local Government Authorities
LMIC	Lower Middle-Income Country
MAFAP	Monitoring and Analyzing Food and Agricultural Policies
MDA	Ministries Department and Agencies
MIVALF	Marketing Infrastructure Value Addition and Rural Finance
MLFD	Ministry of Livestock and Fisheries Development
MoA	Ministry of Agriculture
MoFP	Ministry of Finance and Planning
MTEF	Medium Term Expenditure Framework
NAIVS	National Agriculture Inputs Voucher System
NAPA	National Adaptation Program of Action
NCCS	National Climate Change Strategy
NFRA	National Food Reserve Agency
NGO	Non-Governmental Organization
NIRC	National Irrigation Commission
NRA	Nominal Rate of Assistance
NRP	Nominal Rate of Protection
OECD	Organization for Economic Co-operation and Development

PRO-RALG	President Office Regional Administration and Local Government
SADC	Southern Africa Development Community
SMEs	Small &Medium Enterprises
SSA	Sub Saharan Africa
TAFIRI	Tanzania Fishery Research Institute
TAFORI	Tanzania Forestry Research Institute
TALIRI	Tanzania Livestock Research Institute
TARI	Tanzania Agriculture Research Institute
TARURA	Tanzania Rural and Urban Road Agency
TFSA	Tanzania Forestry Services Agency
TOSCI	Tanzania Official Seed Certification Institute
TRA	Tanzania Revenue Authority
UNFCC	United National Framework Convention on Climate Change
UPOV	Union of Protection of New Verities of Plants
URT	United Republic of Tanzania
USAID	United State of America International Development
VAT	Value Added Tax
WRS	Warehouse Receipt System

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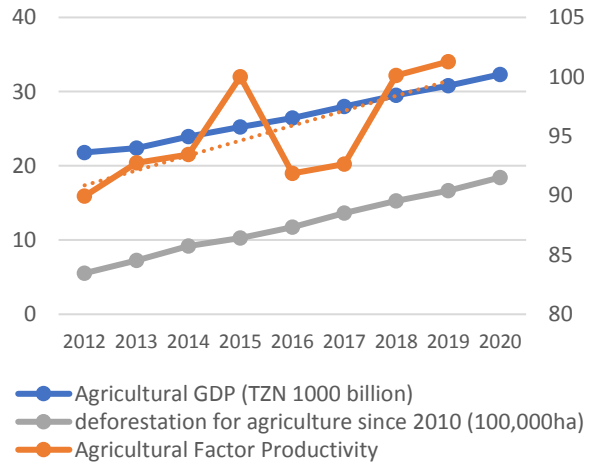
Executive Summary

Agriculture is the backbone of Tanzania's economy and could become its growth engine. The sector currently employs 65 percent of the population and provides livelihoods for 75.5 percent of the poor. It is growing and creates jobs with strong backward and forward linkages to the rural economy, as witnessed by the 13 million days of additional work for hired agriculture labor annually created by emerging medium-scale farms between 2008 and 2014 (World Bank 2019f). Since 2016, agricultural GDP yearly increased by about 4.2 percent, slower than national GDP (5.2 percent). This upward trend is partly driven by intensification, with the growth of agricultural total factor productivity increasing from 0.5 percent per year over 2001-2010 to 1.8 percent over 2011-2019. Yet it also arises from agricultural area expansion by deforestation, combined with natural resources depletion (soil, water) (Figure ES.1).

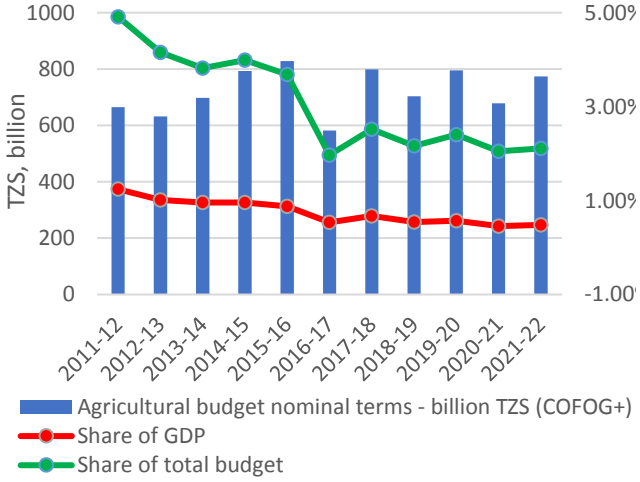
This report shows that additional public investments into agricultural public goods (climate change resilience, research, extension services, irrigation) would gear up the sector's growth in a more sustainable and inclusive way for Tanzania to reach its Vision 2025. It uses historical data from 2017 to 2022 to review the level and composition of public expenditure in the agriculture sector (crop, livestock, fisheries, and forestry). It also analyzes its allocative efficiency and effectiveness and its alignment with the Government's strategic sectoral goals as defined in Tanzania Vision 2025 and the Agriculture Sector Development Program (ASDP II).

Figure ES.1 – Agricultural growth and its drivers in Tanzania



Source: Auhors. Data Bank of Tanzania, USDA and Global Forest Watch.

Figure ES.2 – Agricultural budget in nominal terms (left axis) and as shares of GDP and of national budget (right)



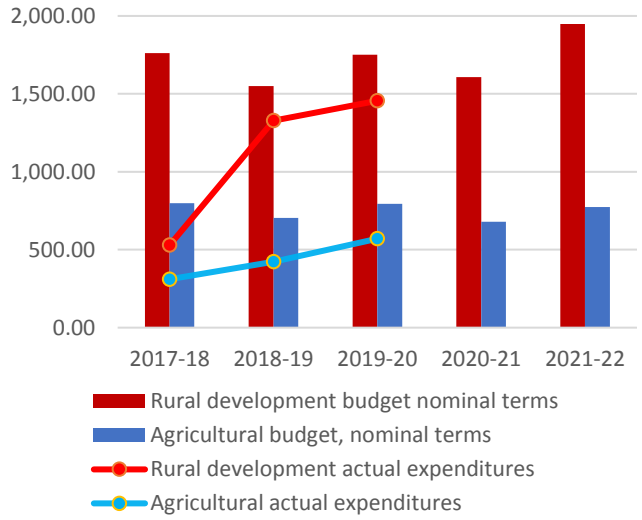
Source: Authors. Data FAO, PER data, Bank of Tanzania, IMF and MoF.

a. Level, composition, and governance of agriculture sector expenditures

Since 2017/18, Tanzania's agriculture sector budget has been low and volatile, averaging 2.25 percent of its national budget (Figure ES.2). Over the past five years, it experienced ups and downs around the average value of TZS 750 billion (USD 328 million). Measured as a share of GDP, the agricultural budget sharply declined between 2011 and 2017 to stabilize at a low 0.5 percent. The livestock subsector, which contributes 7.4 percent of the GDP, is critically disadvantaged with an allocation estimated at 0.03 percent of GDP. Insufficient budget allocation to agriculture has hampered the implementation of Tanzania's second Agriculture Sector Development Program (ASDP II), slowing down the agricultural transformation

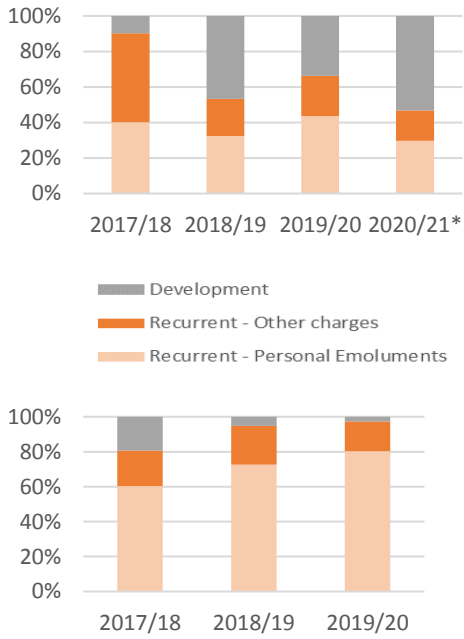
needed to materialize Vision 2025. However, broader rural development budget (including roads, energy and rural health services) has been more significant (Figure ES.3), averaging 1.2 percent of GDP and providing much needed infrastructure in rural Tanzania. In addition, the country is undergoing a strategic turn: the 2022/23 budget for the Ministry of Agriculture (MoA) is expected to increase by 155 percent and for the Ministry of Livestock and Fisheries Development (MLDF) by 252 percent.

Figure ES.3 - Agricultural and rural development budget and actual expenditures in Tanzania



Source: Authors. Data: agriculture PER and Budget Books..

Figure ES.4 - Economic composition of expenditures of MoA (top) and LGAs (bottom)



Source: Authors. Data Budget Books and LGA survey.

While the overall level of public expenditures is low, budgetary spending mostly targets public goods which supports sector growth. Tanzania moved away from general agriculture input subsidies. Only 5 percent of budgetary transfers directly support producers, but this takes place mostly through distortive input subsides in things such as agrochemicals, seeds, and seedlings. By importance of budget allocation, other main key functions are administration (30 percent), forestry management (17 percent), extension services (18 percent), marketing and storage (14 percent), research (5.2 percent) and irrigation (4.3 percent). Regrettably, climate smart agriculture funding was anecdotical (about 0.05 percent), despite its critical importance in sustaining productivity and resilience.

The tight agricultural budget left little fiscal space for development expenditures and led to insufficient support for critical public services needed to catalyze agriculture transformation. Whereas budget essentially targets public goods, it is beneath the critical levels needed for them to materialize. Two-thirds of actual central-level agricultural expenditures were recurrent, which do not support the growth of the sector. It is commendable that development expenditures increased over the period for the Ministry of Agriculture (MoA) (Figure ES.4, top), a trend expected to accelerate in the light of the newly announced budget for 2022/23.

Three-quarters of agriculture budget were allocated at the central level, contrary to Tanzania's "decentralization-by-devolution" policy. Local Government Authorities (LGAs) play a critical role in delivering agriculture services, including provision of extension services, and were supposed to receive 75 percent of the sector allocation budget to support service provision. However, LGAs' development expenditure collapsed over the period (Figure ES.4, bottom).

Low outturns and execution rates compromise the credibility of the budgeting and planning process and prevent needed policy implementation. The declared overall budget outturn for the sector was 57 percent over 2017 to 2020. Delays in accessing funds remain a concern, with significant portions of development funds usually released in the final months of the fiscal year. However, agriculture budget execution is on an upward trend over the period from 52 percent in 2016/17 to 83 percent in 2019/20 (Figure ES.3), which remained below the overall budget execution level. At the LGA level, insufficient agricultural allocations resulted in full budget execution.

Financial sustainability increased over the period, but agriculture funding remains dependent on donors. Development partners supported about one-fifth of agricultural budget. Their "off-budget" expenditures over 2017/18-2019/20 weights as much as half of public agricultural funding. Thirty percent of the MOA budget depended on foreign funding and 26 percent of the fisheries activity of the Ministry of Livestock and Fisheries Development (MLFD). The overall level of foreign aid (on- and off-budget combined) has been rapidly decreasing over 2016 to 2021, as funding provided through first Agriculture Sector Development Program (ASDP I) basket in 2014/15 winded down without being replaced by new engagements. As a result, 73 percent of the approved 2022/23 MOA budget is funded from domestic resources, thus increasing fiscal sustainability. A drawback is that several plans—such as ASDP II, Climate Smart Agriculture Plan, Irrigation Master Plan—had counted in part on donor funding that did not materialize, to the detriment of implementation of some planned activities.

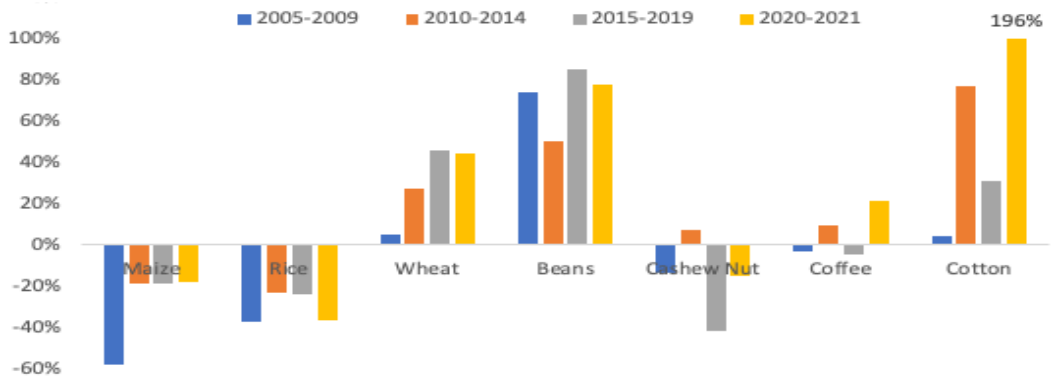
b. **Effectiveness of agriculture expenditure**

Commendable progress has been made to improve the business environment, but Tanzania can make further steps. In a context of extremely low public spending on agriculture, policy measures largely shape its incentive structure. The report thus assesses price incentives for selected commodities—maize, rice, beans, wheat, coffee, cashew, and cotton—over the past fifteen years (Figure ES.5). Well targeted interventions helped strengthen productivity and competitiveness in some value chains—such as beans, cotton and occasionally coffee—while export restrictions (bans and taxes) lowered farm prices and hampered competitiveness in maize and cashew value chains. Tanzania moved away from agricultural commodity export bans in 2017 and reduced agriculture taxes by local government (the agriculture cess was reduced from 5 to 3 percent), as well as over a hundred taxes and levies collected by other agents. The country still maintains some export taxes, however. Import restrictions on rice and wheat did not increase prices for producers of these commodities. Government's *ad hoc* marketing interventions tended to disrupt value chains at the cost of farmers, as seen recently in the cashew nuts and coffee value chains. All analyzed commodities are also affected by: (i) the agriculture cess, little of which is reinvested in the sector; (ii) excessive margins by specific actors; and (iii) high transport costs between farm gates and wholesale markets due to poor feeder roads and processing and storage capacity.

Agricultural public service delivery deteriorated over the past decade in Tanzania, at the notable exception of access to improved seed. According to the National Sample Census of Agriculture, irrigated areas cropped by farmers went down from a low 3 percent to 2 percent of all farmed area between 2008 and 2020. Meanwhile, access to extension services collapsed from 67 to 7 percent over the period, with women and herders being the most affected. Funding to agricultural research shrank to rank among the

four lowest in Africa, bringing the knowledge system to the verge of collapse, with its livestock side being in a dire situation. Adaptation to climate change has not progressed, and ambitious and relevant policy plans remain largely unimplemented. On the bright side, the number of farms that use improved seeds more than doubled between 2008 and 2020, driven by strong public institutions and a dynamic private sector that benefited from an improved regulatory environment.

Figure ES.5 - Nominal Rate of Protection (NRP) at Farmgate



Source: Authors.

Public investments in seed system, irrigation, and extension services have yielded high returns, calling for increased funding, but large efficiency gains could also be realized. While public services collapsed due to lack of funding combined with inefficiencies, the remaining ones analyzed here demonstrated high value for public money. Table ES.1 summarizes key results found based on benefit-to-cost ratios. The seed system, which captures a share of research expenditures, appears to have the highest ratio (17), followed by irrigation (16), and extension services (9). These ratios are in the range of past SSA results, with the estimated returns of public spending being 22–55 percent for research, 8–49 for extension, and 11–22 percent for irrigation (Goyal and Nash, 2017). Still, large efficiency gains could be achieved in extension services, where the number of extension officers appear disconnected from service accession, and in irrigation, where we observe a widening gap between the area equipped for irrigation and the one actually used.

Table ES.1 – Comparison of the benefit-cost ratio estimated for key public services in Tanzania

Activity	**Cost: estimated annual public expenditure**		**Benefit: estimated yearly increase in farm household income**		**Benefit-cost ratio**	
	TZS billion	USD million	TZS billion	USD million		
Irrigation	46.3	20.2	754	329	16	**Climate change adaptation** ↕ Net annual direct gain USD 47.3 M (for 6 main crops)
Extension	138.5	60.5	1,283	560	9	
Seed	28.6	12.6	625	273	17	
Research	40.1	17.7	nc	nc	Nc	

Source: Authors (see Chapter 4.2 and background papers).

Investing in climate change adaptation in the agriculture sector is critical for Tanzania, with the lowest estimate of economic gain at US$ 1.41 billion by 2040. This figure, based on the adaptation trajectories of key crops (maize, rice, cassava, beans, sorghum, and banana), is very conservative, as it does not account for extreme events or negative effects on the livestock sector. And yet, the yearly cost of public investments in climate change adaptation would be largely offset, with an average yearly gain of US$ 47.6 million. In addition, climate change resilience underpins the performance of other public investments such as irrigation and improved seeds. While ambitious climate change adaptation plans are in place for agriculture, they are not implemented due to lack of public funding. Beyond these plans, maintaining Tanzania's agricultural productive capacity and income growth in the mid to long-term requires aligning all public investments on building climate change resilience and preserving natural resources such as water and soil. Agriculture can also contribute to Tanzania's climate change mitigation objectives, with large emission reduction potential mostly on land use changes but also on climate smart agriculture practices and improved animal breeding and feeding.

Finally, policy coherence, analyzed through the lens of ASDP II, could be scaled up. The livestock sector is an overlooked priority with large potential to contribute to agricultural growth, rural poverty reduction, and food security. Reaching the objective of higher productivity is held back by extremely low agricultural research funding, inefficient innovation dissemination through extension services, price distortions that disincentivize producers to invest in new technologies, and high productivity gender gap. A number of issues also seem to impede achievement of country objectives to increase commercialization and rural income and decrease rural poverty, including trade policies, marketing interventions, commodity taxation (cess), and poor transport infrastructure. The current set of agricultural expenditures has mixed effects on the objective of improving food security, with agricultural diversification being a strength Tanzania could promote. Finally, sustainability targets for climate change adaptation and preventing soil degradation cannot be achieved with the current level of funding, jeopardizing the achievement of all other objectives.

c. **Conclusions and policy recommendations**

Tanzania's agricultural public expenditures were overall well targeted over 2017/18-2021/22, but public good provision requires a significant upscale for the country to achieve its Vision 2025. The existing agricultural policy toolbox provides a strong basis on which to build and speed agriculture's contribution to sustainable and inclusive growth for the country, create jobs, and fight rural poverty and food insecurity. We propose three categories of actionable policy options that are detailed and prioritized in the report, as summarized in Table ES.2 below:

1) Increasing public funding for agricultural public goods. This first group of recommendations aims at sustaining the new administration's resolve to increase public support to agriculture. Recent increases in agriculture budget represent bold steps, that will need to materialize into increased development spending and pursued over time for agriculture to become Tanzania's growth engine. It would particularly help unlock the potential of the livestock sector. It is core that additional funding targets public good provision, starting with building climate change resilience, and refrains from reinstating distortive subsidies that the Government succeeded in moving away from. Investing in innovation, knowledge dissemination, water-efficient irrigation and climate smart agriculture (CSA) will be particularly key for growth. The national budget could be complemented with LGAs and agencies' own revenues and, on in the longer term, on private funding.

2) Boosting the effectiveness of public expenditures. Full alignment of agricultural expenditures and policies with climate change adaptation and mitigation and natural resources protection (soil, water) is

critical to ensure mid and long-term productivity and resilience to shocks. Spending effectiveness could be promoted by improving budget targeting geographically and in strategic value chains (in particular for extension and irrigation), reallocating remaining input subsidies to less distortive support, and fast-tracking implementation of agriculture reforms under the blueprint for improving the business environment. We also propose specific measures to improve the effectiveness of spending in irrigation and extension services.

3) Improving public expenditure planning, execution, and monitoring. Scaling-up budget predictability and budget outturn and execution is needed for agricultural plans and policies to materialize and deliver planned outcomes. This Public Expenditure Review (PER) also highlights the need to rebuild agricultural public expenditures monitoring and evaluation capacity in agricultural ministries. Foreign funding coordination could be improved to better support government priorities under ASDP II, through the use of District Agricultural Development plans and potentially a sector basket fund.

Table ES.2- Time prioritization of detailed proposed actions

RECOMMENDATIONS	SHORT TERM (2022-2024)	MID TERM (2024-2026)	LONG TERM
1. INCREASING PUBLIC FUNDING FOR AGRICULTURAL PUBLIC GOODS	• **Increasing public investments in the development of agriculture and livestock sector** • Scaling up budget for research (including seeds), water-efficient irrigation and CSA Plan • Reallocating 20 percent of LGA revenues to agriculture • Evaluating scope and impacts of cess and agencies taxes	• Allocating 0.5% of agricultural GDP to research • Developing alternative funding for research, extension and irrigation • Rationalizing cess and agencies taxes	• **Allocating 1% of agricultural GDP to research** • Ensuring financial sustainability with private funding • Eliminate cess
2) BOOSTING THE EFFECTIVENESS OF PUBLIC EXPENDITURES	• **Aligning budget with climate change resilience and soil and water protection** • Improving access to extension • Bridging the gap between area equipped for irrigation vs. used • Reallocating input subsidies to less distortive support • Fast-tracking enabling environment reform (Blueprint) in agriculture • Phasing out ad hoc marketing interventions (ex. cashews)	• Optimizing spatial distribution of funds and investments • Strengthening institutional linkages between research & extension • Improving extension coordination at central level • Piloting e-extension • Promoting farmer-led extension and irrigation	• Upscaling e-extension • Improving water use efficiency
3) IMPROVING PUBLIC EXPENDITURE PLANNING, EXECUTION AND MONITORING	• **Improving budget outturn and execution** • Improving coordination with donors • Revitalizing ASDP II basket fund • Improving access and quality of data on public expenditures	• **Rebuilding monitoring and evaluation capacity** • Improving coordination between agencies and line ministries (ex. feeder roads prioritization) • Developing early agricultural information system	

Introduction

1. **The Government of Tanzania recognizes agriculture as one of its core sources of inclusive economic growth, export earnings and means for achieving other social economic goals, but its potential has not been realized.** This recognition is well articulated in its national development strategies and sector policies and programs, in particular the second Agriculture Sector Development Program (ASDP II) launched in 2018. Ambitious targets are set for agriculture to help creating jobs, reduce rural poverty and improve food security and nutrition. However, implementation of sector programs has fallen short of expectation due to limited financing. From a low base, fiscal allocation to the sector underwent drastic cuts in recent years. In a context of combined tight fiscal space and high expectations for the sector, understanding where and how money is spent on agriculture is crucial to optimize targeting of expenditure.

2. **This agricultural Public Expenditure Review (PER) is the first in Tanzania since the launch of ASDP II in June 2018**. The last sectoral PER was done in 2018 and data has not been updated since the fiscal year 2017. This work has been initiated at the demand of the Government, as part of the Comprehensive Africa Agriculture Development Programme (CAADP) monitoring mechanism. The present report uses historical data from 2017/18 to 2021/22 to review agriculture public expenditures (crops, livestock, fisheries and forestry) and take stock of the trends and composition of sector spending.

3. **This report assesses the efficiency and effectiveness of public spending to help target the scarce fiscal space where it could be most impactful to accelerate agricultural growth**. It unveils that agricultural public budget mostly targets public goods in Tanzania, but at a level too critically low (2.25 percent of the national budget and 0.5 of GDP) for these to materialize and support sustainable productivity and job creation. In a context of low public investments, policy measures are likely to play a more important role in shaping the incentive structure of the sector than agricultural expenditures. While bold steps have been taken by the Government to improve the business environment, the price incentive analysis included in this PER reveals that the remaining policy measures implicitly tax the farmers, hampering private investments and income growth. Strong evidence is provided on the high value-for-money of public investments in four areas identified as strategic by the Government: irrigation, the knowledge system (research and extension services), the seed system and climate change adaptation. Finally, results are brought together under a policy coherence analysis, which shows how additional well-targeted funding and actions could strengthen the alignment of agricultural public expenditures and policy measures with ASDP II objectives.

4. **The report proceeds as follows.** Chapter 1 outlines the role and performance of the agriculture sector in Tanzania and describes the main agricultural policy frameworks. After presenting data sources and methodology, Chapter 2 analyzes the level, evolution, composition and sources of funding of agricultural expenditures. Chapter 3 discusses the budget process, governance and execution. The effectiveness of public spending in the sector is assessed in Chapter 4, which includes the key results of the price incentive analysis, the main findings of thematic deep dives on strategic areas for the Government (irrigation, agricultural knowledge system, seed system, climate change adaptation). Chapter 4 concludes by analyzing the overall agricultural policy coherence. Finally, the report summarizes key findings and suggests detailed actionable recommendations for the Government to improve spending on the agricultural sector to leverage further its growth potential.

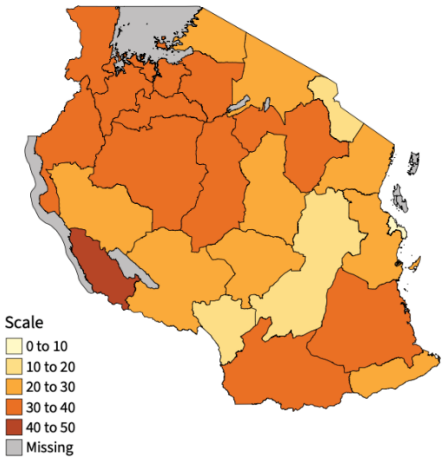
1 The Role and Performance of the Agriculture Sector in Tanzania

1.1 Macroeconomic and fiscal environment

5. While Tanzania's economy expanded steadily for two decades, underpinned by macroeconomic stability and large investments inflows, the COVID-19 pandemic disrupted its upward trajectory (World Bank 2021). From 2016 to 2020, the annual GDP growth rate averaged 5.2 percent, essentially driven by industry. Agricultural sector growth has been slower at about 4.1 percent a year (World Bank 2022a). In July 2020, Tanzania officially graduated from low-income country to lower-middle-income country (LMIC) status. The country's growth has been allowed by macroeconomic stability, with low inflation rates (3.5 percent in 2019/20) and a fiscal deficit averaging 2.0 percent of GDP, as well as large investment inflows which exceeded 30 percent of GDP for the past decade. The COVID-19 pandemic jeopardized Tanzania's trajectory, as witnessed by the drop in GDP growth rate from 5.8 percent in 2019 to 2.0 percent in 2020. An estimated 140,000 formal jobs were lost in June 2020, and another 2.2 million nonfarm informal workers suffered income losses. 2021 witnessed fragile signs of economic recovery, with a projected real GDP growth rate at 4.5–5.5 percent in 2022 (World Bank 2022a). However, to reach the ambitious goals of its Vision 2025, Tanzania needs an annual GDP growth rate of 8 percent, create 8 million jobs and sustain improvements in social indicators (World Bank, 2022a).

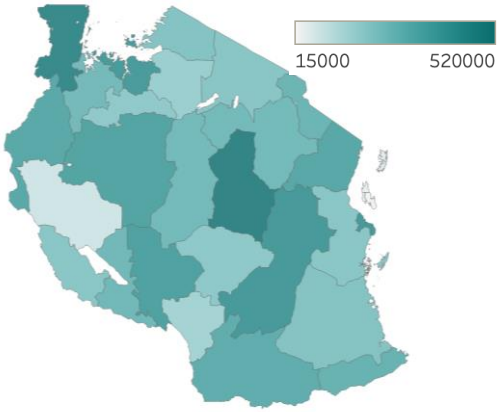
6. **Poverty remains a key challenge in Tanzania, which has the worst poverty rate among new LMICs and a growth less inclusive of rural areas**. In 2018, an estimated 25.9 million Tanzanians lived below the international extreme poverty line of US$ 1.90 per day (2011 purchasing-power-parity terms). Tanzania thus had the fourth largest population of poor people in Sub-Saharan Africa, most of it being farm households located in rural areas (Figures 1 and 2). While the share of the poor population increased due to the country's rapid population growth, with a growing inequality between urban and rural areas, the COVID-19 shock worsened the situation. As the economy slowly recovers, the national poverty rate is expected to be at 26.7 percent in 2022 and to decline to 26.4 percent by 2023, its 2018 level (World Bank 2022a).

Figure 1 - Poverty rate in 2018



Source: Pernechele et al. (2021))

Figure 2 - Number of farm households



Source: Authors. Data: National Sample Census of Agriculture 2019/20

7. **The consequences of energy and fertilizer price surges impose a new strain to the Tanzanian economy through trade supply and price impacts**. Tanzania may see an increase of between 1-2 percent of GDP in the cost of imported fuel, food and fertilizers (World Bank 2022), but this estimate does not include the potential economic cost of the Russian invasion of Ukraine. Since June 2021, the price of fertilizer and edible oil has increased significantly, and in some places the price of fertilizer[1] has tripled. By March 2022, prices of petrol, diesel and kerosene had increased by 37.3 percent, 27.2 percent and 15.4 percent, respectively, relative to the corresponding period in 2021 (BOT 2022). Pressures on fiscal revenue and inflations appear to be significant, but their magnitude are still under assessment.

8. **Strategic policy actions have been adopted to support the recovery of the agriculture sector from the combined effects of the Covid-19 pandemic and the surge in energy and fertilizer prices**. In July 2021, the Central bank reduced the statutory minimum reserve requirement for banks that lend to agriculture from 7 percent to 6 percent. These loans are subject to a reduced annual interest rate cap of 10 percent. However, credit growth to all other sectors—including manufacturing, agriculture, transportation, and hotels and restaurants, inter alia—slowed between April and October 2021. These measures likely contributed to a decline in credit to the agricultural sector, since the interest rate cap of 10 percent does not cover banks' risks and costs (Word Bank 2022a). In June 2021, the government liberalized its fertilizer market again by stopping the use of the fertilizer bulk procurement system to allow free importation of fertilizer. Since the Russia and Ukraine war began, the government has reduced fuel levies, and is planning to re-introduce a fertilizer subsidy program in FY 2022/23 to support farmers access to fertilizer.

9. **In the wake of continued crisis reducing fiscal space, increasing efficiency in public resource allocation and utilization is paramount.** As Tanzania recovers from the Covid-19 pandemic, strives to withstand the effects of surges in energy and fertilizers prices, addresses the impact of the prolonged drought in 2021/22 which will affect food production, and needs to complete its flagship projects, available public spending may tighten, prompting the government to allocate resources more carefully to ensure the best possible returns. The achievement of Tanzania's Development Vision 2025 thus increasingly depends on improving efficiency and effectiveness of public spending, as well as mobilizing private investments. Private investment is core to maintaining a sustainable and manageable level of public debt while pursuing Vision 2025. World Bank (2021) estimates that annual private investment growth would need increase from an average of 8 percent in 2018-2019 to a minimum of 14 percent to reach the country's objectives.

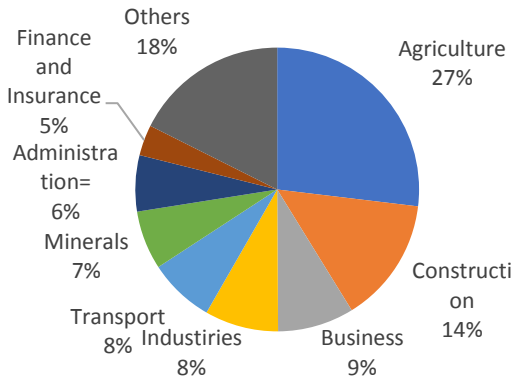
1.2 Agriculture sector performance

10. **Agriculture is the backbone of Tanzania's economy and will continue to be an important driver of growth, job creation and rural poverty reduction.** The sector currently employs 65 percent of the population and provides livelihoods for 75.5 percent of the poor (World Bank, 2020). It accounts for about 26.9 percent of GDP (figure 3), 30 percent of exports, and 65 percent of inputs to the industrial sector. Tanzania holds the second largest cattle stock in Africa and livestock-related activities contribute to 27 percent of the agricultural sector GDP and 7.1 percent to Tanzania's GDP. The sector also supports 90-95 percent of the food requirements for the country, with a stable supply which has been instrumental in maintaining low inflation. Its importance is also underscored by the fact that agricultural growth has been widely shown to be more "pro-poor" than non-agricultural growth. This is particularly true in rural areas

[1] Between June 2021 and May 2022, average prices for Urea increase by 129 percent, Diammonium phosphate (DAP) by 136 percent and Calcium ammonium nitrate (CAN) by 237 percent.

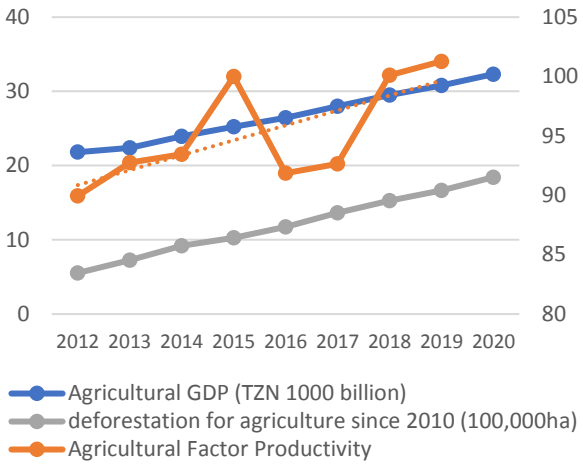
where agriculture and associated value chains will remain the main source of employment for most of the population.

Figure 3 - Sector Contribution to GDP in Fiscal Year 2022



Source: Authors. Data MoFP Guidelines for Preparation of Plans and Budgets for FY 2022/23.

Figure 4 - Agricultural growth and its drivers in Tanzania



Source: Auhors. Data Bank of Tanzania, USDA and Global Forest Watch.

11. **The sector has been growing in size, catching up with the Government's targets set out in its Five-Year Development Programme (FYDP) III.** On average, agriculture grew at a 3.5 percent rate from 2006 to 2016, and at a 4.8 percent rate over 2018-2020 (Figure 4). This growth is comparable to the average real agriculture growth in Sub Saharan Africa (SSA) in the past decade (4.4 percent) and surpasses the 3.2 percent growth in East Asia and the Pacific Region, 3.1 percent in South Asia Region and 2.5 percent in Latin America and Caribbean (WDI database). However, to fulfill Tanzania's 2025 Vision, FYDP III requires the agricultural growth rate to average 6 percent. The economy slowdown related to Covid-19 and the surge in fertilizer and energy prices further increase this need for Tanzania to reduce its rural poverty. While the sector is making rapid progress to reach this target, significant steps are still needed for agriculture to become the national growth engine it can be.

12. **Underpinning this growth is the promising emergence of market-oriented small and medium-scale farms over the past decade** (World Bank 2019a,b; Wineman et al. 2020a,b). Between 2008 and 2014, 368,000 medium-scale farms created 13 million days of additional work annually for hired workers, and US$ 225 – US$ 300 million in net backward and consumer links. These entrepreneurial farms that characterize Tanzania's agricultural transformation remain closely linked to their communities, produce strong positive spillovers on smallholders, invest in technology and knowledge and develop commercial services. They boost employment in upstream activities by increasing demand for agricultural inputs, financial services, capital purchases and rentals, and transportation services. As such they pave the way for reducing poverty.

13. **However, the growth of the crop sector largely comes from land expansion and is hampered by low productivity of land and labor.** TFP growth rate from 2011-2019 in Tanzania was 1.8 percent (Figure 4) compared to 0.15 percent in SSA. This remains below TFP growth rates of 1.9 percent in Latin America and Caribbeans, 2.2 percent in South-East Asia, 2.9 percent in South Asea Region, and 3.0 percent in the World (USDA 2021). Land cultivated expanded by 7.7 percent annually from 2007 to 2016 while land

productivity stagnated at less than 0.4 percent (annually in value terms) and labor productivity modesty rose at about 1 percent (World Bank 2019b). Factors underpinning this low performance include: (i) poor production techniques due to limited adoption of innovations and improved technologies; (ii) underdeveloped markets, market infrastructure and farm-level value addition; (iii) poor rural infrastructure, including rural roads, telecommunications, and electricity; and (iv) inadequate agricultural finance, including public expenditure. Smallholder crop yields have stagnated at only 20 to 30 percent of their potential due to low utilization of improved technologies. By 2020, only 35 percent of farms used non-manual traction, 23 percent used organic fertilizer, 12 percent used herbicides, 9 percent used irrigation, and 24 percent of the cultivated area used improved seed varieties.

14. **Similarly, growth in the livestock sector largely reflects increases in livestock numbers, rather than productivity gains.** The subsector accounts for 11 percent of the African cattle population, ranking Tanzania as the country with the second largest herd in the Continent, but only contributes to 7.4 percent of the GDP, with a low growth estimated at 2.6 percent (Michaels *et al*., 2018). Low productivity in the livestock sector is mainly caused by animal breeds with low reproductivity rate; presence of livestock diseases; shortage of water infrastructure and pasture; inadequate markets and value addition of livestock and livestock products; and inadequate extension services.

15. **Tanzania's agricultural growth is unsustainable as it degrades soils and deplete water resources, undermining the long-term productive capacity of the sector, which is aggravated by climate change**. At least 61 percent of Tanzania's soils are estimated to be degraded, leading to loss in soil fertility, erosion, desertification, salinization and/or acidification (World Bank 2019c, URT 2018). Economic costs of land degradation in Tanzania are estimated to be USD 2.2 billion per annum (almost 10 percent of the country's GDP). These costs mostly reflect losses in the provision of ecosystem services and disproportionately affect local communities and the rural poor, particularly smallholder farmers (Nkonya et al. 2016, World Bank 2019c). In addition, agriculture is responsible for over 90 percent of freshwater withdrawals in a country that is already highly water stressed (World Bank 2019d). Most agricultural withdrawals aim to meet deficits in crop water requirement through irrigation. Since 1994, Tanzania's renewable per capita freshwater resources have declined by almost 50 percent and are projected to continue to fall. In some cases, high agricultural withdrawals leave insufficient water in river systems, compromising performance of other sectors such as hydropower production, tourism, urban and industrial growth.

16. **The agriculture sector of Tanzania urgently needs to adapt to climate change and can also significantly contribute to the country's mitigation objectives as its major source (84 percent) of emissions.** Climate change will cause further downward pressures on agricultural productivity through reduction of yields (see Chapter 4). Tanzania is among the 20 countries predicted to be most affected by climate change, with temperature and extreme events projected to increase significatively (World Bank 2019e, 2015a,b; Future Climate for Africa 2017). In 2019, Agriculture *per se* contributed to 38 percent of Tanzania Tanzania's GHG emissions, and Land Use Change and Forestry (LUCF) – overwhelmingly due to agricultural land conversion – to 46 percent (Climate Watch, 2022). The sector as analyzed in the PER thus produces 84 percent of the country's emissions. Large potential for climate change mitigation thus exists through sustainable intensification on existing farm area, reducing land conversion and dissemination of CSA practices such as agroforestry (CIAT and World Bank, 2017; Anuga *et al*., 2020).

17. **Factors hindering productivity in the livestock sector are also hampering climate mitigation**. Important mitigation opportunities in the livestock sector revolve around increasing productivity and production efficiency, which could reduce GHG emissions per unit of product by roughly 30 percent (World Bank, 2021a). Relevant approaches include improving ruminants' nutrition and feed quality and digestibility to reduce enteric methane emission; introduction of breeds that will increase herd productivity and adaptability to local conditions; and fostering good animal health practices. Efficient land

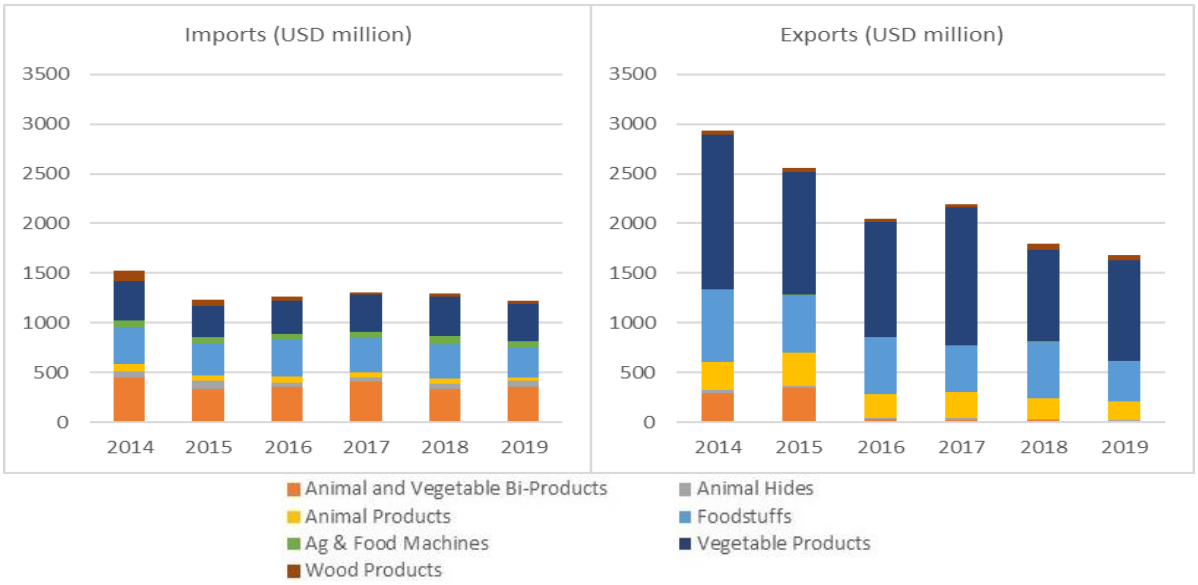
management that increases biomass accumulation and carbon sequestration can also contribute to a better diet for ruminants, further reducing enteric methane production. Climate change mitigation through the livestock sector will require strong support from veterinary and extension services.

18. **Low labor productivity is aggravated by persisting gender inequality.** In 2019, 65 percent of the workforce was engaged in agriculture, including 67 percent of women and 64 percent of men. The sector suffers a 20-30 percent gender gap in agricultural productivity (World Bank, 2022a). Most is explained by women's diminished access to male family labor and lower levels of access to agricultural inputs (World Bank 2022a). Data from the 2020 National Sample Census of Agriculture confirms that male-headed households use more inputs, invest more in crop production and have better access to extension services. For example, 29 percent of female-headed households use improved seeds versus 41 percent of male-headed ones. A similar gap was already found in the 2008 National Sample Census of Agriculture data, suggesting that gender inequality does not narrow over time. Bridging the gender gap in agricultural productivity could boost Tanzania's annual GDP by 0.86 percent and could lift about 80,000 Tanzanians out of poverty every year (World Bank, 2022a). Strengthening women's tenure security would further spur investments in the productivity of agricultural land.

19. **While food production is on an upward trend, with Tanzania now being self-sufficient, persistent poverty leads to high malnutrition and food insecurity rates.** On average, Tanzania produces 18 million tons of food against a 13 million tons food demand per year. Maize is the main staple crop with a planted area of over 4.5 million ha in 2020, followed by rice (around 1.5 million ha), and dry beans (743,000 ha). Other important crops include banana, cassava, groundnut, pigeon pea, sorghum, sunflower and sweet potato. Dry beans constitute the main source of protein for most low- and middle-income households (FEWSNET 2021). Horticulture, a key sector for farm income and nutrition, is among the fastest growing sub-sectors with an annual increase of 8 percent. The total area under fruits and vegetables increased by 126 percent between 2008 and 2020 (2019/2020 National Sample Census of Agriculture data). Despite a diverse and sufficient agricultural production in Tanzania, malnutrition remains above the African average, with 32 percent of children under 5-year-old being stunted. The proportion of the population that is undernourished is 7.8 percent compared to the African Union's 5 percent target by the year 2025 (AU 2022). Malnutrition is closely related to poverty: among households in the lower income quintiles, spending on food staples still consumes more than 30 percent of total household spending (World Bank, 2021b). Demand for food is expected to be 60 percent higher by 2030, driven by urbanization and a population which is increasing by 3 percent per annum (World bank 2019a).

20. **While Tanzania is a net exporter of agricultural and food products and trades them world-wide, exports are eroding**. Imports of agricultural and food products have been stable over 2014-2019. However, exports have steadily decreased from USD 2.9 billion in 2014 to USD 1.7 billion in 2019 (-8 percent per annum in average) (figure 5). According to the Observatory of Economic Complexity (2021), vegetal products and foodstuffs are respectively the second and third largest (in value) categories of products exported by Tanzania in 2019, behind precious metals (mostly gold) (figure 5). Exported vegetal products are diverse and included coconuts, Brazil nuts and cashews (USD 231M in 2019), raw tobacco (USD 210 M), other oily seeds (USD 179 M, including sesame), coffee (USD 154M) and dried legumes (USD 154 M), with Vietnam, China, India and Kenya being the main destinations. Imports are dominated by machinery, refined petroleum, metals, chemical products, transportation and textile (figure 5). The major food and agricultural imported products in 2019 are palm oil (USD 1,898M) from Indonesia and Malaysia, raw sugar (USD 728M), wheat (USD 174M), edible preparations (USD 133M), confectionary sugar (USD 111M) and rice (USD 80M).

Figure 5 - Imports (left) and exports (right) of agricultural and food products and related machinery



Source: authors. Data OEC 2021.

21. **Foreign and domestic private investments into agriculture and agribusiness remain limited, curbing the sector potential to meet country's economic and social targets.** Agribusiness is a key sub-sector accounting for more than half of manufacturing value added, with great expansion potential and job creation opportunities. The potential for the agribusiness sector has not been fully exploited as most (90 percent – MoA 2022) of agriculture products are sold as primary commodities. Agriculture value chains are underdeveloped and fragmented, facing a weak enabling business environment led by high production costs and limiting trade policies, which result in low private investments. On average, between 2007 and 2017, only 4 percent of foreign direct investments went into agriculture, fisheries, and forests. Commercial bank lending to agriculture is low at 8 percent in 2019/20 (BOT, 2020). Low competitiveness is also constraining SMEs growth: Tanzania scored 48.2 on the 2019 global competitiveness index (GCI), ranking 117 out of 140 countries and below all other African countries. Improving the business environment, particularly trade and input markets, will support greater private investment in agriculture and agro-processing.

1.3 Agricultural policy framework

22. **The Government of Tanzania's Development Vision 2025 and third Five-Year Development Plan recognize agriculture as central to inclusive growth and poverty reduction**. The vision and plans set out ambitious goals for transforming agriculture and for sustainable industrialization to accelerate economic development and achieve development goals. Vision 2025 emphasizes the need to move from a "*predominantly agricultural economy with low productivity to a diversified and semi-industrialized economy with a modern rural sector and high productivity in agricultural production which generates reasonably high incomes and ensures food security and food self-sufficiency*".

23. **The agriculture development goals envisioned in these frameworks are articulated in the sector strategies and policies and implemented through the Second Agriculture Sector Program (ASDP II).** ASDP II is a ten-year program which guides investments in the agriculture sector from 2017/18 to 2027/28. It is implemented in two phases, each divided into five-year implementation period. The base cost of the first phase is estimated at TZS 13.8 trillion (USD 6.0 billion). It prioritizes enhanced (i) agricultural

productivity and profitability (58 percent), (ii) commercialization and value addition (26 percent), (iii) sustainable water and land use management (15 percent), and (iv) strengthening sector enablers (1 percent). The objective of the program is to transform the agricultural sector towards higher productivity, commercialization level and smallholder farmer income for improved livelihood, food security and nutrition. These are consistent with the long-term and medium-term policy frameworks for the country, the Agriculture Sector development strategy (ASDS 2015), the Tanzania Livestock Master Plan (2017/2018 – 2021/2022) and Tanzania Agriculture and Food Security Investment Plan.

24. **The Government is committed to accelerate agriculture sector growth and sets out ambitious plans to meet these targets.** The Government has started to increase its budget allocation to agriculture. In FY 2021/22, budget commitments to the Ministry of Agriculture increased by 13 percent and in 2022/23 budget commitments increased by 155 percent. Commitments to the Ministry of Livestock and Fisheries Development (MLDF) increased by 252 percent. In April 2022, the sector launched the "Agenda 1030 initiative" which targets a 10 percent growth for the sector by 2025. The Agenda encompasses the revitalization of the extension services program to support farmers access to improved services, rebranding the sector image, and encouraging private sector investments. Consorted efforts are required to catalyze the targets of this transformation of the sector.

25. **A key strategy to achieve national priorities is improving the agribusiness environment and competitiveness by alleviating taxes and opening trade**. Efforts made include putting in place tax incentives which exempt all agricultural inputs from import duty. Additionally, Value Added Tax (VAT) exemptions are provided for selected agriculture products, strategic industries such as leather, and capital goods (machines and production plants). The Government also removed VAT for animal and poultry feed additives. In recent years, the country has implemented further policy reforms, including removal of over one hundred fees and charges to reduce production costs, promote investments, and protect domestic industries. A key reform is the reduction of Local Government Authorities (LGAs) crop cess from 5 percent to 3 percent. While reducing LGAs revenues, this reform is expected to led to an increase in farm income ranging between 2 and 21 percent depending on options and regions (Ricome, 2020). Stakeholders are still calling for further reduction and eventual cess elimination because these measures are counter-productive. Finally, to improve agribusiness environment, the Government has moved away from the use of export bans for maize and rice since 2017.

26. **Tanzania also mostly phased out wide agriculture input subsidies to reduce fiscal pressure**. By 2014/15, agriculture subsidies accounted for up to 34 percent of the Ministry of Agriculture budget. Since then, central authorities have been exploring alternative policies for reducing fertilizer prices, particularly the introduction of Fertilizer Bulk Procurement system (BPS) and indicative price system in 2017. However, the use of these systems was abolished in July 2021. Currently, the fertilizer market remains liberalized, allowing free importation and sales of fertilizer. Imminent plans are underway to address increasing fertilizer prices caused by the Covid-19 pandemic and the war in Ukraine. Limited amounts of input subsidies are still provided to strategic crops like cotton, cashew nuts and tobacco (mainly agrochemicals) and sunflower seeds. In 2021/22 cropping season, the Ministry of Agriculture distributed 2,000 tons of seeds and plans to distribute 5,600 tons in 2022/23 cropping season.

27. **Despite the agriculture sector potential, well-defined strategic development goals and limited policy distortions, there is a justifiable concern about Tanzania's ability to convert its potential into development outcomes.** A complex set of constraints hampers Tanzania's agricultural development unless addressed by appropriate policies and public investments. Many of these constraints lie beyond the narrow domain of the agriculture sector and require multi-sectoral interventions (i.e rural infrastructure development - rural trunk roads, electricity; trade policy and trade facilitation; access to finance, etc.). These could limit effectiveness of some sector specific interventions to overcome the

constraints for broader agricultural development. As such, there is a need for a comprehensive set of fiscal and policy incentives plus substantive public investments for the sector to make productive and sustainable use of the country's natural resources.

2 Level and composition of public expenditure in agriculture in Tanzania

2.1 Data sources and methodology for the PER

28. **A wide array of methods and data sources have been mobilized to undertake this PER, which has been conducted in close cooperation with the Government of Tanzania and FAO-MAFAP.** Two FAO-led workshops have taken place in Morogoro and Dodoma between July and November 2021 to validate data collection and classification with the Joint Sector Review team members. Composition and trends of agricultural public expenditures have been discussed during a large stakeholder workshop that took place in December 2021 in Dar es Salaam. Analyses of effectiveness of public spending (price incentive analysis and all four deep dives) are anchored in extensive stakeholder consultations and field visits in several regions of Tanzania.

29. The on-budget agricultural public expenditure data presented and analyzed in this section covers Mainland Tanzania (i.e. not Zanzibar) and combines three sources:

(1) **Data on budgeted and actual expenditures for the fiscal years 2017/18 to 2021/22 comes from the public Budget Books** of the Ministry of Finance and Planning (MoFP). Disaggregation is limited.

(2) **Detailed data on agricultural budget for the fiscal years 2017/18 to 2019/20 has been collected by a team of consultants and FAO-MAFAP**, with guidance and validation from the Joint Agricultural Sector Review (JSR) Technical Team. The data has been classified following the FAO-MAFAP methodology. It has been collected from 15 central agencies - Ministries Departments and Agencies (MDAs), 26 Regional Secretariats (RSs) and 184 Local Government Authorities (LGAs). Data at central level comes from the Medium-Term Expenditures Framework (MTEF) books completed with specific data requests. A form was sent to the 184 LGA to collect their data.

(3) **Additional data was directly gathered from specific agencies (**ex. ASA, TARI, TFSA, etc.).

30. **Agricultural sector is defined as per COFOG+ and includes crops, livestock, fisheries and forestry.** Specific sections of the report also analyze public expenditures for rural development using the agricultural definition of FAO-MAFAP. This perimeter is extended to include activities indirectly supporting the sector such as rural roads, rural energy, rural sanitation and rural health centers (see Annex 1).

31. **Obtaining consistent local data series was challenging**. As Budget Books only started disaggregating agricultural budgets at the local level in 2018/2019, BOOST does not contain data at the local level for 2017/2018. In addition, the Budget books do not reflect funding local governments themselves raised. We therefor collected budget data directly by surveying the 184 LGAs. The budget data analyzed in this PER combines LGA-provided data for 2017/18-2019/20 and BOOST data for 2020/21-2021/22. Actual expenditures are based on BOOST (Budget Books) and is thus not available for 2017/18. The authors acknowledge limits resulting from the rupture and mix in data sources and consider that 2020/21 local budget data as well as actual expenditures underestimation of an estimated 30 percent.

32. **Off budget data was also collected from two different sources**. The OECD CRS database provides off-budget commitments and disbursements at project level until 2020. We crosschecked data with data

obtained from the ASDP II National Coordination Unit under the Prime Minister's Office (for 2019 and 2020), which is responsible for coordinating implementation of the ASDP II program since 2019, and with data obtained from the Agricultural Working Group, a donor platform (for 2017 and 2018). We also directly contacted some development partners such as the United States Agency for International Development (USAID) and the World Food Programme (WFP).

33. **Access to harmonized, reliable, and consistent expenditures data has been a challenge and the quality of public expenditure monitoring deteriorated in Tanzania since 2015/16.** Data presented in this report was cross-checked for validation to the extent possible. Stakeholder engagement and validation has been key in this regard, in particular through the Agricultural Sector Review (JSR) Technical Team composed of members from ASLMs MDAs and the other stakeholders. The analysis detailed in this section has also been presented and discussed during a jointly organized FAO and the World Bank stakeholder workshop on December 15, 2021 in Dar es Salaam. While the team is confident in the quality of the analysis presented for central government on-budget expenditures, the local budget data and off-budget data are noisier. The results should be considered as indicative. Overall, the team considers that the quality of public expenditures data and transparency have deteriorated since the 2015 World Bank agricultural expenditure review.

2.2 Agriculture budget trends

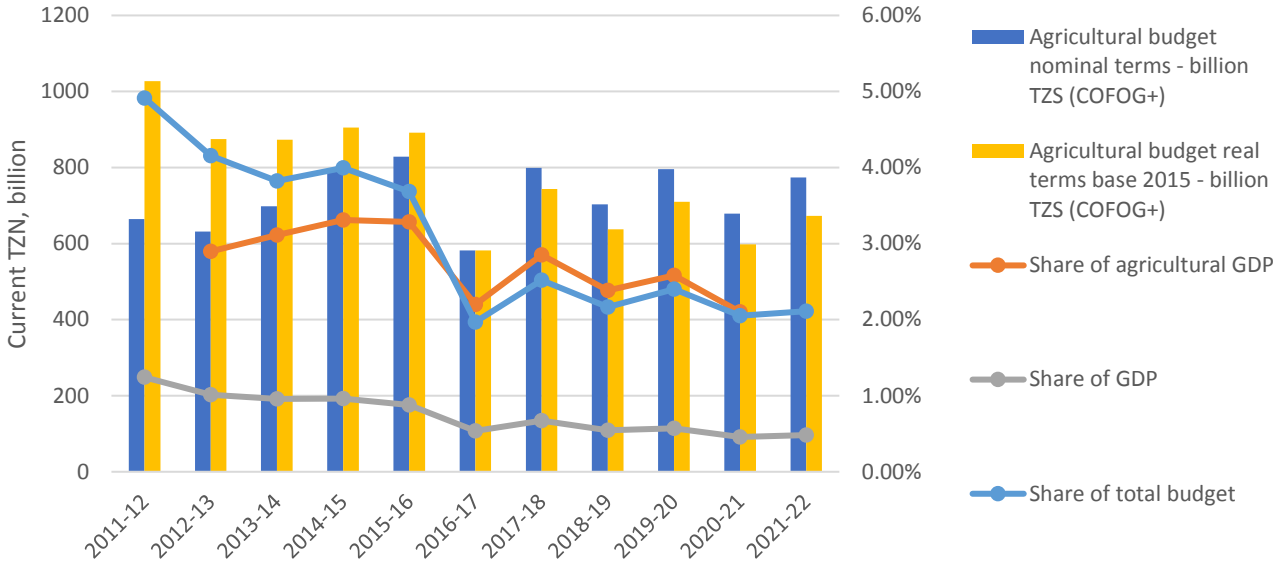
34. **Since 2017/18, the budget for agriculture has varied around the average value of 750 TZS billion (US$ 320 million) in nominal terms.** As Figure 6 shows and table 1 details, the budget for agriculture (including livestock, fishery and forestry) was on an upward trend over 2011/12-2015/16 (increase of 5.2 percent) before plummeting in 2016/17 (-29.8 percent) and rebounding in 2017/18. Since then, it has varied around the mean of 750 TZS billion, with an average increase of 0.12 percent over the past five years. It amounted to 703.2 TZS billion in 2018/19, 795.3 TZS billion in 2019/20, 679 TZS billion in 2020/21 and 774.1 TZS billion in 2020/21.

35. **As a share of GDP, Tanzania's agricultural budget sharply declined between 2011/12 and 2016/17, stabilizing since then at a low 0.5 percent of GDP**. While the budget for the agriculture sector represented 1.24 percent of GDP in 2011/12, it decreased to reach 0.54 percent in 2016/17, decreasing further to 0.46 percent in 2020/21 (0.48 percent for 2021/2022, IMF projections). After a fast decrease in the first half of the decade, decline slowed over the second half (Figure 6).

36. **With agriculture getting 2.25 percent of the national budget over 2017/18-2021/22, ASDPII is underfunded**. Measured as a share of national budget, the cut in the agricultural budget appears drastic, reflecting a switch in policy priorities: it went from 4.91 percent of the national budget in 2011/12 to 1.97 percent in 2016/2017, and then averaged 2.25 percent until 2021/22 (Figure 6, Table 1). This level appears very low compared to regional peers. Over 2015-2018, Pernechele *et al.* (2021) found that Tanzania rated 12th out of the 13 Sub-Saharan countries[2] they analyzed in terms of budget allocation to agriculture. With the current allocation, ASDP II, Tanzania's main framework for agricultural investments over 2018-2028, had only received by 2020 15 percent of its planned allocation for the first five years.

[2] Benin, Burkina Faso, Burundi, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Rwanda, Senegal, Uganda, Tanzania

Figure 6 - Compared evolutions of agricultural budget in nominal and real terms (left axis) and shares of GDP, agricultural GDP and national budget (right axis) from FY 2011/12 to FY 2021-22



Source: authors own elaboration. Agricultural budget data: FAO (2018) for FY2011/12-2016/17, original PER data for 2017/18- 2021/22. GDP and ag. GDP: Bank of Tanzania 2010-2020; IMF estimates for 2021-2022. National budget: Budget Books and MoF (Citizens Budget)

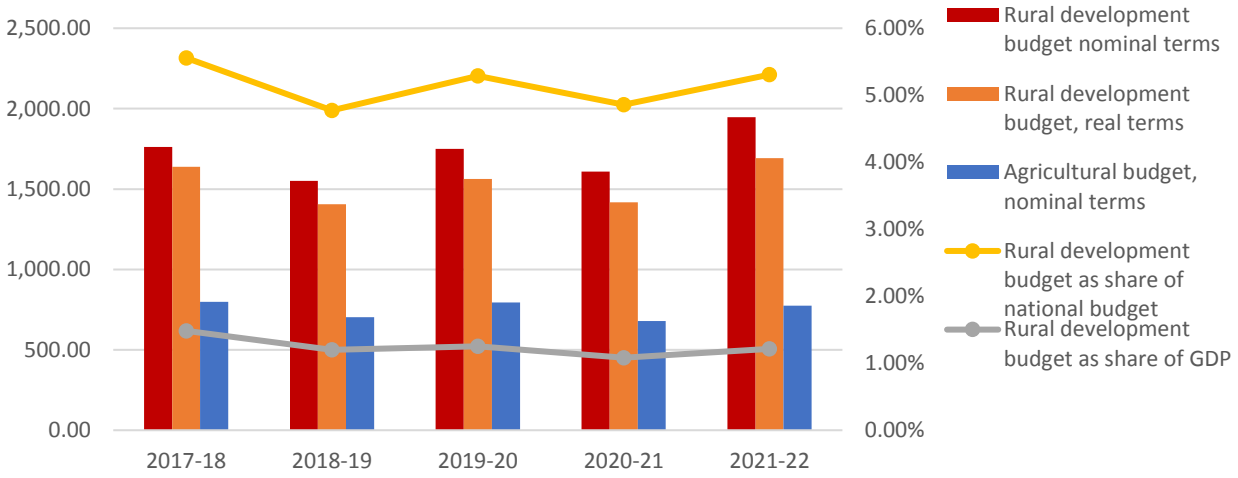
Table 1- Evolution of Tanzania's agricultural budget from 2011/12 to 2021/22 (estimates for 2020/21 and 2021/2022)

	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	*2021/22**
Agricultural budget (current TZS, billion) (cofog+)	631.4	697.7	792.9	828.8	581.7	799.0	703.2	795.3	*679.0*	*774.1*
Evolution	-5.0%	10.5%	13.6%	4.5%	-29.8%	37.4%	-12.0%	13.1%	*-14.6%*	14.0%
Agricultural budget (constant 2015 TZS, billion) (cofog+)	874.9	873.0	904.7	891.7	581.7	743.4	637.5	709.9	*597.8*	*672.9*
Evolution	-14.8%	-0.2%	3.6%	-1.4%	-34.8%	27.8%	-14.2%	11.3%	*-15.8%*	12.6%
Share of GDP	1.01%	0.96%	0.96%	0.88%	0.54%	0.67%	0.54%	0.57%	*0.46%*	*0.48%*
Share of agricultural GDP	2.90%	3.11%	3.31%	3.28%	2.20%	2.85%	2.38%	2.58%	*2.10%*	
Share of national budget	4.16%	3.82%	3.99%	3.68%	1.97%	2.52%	2.17%	2.40%	*2.05%*	*2.11%*
Extended Agricultural budget (current tZS, billion) (MAFAP)						1,761.60	1,550.42	1,750.73	*1,607.7*	*1,947.7*

Source: Authors. Agricultural budget data: FAO (2018) for FY2011/12 to FY2016/17, original PER data for FY2017/18 to FY 2021/22. GDP and agricultural GDP: Bank of Tanzania 2010-2020; IMF estimates for 2021-2022. National budget: Budget Books and MoF (Citizens Budget)

37. **Support to rural development, while still volatile, overall stagnated at about 1.2 percent of GDP and 5.2 percent of total budget over 2017/18-2021/22**. Rural development budget encompasses agriculture-specific budget (COFOG+) as well as budget not directly targeting agriculture and food to support broad development of the sector (MAFAP definition). It includes rural water and sanitation, rural health, rural education, rural roads, and rural energy (see Annex 1). Budget to rural development increased by 10.6 percent between 2017/18 and 2021/22 in nominal terms (3.3 percent in real terms) to reach an estimated 1,948.6 TZS billion in 2021/22 (USD million 843.1) (Figure 7). As a share of total budget, it decreased from 5.6 percent in 2017/18 to 5.3 percent in 2021/22, and averaged 5.2 percent over the period. As a share of GDP, the budget for rural development averaged 1.2 percent over the period.

Figure 7 - Evolution of agricultural and rural development budgets



Source: Authors. Original PER data for FY2017/18 to FY 2021/22; GDP: Bank of Tanzania 2017-2020; IMF estimates for 2021-2022. National budget: Budget Books

2.3 Agriculture budget and expenditures by levels and agencies

38. **The agriculture sector in Tanzania is serviced by many actors, including about 15 Agriculture Sector Line Ministries (ASLMs), departments, and agencies.** The agriculture budget encompasses entire budgets for (i) two main ministries—the Ministry of Agriculture (MoA) (including the Tanzania Cooperative Development Commission (TCDC), the National Irrigation Commission (NIRC) and the Agriculture Seed Agency (ASA)) and Ministry of Livestock Development and Fisheries (MLDF); and (ii) small shares of the budgets for the Ministry of Industry and Trade (MIT), the Prime Minister Office (PMO), President's Office – Regional Administration and Local Governments (PO-RALG), Regions, LGAs, and a few others ministries.

39. **Under the Government's Decentralization by Devolution (D-by-D) policy, LGAs play an important role in the delivery of social services including agriculture services.** LGAs implement a large portion of agriculture development activities based on District Agricultural Development Plans (DADPs). LGAs employ extension officers (crop and livestock) with no clear line of command with the Ministry of Agriculture and the Ministry of Livestock and Fisheries. In line with the D-by-D policy adopted in 1999, agriculture project implementation (including provision of extension services) takes place at the LGA level, where 75 percent of the sector budget is allocated. ASLMs at the central level are responsible for sector policies, coordination, and backstopping LGA project implementation, utilizing the remaining 25 percent

of the sector budget. Regions are part of the central Government, and they are responsible for backstopping LGAs and coordination at the local level. The PMO is responsible for coordinating ASLMs at the central level and hosts the national coordination team for ASDP II. Crop research is the responsibility of the semi-autonomous Tanzania Agriculture Research Institute (TARI), Livestock research is the responsibility of Tanzania Livestock Research Institute (TALIRI), and fishery research is the responsibility of the Tanzania Fishery Research Institute (TAFIRI). The mandate for rural roads rest with the recently formed Tanzania Rural Roads Agency (TARURA).

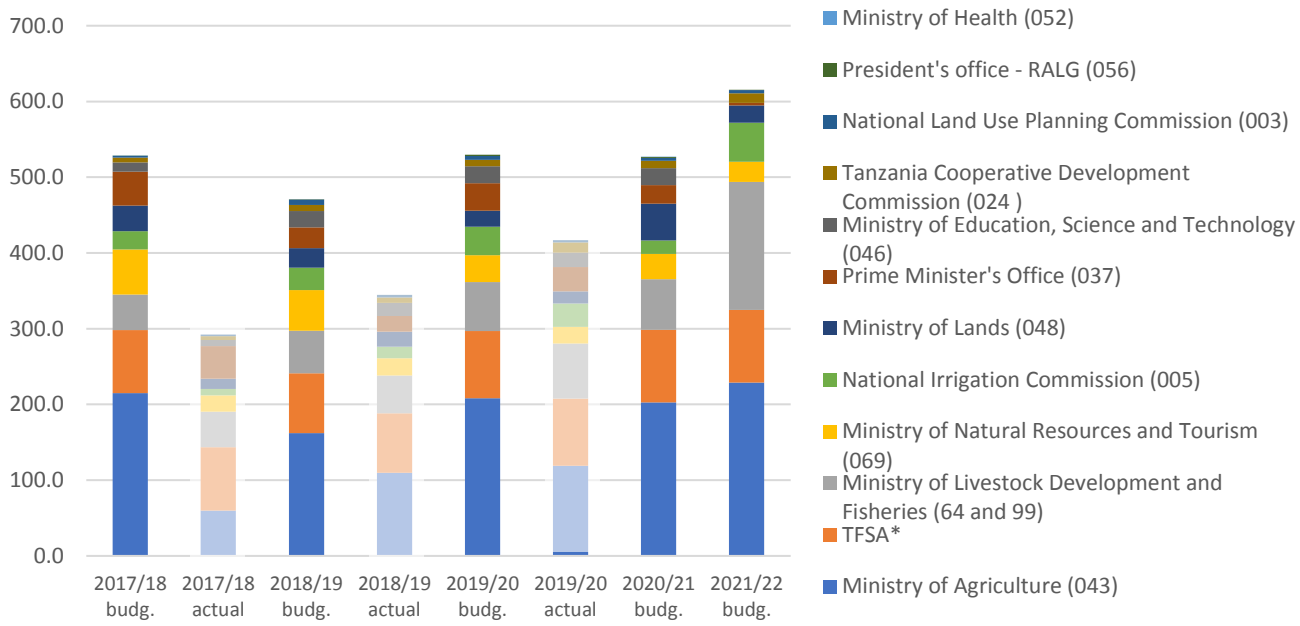
40. Over 2017/18-2021/22, about three-quarters of the agriculture budget was allocated at the central level and one-quarter at the local level. Allocation to the central level was about 70 percent of the agriculture budget, increasing to about 80 percent for 2020/21-2021/22. The evolution is likely driven by underestimation LGA budgets over these two years as a result of not accounting for own financing.

41. **At the central level, the agricultural budget a large array of ministries and agencies share the budget, with the Ministry of Agriculture the largest recipient (37 percent)**. Fourteen ministries and agencies received budget that directly contributes to the agriculture, fishery, and forestry sectors (COFOG+). Figure 8 illustrates budget allocation, actual expenditures, and evolution per agency. Table 2 presents key data for the five main recipients. The largest recipients were, by decreasing order of budget importance:

- **Ministry of Agriculture** (36.5 percent over 2017/18-2021/22): MoA's allocation collapsed by a quarter in 2018/19. Since then, it has been on an upward trend and reached 202 TZS billion in 2020/21 (228 in 2021/22), with actual expenditures of 129 TZS billion.
- **Tanzania Forest Service Agency** (15.9 percent): This semi-autonomous agency is not funded by the general budget—thus does not appear in Budget books—but by the Tanzania Forest Fund (TaFF), a Public Conservation Trust Fund with income mostly stemming from different levies. We did not access its actual expenditures.
- **Ministry of Livestock and Fisheries** (14.5 percent): After a steady increase over 2017/18-2020/21, MoLF's allocation nearly tripled in 2021/22. The jump is mostly driven by the earmarked budget for construction of a modern fishing port in Kilwa District, Lindi region, as part of efforts to promote the fishing sector in the country.
- **Ministry of Natural Resources and Tourism** (7.5 percent): Agricultural budget is allocated to forestry and beekeeping subsector through this ministry, which adds to TFSA and has been eroding over the period.
- **National Irrigation Commission** (5.8 percent): see chapter 5 on the irrigation sector.
- **Ministry of Lands, Housing, and Human Settlements Development** (5.4 percent): Allocation to the Land administration division.
- **Prime Minister's Office** (4.9 percent): Allocation to the agriculture sector concerns sectoral coordination or transversal programs, such as for market infrastructure and value addition or early warning systems. It collapsed over the period.
- **Ministry of Industry and Trade** (4.0 percent): Allocation to the Commodity Market Development Division.
- **Ministry of Education, Science and Technology** (2.8 percent): Allocation to school feeding programs (for secondary schools only). Funding stopped in 2021/22.
- **Tanzania Cooperative Development Commission** (1.6 percent).
- **National Land Use Planning Commission** (0.8 percent).

- **President's office** - Regional Administration and Local Government Authorities (0.1 percent): Allocation to sector coordination, in particular to ASDPII coordination. It did not record any actual expenditures in Budget Books over the period.
- **Ministry of Health, Community Development, Gender, Elderly and Children**: Erratic allocation to Nutrition centers, without any actual expenditures over the period.

Figure 8 - Agricultural budget and actual (light color) expenditures per recipient in TZS billion



*Source: Authors. Data: Budget Books and agricultural PER data. *Note: TFSA actual expenditures are not available.*

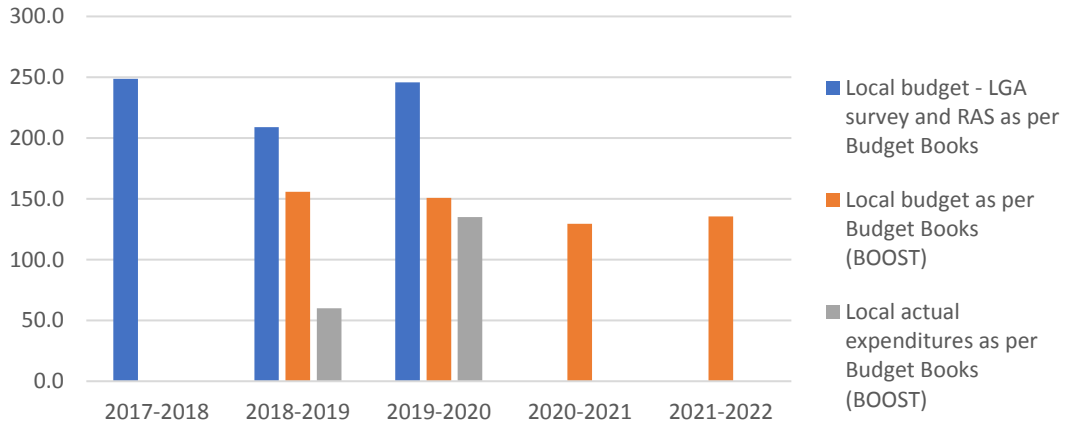
42. **At the local level, agricultural budget mostly goes to the 184 Local Government Authorities (98 percent), with the 26 Regional Secretariats receiving about 2 percent of the budget**. LGAs receive allocation for the agriculture sector from the central level, but also raise their own income through variable levies and taxations. Data thus significantly differs between budget as per official Budget Books (BOOST data, not available for 2017/18) and as directly reported by LGAs for the purpose of this PER (survey for the 2017/2018-2019/20 period), as Figure 9 shows.

Table 2 - Agricultural budget and actual expenditures of four main recipients in TZS billion

	2017/18	2018/19	2019/20	2020/21	2021/22*	Total	*% total*
MINISTRY OF AGRICULTURE (043)							
budgeted	214.8	162.2	208.0	202.5	228.9	214.8	*36.5%*
% change		*-24.5%*	*28.2%*	*-2.7%*	*13.0%*		
actual	*60.1*	*109.6*	*119.1*				
execution rate	*28%*	*68%*	*57%*				
TFSA*							
budgeted	83.5	78.8	88.8	95.9	*95.9**	83.5	*15.9%*
% change		*-5.6%*	*12.7%*	*8.0%*	*0.0%*		
actual	n.a.	n.a	n.a	n.a	n.a		
MINISTRY OF LIVESTOCK DEVELOPMENT AND FISHERIES (64 AND 99)							
budgeted	46.8	56.5	64.9	66.8	169.2	46.8	*14.5%*
% change		*20.7%*	*15.0%*	*3.0%*	*153.2%*		
actual	47.0	49.8	72.4				
execution rate	100%	*88%*	*111%*				
MINISTRY OF NATURAL RESOURCES AND TOURISM (069)							
budgeted	59.6	53.4	35.3	33.6	26.5	59.6	*7.5%*
% change		*-10.4%*	*-33.9%*	*-4.8%*	*-21.2%*		
actual	21.5	22.8	22.2				
execution rate	36%	*43%*	*63%*				
TOTAL BUDGETED (ALL RECIPIENTS)	550.3	494.1	549.5	549.4	638.5	2,781.8	
TOTAL ACTUAL (ALL RECIPIENTS)	317.2	373.4	447.2				

*Source: Authors. Data: Budget Books and original agricultural PER data. *Assumed in absence of data.*

Figure 9 - Evolution of local agricultural budget and expenditures in TZS billion (nominal terms) from 2017/18 to 2021/22 according to Budget Books and to LGAs survey

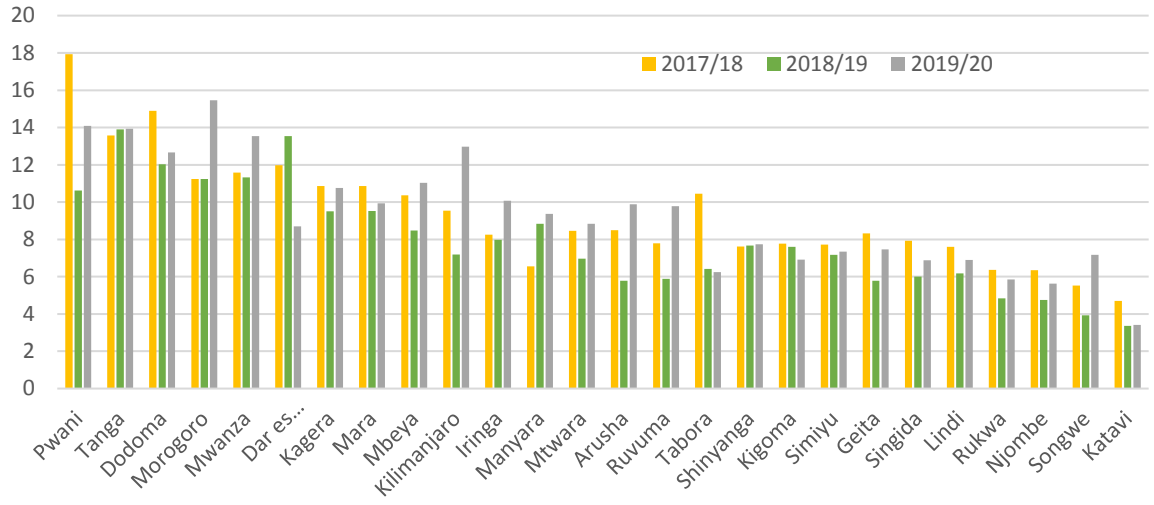


Source: authors' own elaboration. Data Budget Books and PER LGA survey data.

43. **LGA's self-reported budget varies notably: the budget of the five largest recipients (Pwani, Tanga, Dodoma, Morogoro, and Mwanza) represents 29 percent of the total** (Figures 10 and 11). These

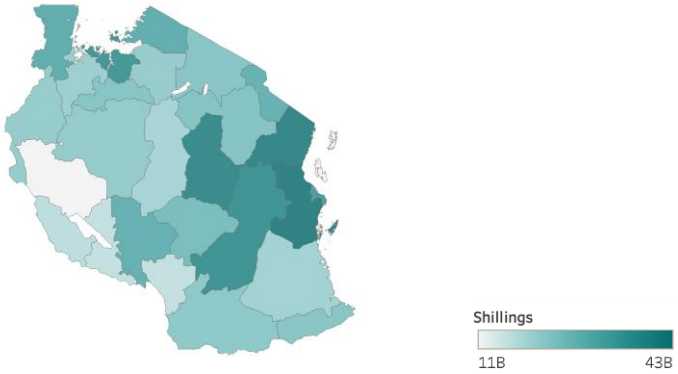
regions respectively declared an agricultural budget of 6.2 percent, 6.0 percent, 5.7 percent, 5.5 percent, and 5.3 percent of the national agricultural local budget over 2017/18-2019/20. At the other end of the spectrum, Rukwa, Njombe, Songwe, and Katavi all receive less than 3 percent of the total.

Figure 10 - Distribution of agricultural budget (COFOG+) per Region in TZS billion (nominal terms) from 2017/18 to 2019/20



Source: authors' own elaboration. Data: PER LGAs survey data

Figure 11 - Map of agricultural budget in TZS billion allocated over 2017/18-2019/20



Source: authors' own elaboration. Data: PER LGAs survey data

2.4 Composition of agriculture spending

44. **Composition of agricultural public expenditure matters as much as the amount spent.** Consistent with international good practices, this section breaks it down by economic classification and functional classification.

45. **Tight budgets leave little fiscal space for development expenditures, and nearly two-thirds of actual central agricultural expenditures were recurrent.** Overall, during 2017/18-2020/21, recurrent expenditures represented 62 percent of actual expenditures of central agencies. Typically, recurrent

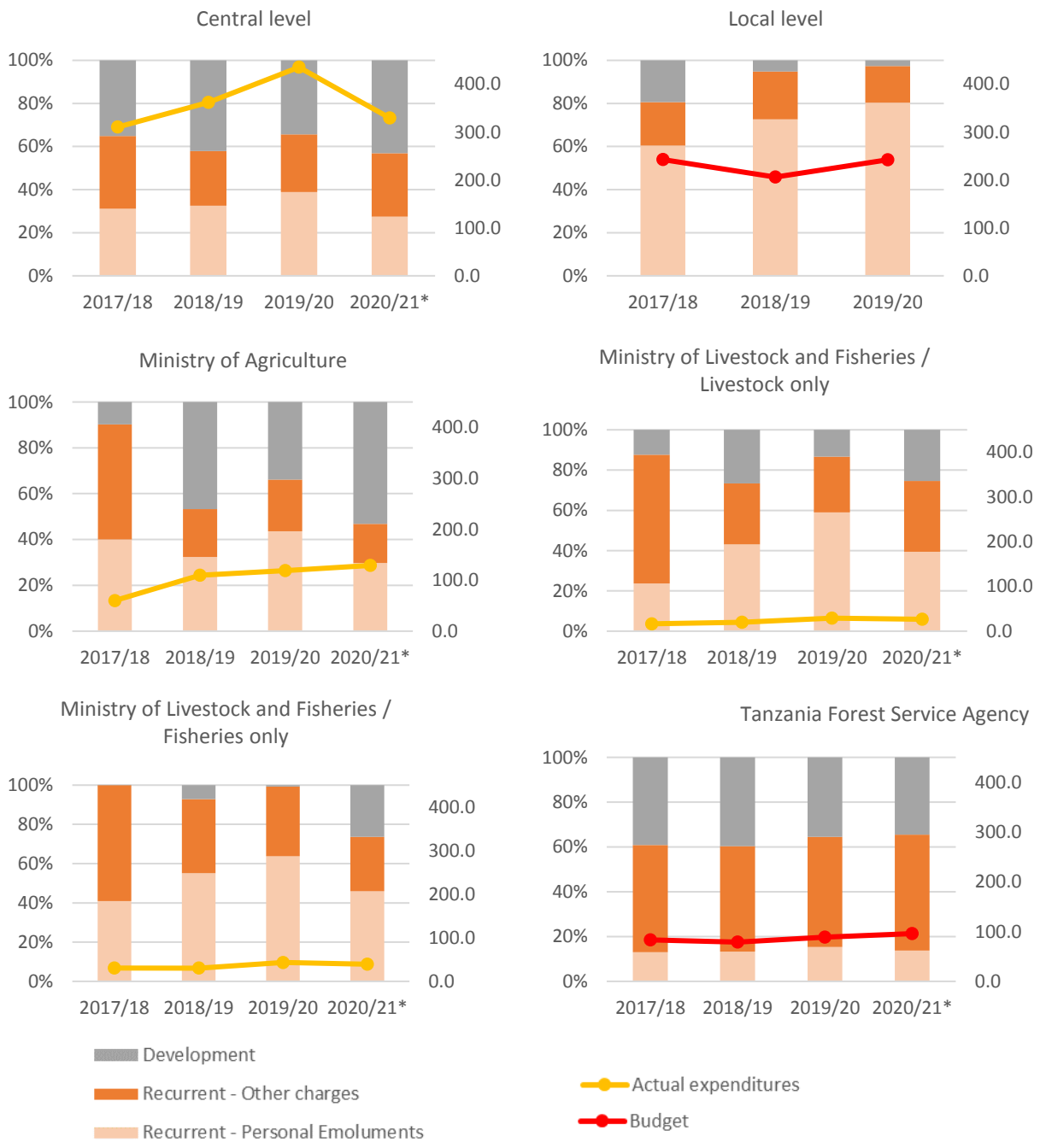
expenditures fuel vital activities for the central agencies, but do not support the growth of the sector and of its productive assets. Spending varies by ministry, as Figure 12 shows, reaching 87 percent for the Ministry of Livestock and Fisheries.

46. **At the central level, recurrent expenditures included overall 54 percent of personal emoluments (wages and salaries) and 46 percent of other charges**. As Figure 12 shows, personal emoluments represent 20 percent and 33 percent of actual expenditures of MoA and MLDF. Other charges essentially encompass Goods and Services, Grants to other units, Wages and Salaries (not classified in Personal emoluments) and Fixed Assets. Grants to other units (classified either in recurrent or development expenditures) represent respectively 51 percent and 26 percent of MoA and MLDF's budget. Indeed, many agencies receive funding from these ministries, most of them depending on both ministries' allocations and self-raised funds (see chapter 5 on seeds, for instance).

47. **Development expenditures considerably increased over the period for the Ministry of Agriculture (MOA) and the Ministry of Livestock Development and Fisheries (MLDF)**. Additional resources targeted development of the sector. The Ministry of agricultural spent 69 TZS billion (nominal) on development expenditures in 2020/21, compared to 6 TZS billion in 2017/18. Similarly, the MLDF witnessed a massive growth in development expenditures from 2 TZS billion 2017/18 to 29 TZS billion in 2020/21 (Figure 12), mostly driven by fishing investments.

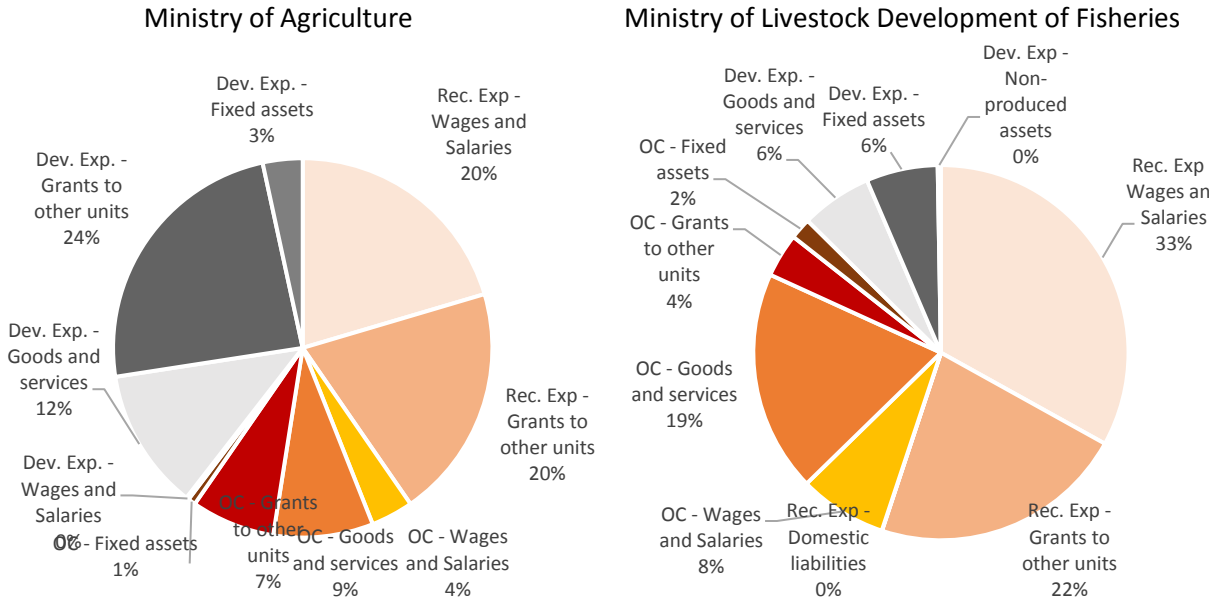
48. **Conversely, development expenditures collapsed at the local level over the period. The share of wages increased to reach 80 percent of local agricultural budget in 2019/20**. While LGAs reported a variable budget over 2017/18-2019/20, the share of development expenditures decreased from a low 19 percent in 2017/19 to 2 percent in 2020/21 (Figure 12, top right). During 2017/18, most LGAs planned for development activities financed through ASDP II funds. However, those funds were not transferred, and budgets were corrected accordingly. The current share of recurrent versus development expenditures reflects changes in distribution of roles and responsibilities between central and local levels, with more responsibilities taken up at the central level. Personal emoluments, which already constituted 60 percent of local government budgets in 2017/18, increased to reach 80 percent in 2019/20. This strikingly high share is equivalent to wage increases the 2020 Tanzania Health sector PER (World Bank).

Figure 12 - Detailed economic composition of agricultural actual expenditures and budget at central and local levels and per main recipient (share left axis; value in nominal terms in TZS billion right axis)



*Source: authors's own elaboration. Data Budget Books, TFSA and PER LGA survey data. *Notes: 2021/22 TFSA allocation is estimated by authors. 2020/21 Actual expenditures are underestimated due to uncomplete data classification in Budget Books.*

Figure 13 - composition of actual recurrent expenditures (Rec. Exp), other charges (OC) and development expenditures (OC) of MoA and MLDF over 2017/18-2020/21



Source: authors's own elaboration. Data Budget Books.

2.5 Functional composition of agriculture budget

49. **Over 2017/18-2019/20, administration drew an estimated 30 percent of the budget.** Overestimation is likely due to lack of disaggregation of the data provided by most agricultural implementing agencies (ministries, commissions, regional secretariats, and local authorities). For example, personal emoluments (PEs) were often aggregated into "Administration" rather than detailed by specific function.

50. **Administration costs aside, agriculture supportive expenditure is defined as spending which falls in two broad categories: producer support and general services support.** Producer support comprises private transfers where the agricultural producer is the direct and final beneficiary, using mechanisms that include input/output subsidies and income support. General services support, on the other hand, does not create direct transfers for private agents but instead aims to create an enabling environment for the sector through creation of public goods and services, such as research and extension, marketing, and infrastructure development.

51. **The wide majority of Tanzanian agriculture support is categorized as general support to finance public goods for the sector**. Figure 14 shows the average allocation of agriculture supportive expenditure across producer support and general support over 2017/18-2019/20. Agricultural extension is the primary mechanism, representing 18 percent of agriculture support spending. This is followed by spending on forestry, with the majority of funding channeled through the Tanzania Forest Services Agency (TFSA) for establishing wood plantations, productive logging, and managing forests[3]. Agricultural infrastructure was another important spending category, primarily comprising construction and rehabilitation of irrigation

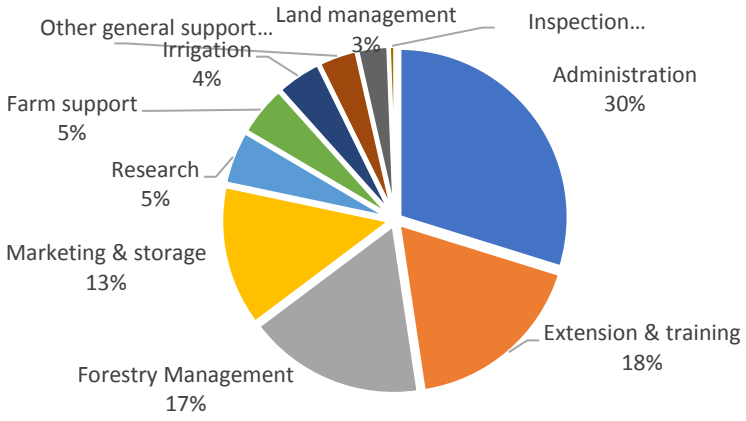
[3] TFSA is also in charge of managing forest ecosystems and their services. The budget for this mission that does not pertain to agriculture has been excluded here.

systems to improve sector productivity and resilience. Spending under storage was also closely linked with infrastructure as spending mostly consisted of supply, construction, installation, and rehabilitation of silo complexes and warehouses. Expenditure under marketing was focused on building market linkages between farmers and other actors in value chains and supporting cooperatives to reduce market access costs. Other general support included spending on public services such as land surveys, registries, and project monitoring and evaluation.

52. **While producer support only represents 5 percent of budgetary transfers, they mostly consist of distortive input subsides**. Over 2017/18-2019/20, MoA procured agrochemicals to control fall armyworms and desert locust invasions and outbreaks, and supported seeds and seedlings for targeted commodities (see section 4.1). Such input subsidies alter marginal returns, which alters production decisions. Alternative support mechanisms, such as income payments, are much less distortive as they do not directly stimulate input use or output increases. Hence, repurposing this support through income subsidies or input support linked to on-farm capital formation would reduce market distortions and improve the sectors' competitiveness and productivity.

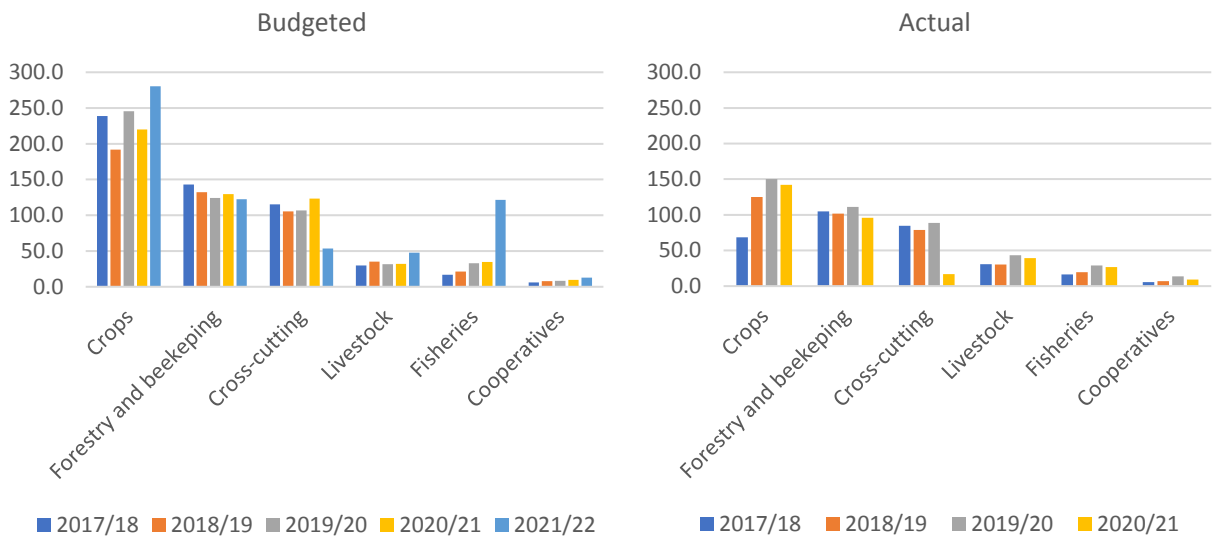
53. A breakdown per commodities highlights the crucially low allocation to the livestock sector, estimated at only 0.03 percent of GDP over 2017/18-2021/22, while it contributes to 7.4 percent of GDP. The livestock subsector receives 6.4 percent of the agricultural budget allocation and represents 10 percent of actual expenditures. Allocation to livestock thus represents 0.03 percent of the GDP over the period. The crop sub-sector receives the largest share of agricultural budget (42 percent over 2017/18-201/22), at both the central and local levels. It also suffers the lowest budget execution (54 percent), representing 33.8 percent of actual expenditures (Figure 15). Section 4.1 and Annex 2 detail how government incentives and market conditions affect prices that farmers receive beyond direct allocations. Comparatively, the forestry sub-sector, which contributed 1.8 percent of GDP in 2019 (World Development Indicators, 2022), receives a high allocation (23.4 percent of budget and 28.8 percent of actual). Essentially targeted to the Tanzania Forest Service Agency (TFSA), this budget also includes revenues the Agency raises through levies and forest product sales. This allocation corresponds to a TFSA development phase to invest wood plantation capital for long-term commercial logging in Tanzania.

Figure 14 -Functional composition of budgetary transfers to agriculture (average 2017/18-2019/20)



Source: Authors. Data: PER database.

Figure 15 - Composition of agricultural budget and actual expenditures by commodities category over 2017/18-2021/22



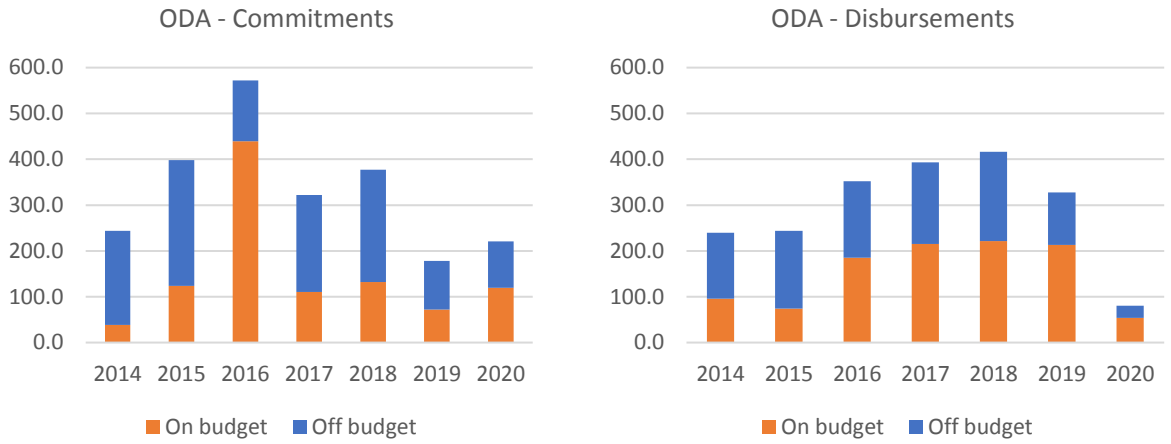
Source: authors' elaboration. Data: Budget Books.

2.6 Funding sources of public expenditures in agriculture

54. **Donors' disbursements averaged 87 percent of public expenditures from 2017 to 2020.** According to OECD-CRS data (self-declared by donors), ODA commitments amounted to 1,098 TZS billion in nominal terms over 2017 to 2021, 37 percent of the agricultural budget. These commitments include both on-budget (433 TZS billion, 15 percent of agricultural budget) and off-budget (665 TZS billion, 22 percent). However, ODA disbursements over 2017-2020 amounted to 1,137 TZS billion, representing 87 percent of agricultural actual expenditures over the same period. Off-budget financial flows amounted to 50 percent of actual expenditures and on-budget to 37 percent.

55. **The overall level of foreign aid (on- and off- budget) has been rapidly decreasing since 2016.** Large commitments to the agricultural budget from international donors accompanied ASDP II implementation in 2016. As Figure 16 shows, they more than tripled the on-budget commitment level of 2015/16's 124 TZS billion to reach 440 TZS billion in nominal terms (US$ 201 million) (OECD CRS), at the expense of off-budget commitments. The African Development Bank (AfDB), the World Bank, Poland, and the United States were among the largest contributors. The following years, on-budget commitments shrank back to pre-ASDP II levels, with exception of 2018/19 which witnessed a significant shortfall (72 TZS billion). The 2016/17 high levels of commitments nonetheless allowed fairly stable disbursements over 2016/17-2019/20 compared to previous years.

Figure 16 - Evolution of Official Development Aid commitments and disbursements to Tanzania's agriculture, forestry and fishery sector over 2014-2020 (TSZ billion)



Source: authors' computation. Data: OECD-CRS (2022)

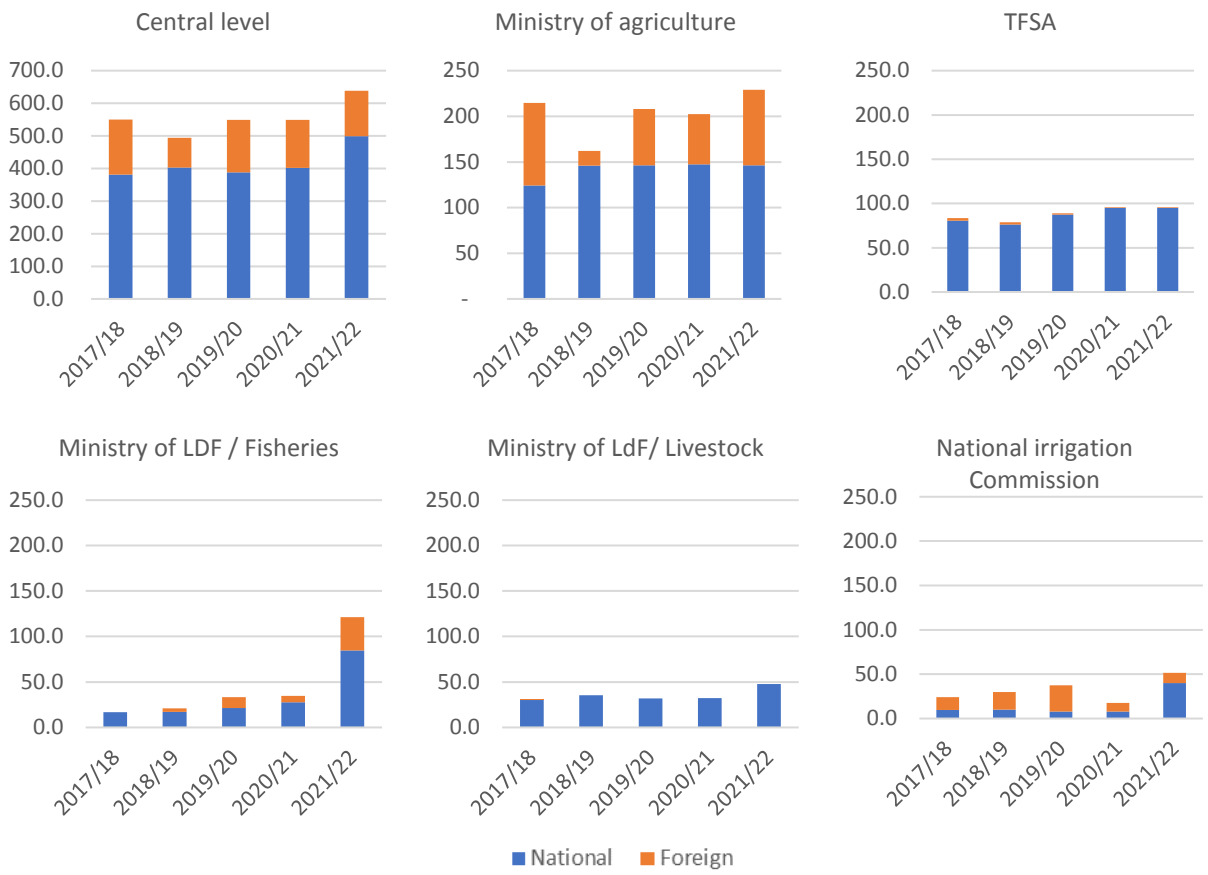
56. **Focusing on on-budget foreign funding, 19 percent of the agricultural budget depended on donors' support over 2017-2022 (Budget books)**. OECD-CRS data (self-reported by donors) leads to a smaller share of 15 percent. As Figure 17 shows, funding varies significantly by recipient. The National Irrigation Commission is the only agency that received more donor funding (53 percent over the period) than funding within Tanzania (47 percent). Over 2017-2022, 30 percent of the MOA budget depended on foreign funding, as did 26 percent of the MLFD's fisheries activity, and only 2 percent of TFSA's. The MLFD's livestock activity did not receive any foreign support.

57. **While scaling down of international donor support explains the 2018/19 drop in agricultural budget, the 2021/22 raise is due to increased national funding**. The share of donor resources in the agricultural budget sharply fell from 31 percent in 2017/18 (169 TZS billion nominal terms) to 18 percent in 2018/19 (96 TZS billion), explaining the overall budget drop that year. The following year, donors' on-budget funding nearly reached its previous level (162 TZS billion) and has slowly been eroding since to reach 139 TZS billion in 2021/22. The overall increase of agricultural budget in 2020/21 comes from a jump in national funding from 402 TZS billion to 499 TZS billion. It is explained by the 80 TZS billion earmarked for construction of a fishing harbor, as well as increased national funding for livestock and the Irrigation Commission. Similarly, the increase in the Ministry of Agriculture budget in 2023 comes from domestic resources.

58. **Poland, the World Bank, AfDB, and IFAD are the main donors supporting agricultural budget (on budget) since 2017/18**. According to BOOST data, Poland contributed 43 percent of foreign support to the agricultural budget over 2017-22, Tanzania being among its five priority African countries for foreign aid. Its support essentially went to food storage infrastructure and water management projects. The World Bank is the second contributor at 18 percent of foreign support to the agricultural budget, mostly due to the Expanded Rice Production Project (ERPP). The AfDB also contributes 16 percent, but largely to the Tanzania Initiative for Preventing Aflatoxin Contagion. IFAD contributed 10 percent to support the Agricultural and Fisheries Development Programme.

59. **The MOA budget varied depending on donor commitments**. Figure 17 shows that after an increase from 124 TZS billion (nominal terms) in 2017/18 to 146 TZS billion in 2018/19, national MOA allocation remained stable until 2021/22.

Figure 17 - Distribution of budget funded with national resources (orange) and with donors' support (blue) over 2017/18-2021/22 at central level and for main recipients



Source: authors's own computation. Data: Budget Books and TFSA. Note: Data for TFSA for 2021/22 is projected by authors.

60. **Funding Tanzania's agricultural sector is heavily dependent on off-budget support by development partners**. According to OECD-CRS data (self-reported by donors), off-budget financial flows over 2017-2020 represented half of agricultural public expenditure over the period.

61. **Apart from foreign aid, self-raised resources represent another important source of public funding for agricultural agencies and LGAs.** As observed in other sectors (such as Health, World Bank 2020), own source revenues could potentially play a significant role for already substantial LGAs operational funding. Own source revenues are locally-generated from LGAs-levied taxes, fees, and charges. Data could not be directly collected on agricultural own income, but the gap between Budget Books and LGA survey data suggest that own sources could represent up to one-third of central allocation to LGAs.

3 Budget Process and Performance

3.1 Budget process

62. **Over the past two decades, Tanzania has implemented several phases of Public Sector Financial Management reforms to improve fiscal discipline**. These were implemented concurrently with public service management reforms, under the auspices of New Public Management with the objectives to reduce fiscal deficits and improve efficiency, accountability, and service delivery. Through these reforms, Tanzania adopted performance budgeting, cash budgeting, and use of Medium-Term Expenditure Framework (MTEF) in its budget process.

63. **The budgeting process involves four main stages: (i) formulation, (ii) proposals and dialogue, (III) execution, and (iv) budget monitoring, evaluation and control**. Budget formulation starts in November each year with plan and budget guidelines prepared and issued to guide financial resource mobilization and allocation for implementation of the Annual Development Plan and Budget per socio-economic development goals and objective, as stipulated in the FYDP III and institutional strategic plans. Plan and budget guidelines guide MDAs, Regional Secretariats, LGAs, and Public Institutions and Statutory Corporations (PISCs) to prepare plans and budget for the year. Guidelines includes areas of priority for each sector and budget ceilings for the year for each institution, according to the resource envelope generated from tax and non-tax revenue sources, grants, and domestic and foreign loans. MDAs submit their draft budgets to the Ministry of Finance and Planning (MOFP), while LGAs and Regional Secretariats submit to PO-RALG. PISCs submit to the Office of the Treasury Registrar by early February for scrutiny and further dialogue with stakeholders.

64. **Planning guidelines emphasize budget allocation to prioritize national projects and strategic cross cutting issues.** For agriculture, in addition to focus of farmers' incomes, productivity, and national food security, MDAs priorities are to: (i) allocate adequate resources for nutrition interventions as enshrined in the National Multi-sectoral Nutrition Action Plan (NMNAP II) 2021-2026, (ii) incorporate environment and climate change priorities in accordance with the Environmental Management Act 2004, and the National Climate Change Strategy.

65. **LGAs are required to allocate 40 to 60 percent of their own-source revenue to development activities that generate revenue (such as agriculture).** LGAs are requested to invest at least 20 percent of their budget into agriculture**.** Other priority areas for LGAs involve allocating 10 percent of their revenues to youth (4 percent), women (4 percent), and people with disabilities (2 percent). LGAs are also required to strengthen production of existing food and cash crops and introduce new crops to diversify risks and facilitate agro-processing industries for value addition.

66. **The MOFP facilitates technical scrutinization of Medium-Term Expenditure Frameworks.** It consolidates budget estimates for submission to their respective Parliamentary Sectoral Standing Committee from the third week of March to the first week of April, for policy prioritization scrutiny and recommendations for adjustment and improvement. The parliamentary committee for Agriculture, Water and Livestock is responsible for scrutinizing the agriculture budget before submission to parliament. Thereafter, consolidated budget estimates are submitted to the Parliament for deliberation and approval from by mid-April to June. Budget execution commences on 1st July and ends on 30th June of each year.

67. **Budget monitoring, evaluation, and control takes place throughout the year**. MDAs and LGAs are required to submit quarterly progress reports to the MOFP within 30 days after the end of each quarter. In addition, they are required to submit Annual Performance Reports not later than 15 October

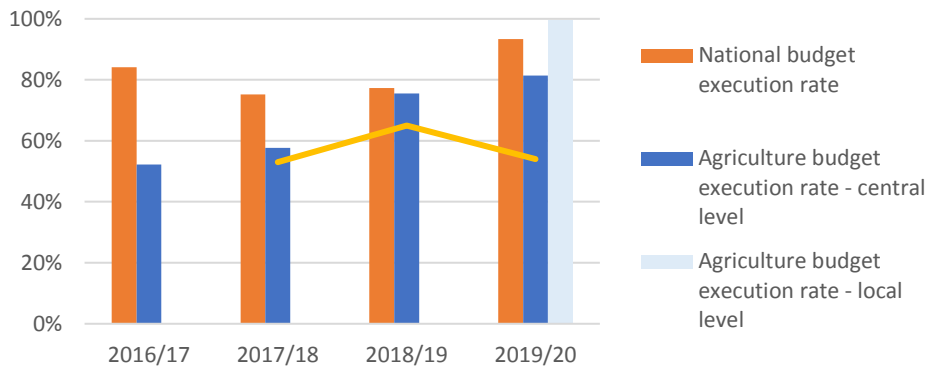
after the end of the financial year. Successful implementation of Plans and Budgets depends on the effectiveness of monitoring, evaluation and reporting systems in place.

3.2 Budget execution

68. **This section analyzes budget outturn and execution rates for 2017-2020.** *Execution rate* is here defined as the percentage of the approved budget for agriculture actually executed, calculated based on BOOST data (Budget Books). The analysis excludes 2020/21 as data was incomplete. Budget execution closely depends on budget outturn, here defined as the percentage of funds released by the Ministry of Finance to agricultural agencies (ministries, LGAs, among others.) over funds that have been committed to the sector (approved budgets). *Budget outturn* estimates come from data directly collected from the Ministry or agency.

69. **Agriculture budget execution has been rapidly improving over the period but remains below overall budget execution**. Figure 18 shows that the agriculture execution rate increased from 52 percent in 2016/17 to 83 percent in 2019/20. While it lagged overall budget execution in 2016/17, the gap reduced the following year. Table 3 shows that the agriculture execution rate still compares poorly to sectors such as Health or Education, which have improved budget execution over the period.

Figure 18 - Compared evolution of budget execution rates and budget outturn over 2016/17-2019/20



Source: Budget Books for execution rates; PER data 2017/18-2019/20 for budget outturn

Table 3 - Benchmark of budget execution rates in 2016/17 and 2019/20

Sector	Total		Recurrent		Development	
	2016/17	2019/20	2016/17	2019/20	2016/17	2019/20
Agriculture	52%	83%	94%	117%	8%	33%
Education	45%	110%	98%	121%	14%	85%
Health	73%	108%	104%	124%	50%	88%
Water	31%	73%	75%	142%	25%	57%
Defense	141%	112%	161%	114%	2%	70%

Source: Authors. Data: Budget Books

70. **Low budget outturns cause high execution rates.** Implementing agencies have reported large gaps between committed resources and resources they actually received, as table 4 shows. The declared overall budget outturn was 57 percent. It was reported to be worse in irrigation (40 percent) and better in livestock (81 percent) (Table 4). Figure 18 shows that when budget outturn increased in 2018/19, the agricultural budget execution rate mechanically increased: implementing agents can only spend funds they have access to. Budget outturn is even lower in development expenditures (37 percent). A similar situation has been found in the health sector by World Bank (2020). Adverse macro-fiscal conditions partially explain low budget outturns, often following inadequate revenue projections and unforeseen spending pressures. On the revenue side, reduced foreign direct investment (FDI) between 2013 and 2017 has also dampened revenue mobilization (World Bank, 2019).

Table 4 - agriculture budget outturn for main implementing agents at central level

Vote	Title	2017	2018	2019	Total
003	National Land Use Planning Commission	88%	52%	33%	50%
005	National Irrigation Commission	40%	51%	30%	40%
024	Tanzania Cooperative Development Commission	64%	82%	87%	77%
043	Ministry of Agriculture	44%	66%	48%	52%
048	Ministry of Lands (subvote 2001)	55%	80%	56%	63%
064	Ministry of Livestock Development and Fisheries - F	23%	79%	73%	59%
069	Ministry of Natural Resources and Tourism (subvote 3	193%	17%	61%	80%
099	Ministry of Livestock Development and Fisheries - L	88%	69%	92%	81%
052	Tanzania Food and Nutrition Centre	70%	64%	83%	72%
	Total	53%	65%	54%	57%

Source: PER data 2017/18-2019/20; data directly collected from agencies

71. **Low budget outturn also explains extremely low development budget execution rates compared to high recurrent budget.** Analysis of the composition of the execution rate (Table xx) highlights that recurrent budget is usually executed in full. Recurrent budget was even over executed in 2019/20, in all sectors benchmarked in Table 3. Conversely, while the execution of development budget improved significantly over the period, it remained at a low 33 percent in 2019/20, far behind health (88 percent), education (85 percent), defense (70 percent), or water (57 percent). Low budget outturn results in insufficient funding: wages and salaries, considered priorities, are generally executed in full, and funds lack for development expenditures. However, the 2022 World Bank Economic update (2022) notes recent acceleration in capital projects implementation, with development expenditures reaching a 10-year high in 2020/21 and an execution rate for (overall budget) development expenditures reaching 96 percent. This trend still has to be assessed in agriculture.

72. **At the LGA level, insufficient agricultural allocations result in full budget execution**. Figure 18 shows that in 2019/2020, LGA executed all their budget. Section 2.3 has shown that local budget for agriculture is low and declining, resulting in a total collapse in development expenditures. The picture is somewhat more positive for rural development, as LGAs received slightly more funds in 2018/19 for rural roads through TARURA and implementation of the DART phase (construction of the Kilwa road). Despite the planned increase, execution rates have historically been low, partly due to project preparation delays, which suggests that LGA projects may face implementation challenges and will absorb a lower than projected share of public expenditures. At the same time, some LGAs face revenue constraints due to the

Government decision to centralize revenue collection, including from LGA own-sources such as property taxes, and reduction on excess produce tax rates from 5 to 3 percent of farm gate prices.

73. **Budget credibility in Tanzania is poor and has been deteriorating**. Piatti-Fünfkirchen and Ally (2020a and b) report a 15-20 percent deviation between budgeted spending and actual spending in the overall budget and notes a significant deterioration since 2010, partly due to poor revenue forecasts and underestimation of resource needs for priority sectors. Agriculture is more affected than benchmarked sectors. While budget allocations for personnel have largely been protected, development and non-wage recurrent budget have seen significant cuts during implementation. The consequences include low strategic planning; unreliable funding for implementing agencies, including at the local government level; as well as sector inefficiencies stemming from insufficient budget for operational expenditure items.

3.3 Budget governance

74. **Good budget governance adheres to key governance principles.** The OECD (2022) proposes ten principles:

(i) Closely aligning budgets with the medium-term strategic priorities of government.
(ii) Managing budgets within clear, credible and predictable limits for fiscal policy
(iii) Designing the capital budgeting framework in order to meet national development needs in a cost-effective and coherent manner.
(iv) Ensuring that budget documents and data are open, transparent and accessible.
(v) Providing for an inclusive, participative, and realistic debate on budgetary choices.
(vi) Presenting a comprehensive, accurate, and reliable account of public finances
(vii) Actively planning, managing, and monitoring budget execution.
(viii) Ensuring that performance, evaluation, and value for money are integral to the budget process.
(ix) Identifying, assessing, and managing prudently longer-term sustainability and other fiscal risks.
(x) Promoting the integrity and quality of budgetary forecasts, fiscal plans, and budgetary implementation through rigorous quality assurance including independent audit.

While this PER did not undertake a thorough assessment of sector budget governance, this section presents reflections based on these principles on the agriculture budget and processes.

75. **Systems are in place to actively plan, manage, and monitor budget execution and instill accountability and transparency.** A variety of monitoring mechanisms exist through which the Accountant General's Department controls expenditure commitments, executes payments, and generates financial reports. In addition, a poverty monitoring system reports on FYDP implementation, and a public sector performance management system tracks the implementation of departmental strategic plans. The Ministry of Finance publishes quarterly budget execution reports to maintain transparency on actual use of public funds in line with Parliament-approved budget estimates. Internal audit departments conduct internal audits within the implementing agencies. The Chief Auditor General (CAG) performs external audits for all MDAs and submits to Parliament by March 31 each year, to be tabled at the next parliamentary session.

76. **The sector budgeting process attempts to be inclusive and foster participative debate on budgetary choices, but a great deal of improvement is needed**. At the local level, the process starts with opportunities and obstacles to development (O&OD) planning at the village level, which allows a bottom-up approach for articulating community needs and aggregation of them at the ward, district, regional, and national level. However, the process is cumbersome and usually faces significant delays. At the national

level, in theory, the budget process allows for stakeholder inclusion into budget priorities dialogues, their annual contribution to the budget and proposed reforms. This was better practiced in the past under ASDP I, when the sector implemented a sector-wide program (SWAP) and basket funding. However, in recent years, implementation has not adhered to sector consultative processes as proposed in the ASDP II program, including budget consultations.

77. **Access to budget, oversight, and control documents is open, transparent, and accessible**. However, access to budget data has been a challenge in recent years. Budget planning guidelines, budget books, and quarterly budget execution reports are available on the MoFP website. Audit reports are available on the CAG's website and upon request from the CAG office. They can also be downloaded from research for poverty alleviation (REPOA) Tanzania Governance Notice board (HakiEllimu 2008). However, accessing budget data at the national level (including an aggregated view of local level budget and spending) is a challenge (refer to the methodology section).

78. **Insufficient fund releases (low outturn) causing less than the approved budget expenditures affect budget predictability and compromises credibility of the budget**. With only 33 percent of the budget development budget executed, the difference can be attributed to unrealistic government budget allocations. Budget revisions have also been common in Tanzania over the past years to reallocate funds within sectors. The original budget might not have focused on the major priorities, hence a need for reallocation to ensure that priority sectors receive adequate funds. This mismatch between budgeted and actual amounts released makes it difficult to plan and predict future policies. This calls for proper government planning before carrying out the budget process to ensure proper targeting of major priority areas.

79. **Delays in fund releases remain a concern with significant portions of development funds for MDAs usually released in the final month of the fiscal year**. This is a serious problem in the agriculture sector given the seasonal nature of agriculture activities. For example, in FY 2016/17 35 percent of development funds for MDAs were released in June (World Bank 2017). In addition to the overall under-execution, the development funds released to MDAs were considerably delayed, complicating implementation. The month of June sees a large uptick in releases of recurrent funds, amounting to 19 percent in 2016/17 (World Bank, 2017).

80. **Sector dependence on donor funding indicates lack of fiscal sustainability as there is uncertainty about the duration and timing of donor funding commitments**. Donors have tended to take increasingly longer-term view of support, but there are still time limits on donor funding commitments. The timing of donor funding is sometime less predictable, which can lead to periods of funding gaps that can add to uncertainty.

81. **Several reforms introduced improve overall budget credibility, including a new Treasury Single Account.** This includes amendment to the Public Finance Act, Local Government Finance Act, and the Bank of Tanzania Act to establish a Treasury Single Account (TSA) for collection and payment of public funds. This reform is aimed at speeding fund disbursements to spending units, as well as reducing the use of commercial bank accounts for government transactions. This comes on top of recent progress in speeding disbursement of government funds to spending units electronically connected to the Bank of Tanzania. All Crop Board's fees and levies are now deposited into the Paymaster General account starting from 2018/19, since all Crop Boards are now fully dependent on government subventions.

4 Effectiveness of Agriculture Spending

82. **As Chapter 2 highlighted that the budgetary expenditure to the agriculture sector is extremely low (2.5 percent of national budget and 0.5 percent of GDP), policy measures are likely to be the primary public tools that shape the incentive structure for sector**. This chapter first assesses policy measures that shape the incentive and disincentive structure of the sector. Sub-section 4.1 summarizes the price incentive analysis for key commodities and shows that farmers are overall taxed in Tanzania. Annex xx details the analysis. Section 4.2 then explores the effectiveness of public spending on four key strategic areas for the government: irrigation, the knowledge systems (research and extension), the seed system and climate change adaptation. Sub-section 4.3 discusses the overall policy coherence between agricultural public expenditures, broader policy distortions and government objectives for the development of the agriculture sector of Tanzania. Background papers detailing the results of each deep dives are available in Annexes.

4.1 Price incentive analysis for key commodities – main results

83. **To gain a deeper understanding of the policy and market influences faced by agricultural producers, this section summarizes the key lessons stemming from an analysis of the market price distortions for several commodities.** The applied approach is based on the OECD-FAO MAFAP toolbox to calculate price incentives (see Annex 2 for details)[4] which compares the price that farmers receive at the farm gate with an estimated reference price, to determine the nature and extent of incentives or disincentives provided through market price support. This reference price is computed by using the CIF price ("cost, insurance and freight") or FOB price ("Free on Board"[5]), dependent on the trade status of the commodity, and by accounting for marketing margins and exchange rates, as well as transport, processing and handling costs and applicable taxes and fees.

84. **The computed "price gaps" between the farmgate price and the reference price reveals how agricultural policies and market circumstances together affect farm prices.** A *positive* price gap indicates that the domestic price of the commodity is higher than the reference price, implying that, in net, farmers are *incentivized* to increase production**.** Similarly, a *negative* market price gap implies that the reference price is higher than the domestic price, which means that policy environment and marketing functioning *disincentivize* production. The price gap is then presented as ratio of farmgate price, the Nominal Rate of Protection (NRP), allowing comparison across commodities. Including commodity-specific subsidies expenditures in the analysis enables to calculate the Nominal Rate of Assistance (NRA). Price incentives have been calculated for rice and wheat (both mostly imported), maize, beans, coffee, cashew nut and cotton (all four being exported).

85. **A first result is that restrictive and unpredictable export trade policies lowered prices for farmers and hampered competitiveness in the maize and cashew value chains.** Figure 19 displays that maize production was disincentivized overall in the past fifteen years, as highlighted by the negative NRP in all periods (except 2010-2014 – a period of high variability in domestic and international maize prices). Maize producers faced export bans until 2013, a stringent export licensing system until 2017 and another export ban in 2017. Public support through input subsidies (NAIVS) and output subsidies (national food reserve purchases) were not enough to compensate the negative impact of trade policies on their prices.

[4] The Price Incentive Analysis is fully detailed in a separate forthcoming publication (FAO-MAFAP and World Bank, 2022)

[5] These are terms are used in international trade in relation to shipping, where goods have to be delivered from one destination to another through maritime shipping

In addition, there is a wide academic consensus on the negative mid-term effects of trade restrictions on productivity investments, and thus on sectoral growth. While maize trade policies were mostly liberalized over the past four years, trade flows have remained restricted in practice due to trade barriers such as SPS issues (ex. aflatoxin), and lower demand due to bumper harvest in the region. Trade restrictions also apply to the cashew value chain, which suffers a 15 percent export tax that is fully passed down to farmers and thus reduces their income. While the revenue generated from the levy was intended to support the development of processing and value addition to the benefit of farmers, it did not succeed to do so, leading the government to simply retain all the levy revenues without back channeling it to the cashew sector.

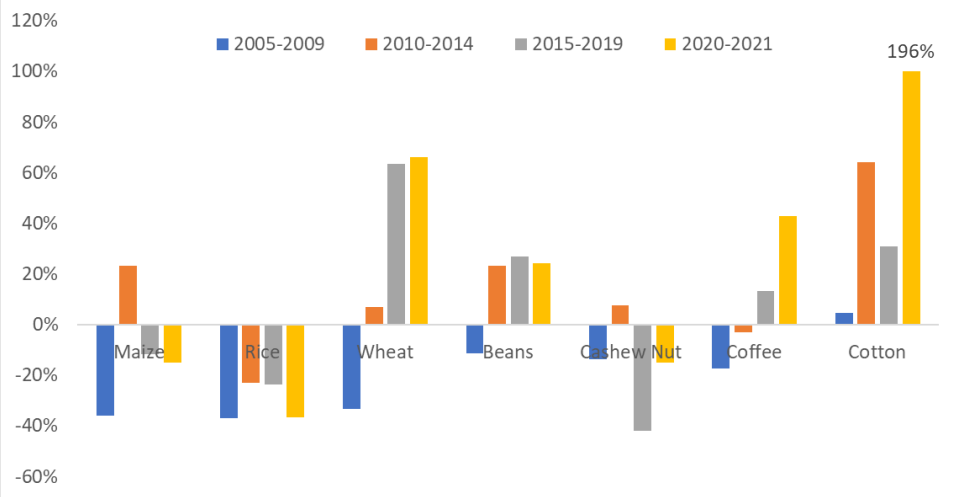
86. Meanwhile, trade measures to limit imports of rice did not yield higher prices for producers while higher wheat prices failed to increase production. Rice and wheat being crops predominantly imported, domestic producers would tend to benefit from trade barriers implemented to protect their market (Common External Tariffs for rice imports beyond EAC, coupled with restrictive import licensing regime). Yet these policies did not reach their goal for different reasons. On the one hand, extremes in rainfall variation and desert locust invasions plummeted wheat production, driving away large commercial farmers despite the positive environment in place. On the other hand, rice incentives were captured by urban wholesalers. In addition, for both crops, high transport costs between farm gates and wholesale markets lowered competitiveness (see below), even when compared to imported taxed products. While domestic production stalls, consumers pay high wheat and rice prices compared to international markets, and thus food import bills remain very high.

87. **Government's *ad hoc* marketing interventions tended to disrupt value chains at the cost of farmers, as seen recently in the cashew nuts and coffee value chains.** In the cashew value chain, the warehouse receipt system (WRS) established in 2008 used for its sales a closed bid auction mechanism that improved market functioning, allowing at first high international prices to be efficiently passed down to farmers. In 2014 and 2015, collusion and price fixing amongst few large players distorted the system and have reportedly led to artificially low domestic prices in relation to the export price. In 2016, the Cashew nut Board of Tanzania took measures to reduce collusion. LGAs intervene in the sector, resulting in excess stock that could not be shipped, reducing further domestic prices. In 2018, another public intervention in the sector led to over 200 000 tons of raw cashew nuts left in warehouses without buyers. In the coffee value chains, *ad hoc* changes in the rules and regulations affecting the marketing of harvested coffee beans impacted price transmission at the cost of production. The prohibition of purchase at farm-gate by middle-men and the obligation to sell at auction through AMCOS in the 2018/2019 season disrupted established marketing and value-chain financing channels and lengthened the transit time from farm to auction, thereby creating market uncertainty for coffee producers. In addition, the temporary suspension of direct export contracts restricted producers' capacity to negotiate premium prices with roasters and international buyers. These interventions were relaxed in 2020/21. The period also witnessed a significant decrease in international coffee prices, with bumper harvests in large producers like Brazil and Vietnam, leading to a 12-year low international price for Arabica coffee in September 2018. In the meantime, Tanzania recorded low production volumes due to the biennial bearing cycle of its coffee trees, which limited supply and supported domestic farm gate prices.

88. **All analysed commodities are also affected by the taxes collected by local governments, namely agriculture cess.** Since 2018, cess rates on both food and cash crops have been limited to 3 percent. Still, these taxes not only create additional disincentives for producers, but also adversely affects traders since they are often asked to pay multiple taxes when produce is moved to another region. The cess is also charged on small volumes of crops and thus limits market access for both smallholder farmers and small traders (PAG/PAC, 2018). Agricultural stakeholders criticize cess as it: (i) reduces the incentive to the farm to produce and trade; (ii) affects farm profitability; (iii) reduces the competitiveness of Tanzanian

agriculture abroad; (iv) creates market distortion, as the level of taxation is not equal between LGAs (creating tax avoidance strategy); (v) worsens food security and poverty level; and (vi) creates uncertainty over the final producer price if there is lack of clarity on the eligibility of the products (e.g. whether crops produced for seeds might be subject to the tax). On the other hand, agricultural *cess* is an important source of revenue for LGAs (if not the most important source for rural LGAs) even though despite guidelines advising to channel 20 percent back to agriculture, revenues are usually spent on other sectors. Building incentives to support implementation of this policy could increase allocation of resources to the sector.

Figure 19 - Nominal Rate of Protection (NRP) at Farmgate



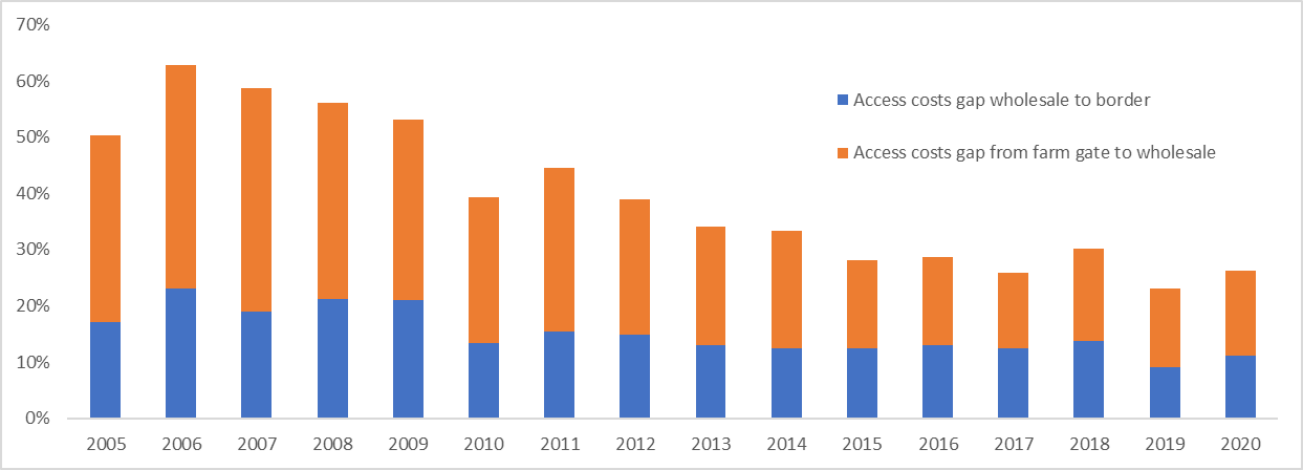
Source: Authors.

89. However, well targeted interventions helped strengthening productivity and competitiveness in some value chains, such as beans and cotton. The NRP reflects the combined effect of rising farm-gate prices and a fluctuating reference price which dropped significantly from 2017 onwards. The results highlight that the pulses and beans sector remains characterized by factors which can limit price transmissions. However, compared to other sectors, the pulse and beans sector is subject to relatively little direct policy and regulatory interventions. In addition, the government has supported the sector with targeted interventions including development of improved varieties, trainings and market access. As a result of this positive environment, production, productivity and farm gate prices steadily increased over the period. Similarly, cotton yields have also increased in the last few years supported by price incentives driven by strong competition from the ginners.

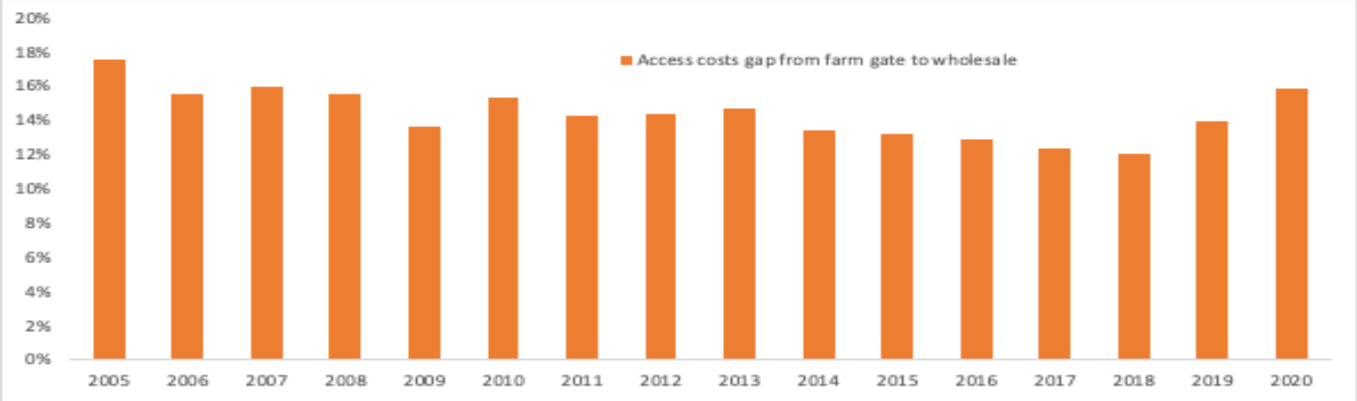
90. **This analysis focuses on the excessive market access costs that farmers face.** Figure 20 illustrates the evolution of these costs. Excessive transport costs owing to poor infrastructure accounts for the highest share of the access costs in Tanzania. It should be stressed that the country significantly improved its performance over the past fifteen years: while in 2007 it was 60 percent as efficient as the top performer in the region, South Africa, it increased to 80 percent in 2016 for overall logistics performance (Logistics Performance Index as of World Bank 2022b). However, over the period farm gate prices could have been higher would further progress be made on reducing access costs and assuming full price transmission. In particular, investments in feeder roads, processing and storage capacities to better connect farmers to wholesale markets and reduce high produce losses could have improved prices by 40 percent on average over 2005-2020 for exported commodities (maize, cashews, coffee, cotton) and by 14 percent for rice and wheat (mostly imported).

Figure 20: Excessive access costs for exported and imported commodities, weighed by value of production, 2005 to 2021

a) *Exported commodities (maize, coffee, cashew, cotton, beans)*



b) Imported commodities (wheat and rice)

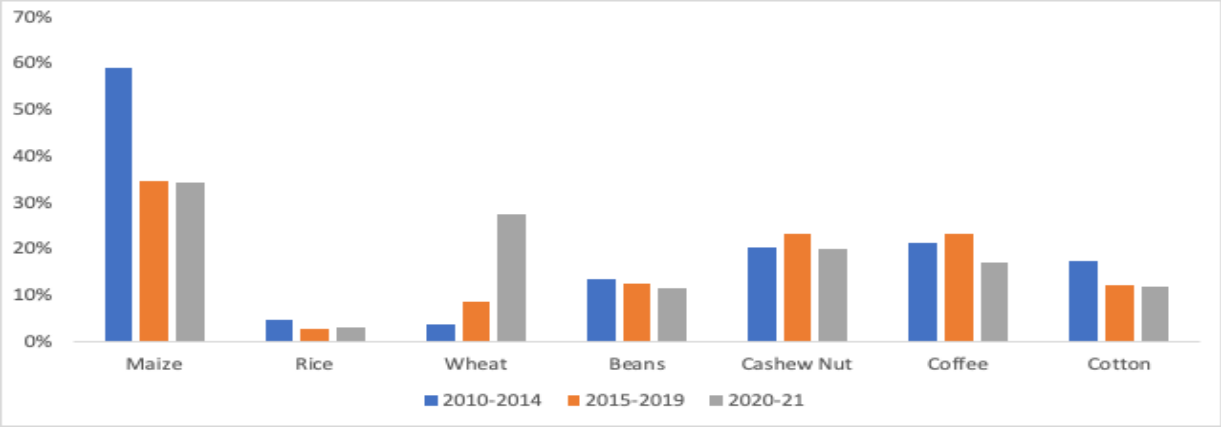


Source: Authors.

91. **At commodity level, the highest inefficiencies are found in the maize export value chain in the north, with transport costs, cess and intermediary fees averaging 58 percent of the farm gate price over 2005-2021**. While it might be encouraging to see the declining share of these costs as a share of farm gate prices (Figure 21), in absolute value per ton of product, these costs have increased. If logistics (transport time and costs) and business environment (cess, fees, bribes) had been equivalent to South Africa, maize producers could have doubled the price they received over the studied period.

92. Finally, the price incentive analysis revealed inefficiencies along the value chains due to excessive margins by specific actors, to the cost of farmers. In the rice value chain, where the market is protected by import barriers, the benefits of these trade measures appeared largely captured by urban wholesalers in Dar es Salaam rather than rice farmers in Morogoro. In the wheat value chain, importers' margins contribute to increasing wheat prices for consumers.

Figure 21 - Excessive access costs in percent of farm gate price, by commodity, 2010 to 2020/21



Source: Authors. Note: For exported products, this includes the leg from farm gate to wholesale and from wholesale to the border. For imported products, this covers the leg from the farm gate to wholesale.

93. **Overall, this analysis further emphasizes the importance of public goods and services to create an enabling environment to encourage agriculture growth.** It highlights that spending on provision of public goods and services can play an important role in improving the competitiveness of the sector by reducing market frictions and excessive cost of doing business. Removing these barriers would also incentivize investment in the sector that improves productivity and sustainability.

4.2 Deep dives on irrigation, knowledge system, seed system and climate change adaptation

94. **The objective of the deep dives detailed in this chapter is to assess public spending effectiveness on areas considered as strategic by the Government**, namely: irrigation; the knowledge system (research and extension services); the seed system; and climate change adaptation. Each deep dive is based on in-depth literature review; quantitative and qualitative data collection from interviews with key stakeholders at central level and at local level; field visits in selected districts (See Annex 3); and analyses of the 2008 and 2020 National Sample Census of Agriculture. Benefit-costs are calculated where allowed by data availability. We first present transversal lessons before summarizing key results for each deep dive. Background papers in the Annex detail results and findings for each of them.

a) Cross-sectional analysis

95. **The selected strategic areas are closely interrelated and the estimation of their public spending efficiency required different approaches**. Extension services contribute to irrigation development and improved seed use; research provides knowledge for extension services and generates seed improvement; irrigation, extension services and improved seed are assets for climate change adaptation, which, in turn, impacts the availability and need of water for irrigation and effectiveness of improved seeds. Econometrical analysis of the 2019/20 National Sample Census of Agriculture data enabled to estimate nationwide the contributions of irrigation, public extension services and access to improved seeds to farm household income. These benefits are then related to the estimated annual average public costs of delivering these services (Benefit-cost ratios). While point estimates should be considered as indicative, the analysis provides robust evidence on the positive impacts of these services on farm income

and their relative magnitude. Climate change adaptation required a different and innovative approach (see Background Chapter 4).

96. **Public investments in seed system, irrigation and extension services all three have large benefit-cost ratios, with seed systems being particularly good-value for money**. Benefit-costs ratio (BCR) are calculated here as the average yearly gain in farm household income due to a public service (in 2019/2020, using National Sample Census of Agriculture data), related to the average yearly cost of that public service (over 2017/18-2019/20). This standard ratio summarizes the value for money of the public service. The seed system - which captures a share of research expenditures - appears to have the highest Benefit-Cost ratio with 17. Irrigation comes second with 16 and extension services third with 9. Table 5 summarizes key results. These ratios are in the range of past results in SSA, with the estimated returns of public spending being 22–55 percent for research, 8–49 for extension, and 11–22 percent for irrigation (Goyal and Nash, 2017).

Table 5 - Comparison of the benefit-cost ratio estimated for irrigation, extension services and seed system in Tanzania

Activity	**Cost: estimated annual public expenditure**		**Benefit: estimated yearly increase in farm household income**		**Benefit-cost ratio**	**Climate change adaptation** ↕ Net annual direct gain USD 47.3 M (for 6 main crops)
	TZS billion	USD million	TZS billion	USD million		
Irrigation	46.3	20.2	754	329	16	
Extension	138.5	60.5	1,283	560	9	
Seed System	28.6	12.6	625	273	17	
Research	40.1	17.7	nc	nc	nc	

*Source: Authors. *Methodologies differ. See details in each section and background papers. **Part of the cost of seed system is also encompassed in research (double counting)*

97. **If Tanzania chooses to allocate budget to implement its Climate Smart Agriculture Plans, the yearly cost of public investments would be largely offset, with an average yearly gain of USD 47.6 million (because of yield increases) for its six main crops only** (over 2022-2040). While climate change adaptation underpins the overall performance of irrigation and improved seeds, the deep dive shows that little happens in the field and budget wise. Inaction will be costly for Tanzanian agriculture and will hit the hardest the most vulnerable population. Investment in research and extension services provision appears to be the most efficient way to support farmers' adaptation to climate change

98. **Agricultural public service delivery has been degrading over the past decade in Tanzania, at the notable exception of access to improved seed.** Irrigated areas cropped by farmers went down from a low 3 percent to 2 percent of all farmed area between 2008 and 2020. Meanwhile, access to extension services collapsed from 67 to 6.9 percent over the period. Adaptation to climate change has not moved forward, ambitious and relevant policy plans havening not been implemented. On the bright side, the number of farms that use improved seeds more than doubled between 2008 and 2020, driven by strong public institutions and a dynamic private sector.

99. **While climate change adaptation, irrigation, research and (to a lesser extent) the seed system appears clearly underfunded until 2022, the effectiveness of spending on extension services could be**

improved. On the one hand, public resources currently flowing to irrigation, research and the seed system are insufficient to allow these services to function normally. The high Benefit-Cost ratios observed partly stowaway on existing capital and knowledge due to past investments. As a result, these public services are close to collapse with the funding they were receiving over 2017/18-2019/20. In this light, the announcement of record increases in budget for irrigation, seeds and research for 2022/23 is a much welcome decision. However, climate change adaptation *per se* remains absent of this budget. On the other hand, budget for extension services appears tight but reasonable compared to other countries, particularly regarding scarce fiscal space available. Results highlight potential efficiency gains as service delivery collapsed over the past ten years and does not appear distributed optimally over the territory.

100. **Livestock is systematically the forgotten subsector, with research barely existing due to scarce funding and wide gaps in access to extension services**. The dialog on irrigation also nearly never tackles livestock, while access to water is also core for the industry to raise its productivity.

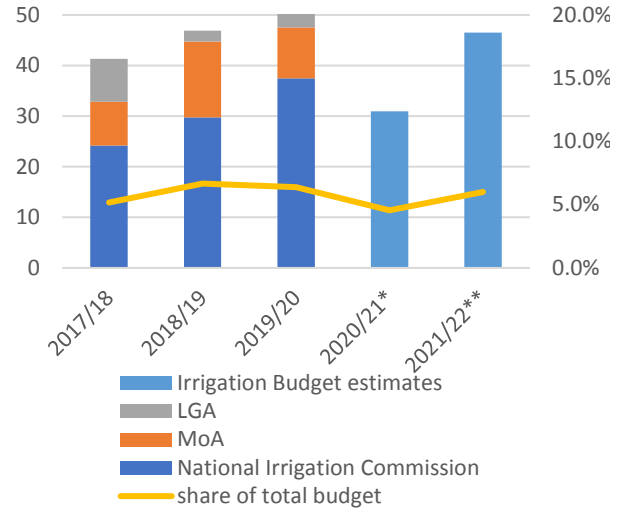
b) Effectiveness of public spending on irrigation

101. **Irrigation allocation averaged 6 percent of national agricultural budget over 2017/18-2021/22 and highly depends on development partners**. It amounted to TZS 216.4 billion (USD 94.7 million) over 2017/18-2021/22, averaging TZS 43.3 billion (USD 18.9 million) per year. Only 44 percent of this budget was capital expenditures (over 2017/18-2019/20). The 2022/23 allocation is expected to reach a record of TZS 361.5 billion (USD 156.5 million), which would largely exceed the past five years irrigation budget. The National Irrigation Commission (NIC) received 66 percent of the allocation over 2017/18-2019/20, reflecting its preponderant role in the subsector. Development' partners financing represented 60 percent of NIC allocation in 2017/18 and up to 79 percent in 2019/20. NIC budget was cut in half in 2020/21 as donors' financed projects ended, with no replacement in the pipeline. MoA, in charge of irrigated agricultural services, was allocated about 24 percent of the budget for irrigation, with large fluctuations over 2017/18-2019/20. Finally, while LGAs are the main implementers of small-scale irrigation development, their allocation collapsed over 2017/18-2019/20 and averaged about 10 percent of the irrigation budget. The announced record 2022/23 allocation is expected to mostly benefit LGAs.

102. **Annual budget for irrigation amounted to 12.5 percent of the estimated needs for the development of the subsector over 2017/18- 2020/21.** It is estimated at USD 18 million (TZS 43 billion), including USD 8 million of donors financing of NIC[6]. According to OECD-CRS data, annual off-budget contribution was about USD 0.9 million for the period. However, the National Irrigation Master Plan (JICA, 2018) counted on annual financial support of USD 52 million from the Government and USD 100 million for development partners over 2018-2025 (plus USD 65 million for the private sector). Public financing would thus represent about 12.5 percent of the need. Government allocated about 34 percent of what was estimated as needed, and donors only 8 percent.

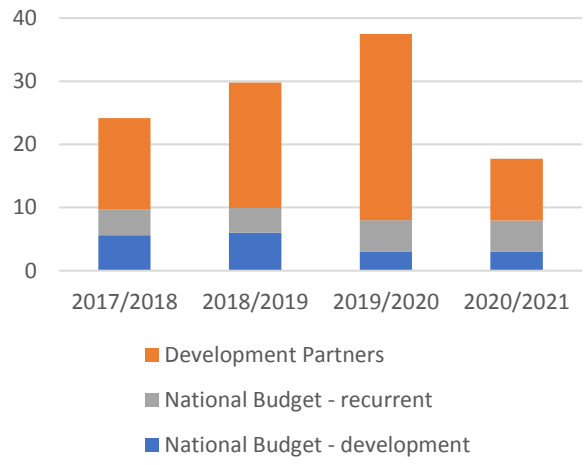
[6] On-budget foreign financing targeting irrigation at MoA and LGAs levels could not be estimated.

Figure 22 - Evolution of public budget for irrigation per agency and share of total agricultural budget



Source: Authors. PER database.

Figure 23 - Evolution of budgeted expenditures of the National Irrigation Commission

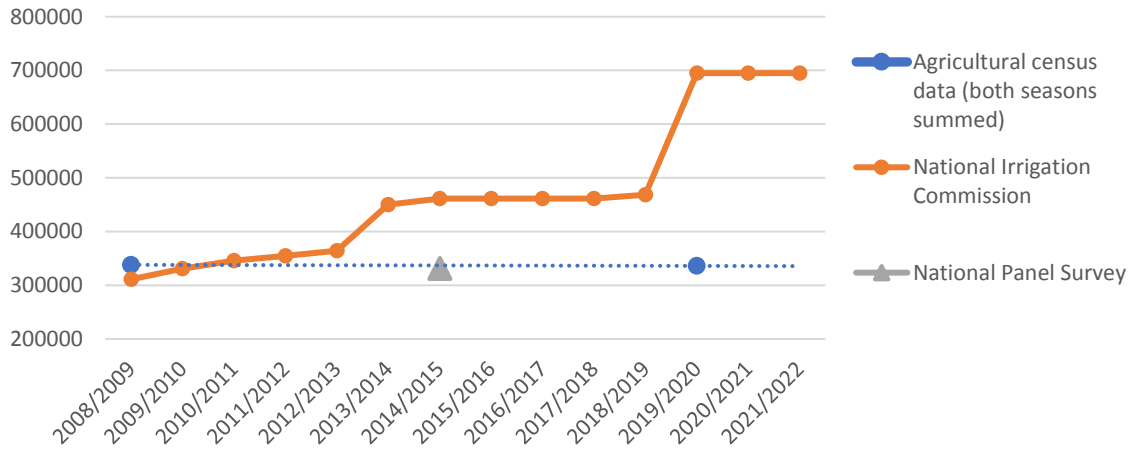


Source: Authors. Data NIC.

103. **Over half of the formally existing irrigation systems appears neither used nor functioning, calling for in-depth investigation of the underlying issues**. According to the National Sample Census of Agriculture data, the total irrigated area used by farmers (both seasons summed) was 335,996 ha in 2019/20. However, the National irrigation Commission records an area equipped for irrigation of 694,715 ha for the same year. Provided both data sources are reliable, the gap between area equipped for irrigation and area actually irrigated according to users widens since 2008/09 (Figure 24). This striking observation calls for further investigation to understand its root causes. Multiples reasons can explain low exploitation of irrigation system: a lack of manutention, monitoring and rehabilitation; the lack of water resources; misalignment between infrastructure developed and users' needs or capacity to use the infrastructure.

104. **According to the National Sample Census of Agriculture data, the total area irrigated by farmers decreased in the country over the past decade, representing in 2020 a dramatically low share of 2 percent of farmed area.** The area irrigated (both seasons summed) went down from 338 thousand hectares in 2008 to 336 thousand hectares in 2020 (-0.5 percent), while the total area planted went up from 10,523 to 13,908 thousand hectares (+ 32 percent). The share of area irrigated thus went down from 3 to 2 percent, implying Tanzania's agriculture is overwhelmingly dependent on rainfalls. Irrigated areas shifted over space between 2008 and 2020, declining in areas such as Kilimanjaro and Arusha and increasing near Dar es Salaam and in Mbeya, potentially for vegetables sold to urban markets. Indeed, while irrigation remains mostly used for cereals, it uses are shifting to horticulture, which has higher nutritional, market and climate co-benefits. Irrigation methods remain very rudimentary, with extremely low efficiency. Over half of it is hand water buckets, and a small third gravity irrigation.

Figure 24 - Comparison of area equipped for irrigation (National Irrigation Commission data) and area irrigated used by farmers (National Sample Census of Agriculture and National Panel Survey data)



Source: authors. Data NCO, 2008 and 2020 National Sample Census of Agriculture and 2014 panel survey

105. **The net productivity of irrigated area is on average two thirds higher than not irrigated one**. In average for all crops, the net land productivity of irrigated land is TZS 4.1 million per ha versus TZS 2.4 million per ha when it isn't (2019/20 National Sample Census of Agriculture data). Fruits and vegetables productivity is 79 percent higher on irrigated areas (USD 574 versus 320 per hectare) and rice is 16 percent (USD 204 versus 175 per hectare). The latter gain is lower than expected in the light of past evaluations such as those of the system of Rice Intensification trialed in Rufiji, Pangani and Wami - Ruvu basins (+ 15-40 percent)(World bank 2019d) or of the Expanding Rice Production Project in Morogoro (+316 percent). However, these observed yield increases have been the combination of irrigation plus use of other Good Agricultural Practices (ex. improved seeds, fertilizers, etc.). In addition, the difference in land productivity could stem from structural factors. For instance, farms that grow vegetables (an increasingly irrigated crop) have higher land productivity than cereal farms. An econometrical analysis on the 2019/20 National Sample Census of Agriculture data has been used to estimate the effect of irrigation itself to compute irrigation Benefit-Cost ratio (Table A, Background Chapter 1).

106. **The Benefit-Cost ratio of irrigation is estimated at 16, confirming international results on the high value for money of investing in this infrastructure** (Table 5). All factors controlled for (including crop system, other inputs, size, etc.), irrigation increased net farm household income by 6 percent. The ratio is obtained by relating this benefit to the average annual budget for irrigation over 2017/18-2019/20. Our analysis uses irrigation data from the National Sample Census of Agriculture, as we focus on the service used by farmers.

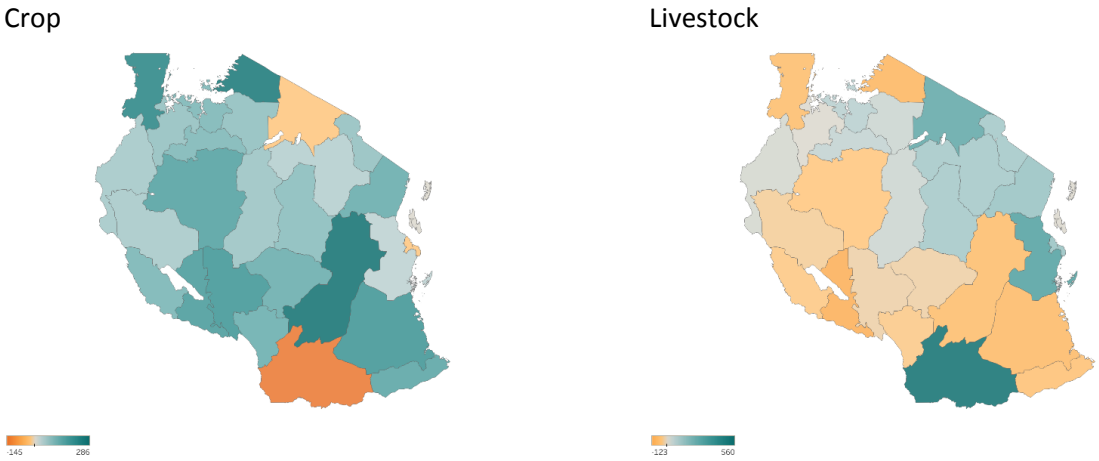
107. **However, public spending per newly equipped area appears extremely high**. According to National Irrigation Commission data, 330 new hectares were irrigated over 2020-22. We roughly estimate related public expenditure at USD 22,728/ha (see Background Chapter 1), which exceeds all comparison points. The evaluation of ASDPI (2006/07-2018/09) had found that a new irrigated hectare costed about 3500 USD/ha, and the National Irrigation Master Plan 2018-2025 (JICA, 2018) 850 USD/ha. In average in Sub-Sahara Africa, the cost was about 50 to 2500 USD/ha for small and simple irrigation systems (shallow wells, small hillside canals, etc.), 1500 to 3000 USD/ha for more sophisticated small irrigation, and over 12000 USD/ha for new public large scale irrigation scales (Shah *et al.,* 2020).

c) Spending effectiveness on research, training and extension services

108. **Research and extension services are the core pillars of the Agricultural Knowledge System, which are disconnected, reducing the effectiveness of both**. The concept of Agricultural Knowledge System describes the ways people and organizations interact within a country to generate, share, and use agriculture-related knowledge and innovation and promote mutual learning (OECD 2012; EIP-Agri 2018). Linkages between research, training and extension services are core to ensure that research developments are translated into field implementation and that bidirectional learning is fostered between farmers and scientists. Field evidence and stakeholders interview overwhelmingly pointed out to their weaknesses in Tanzania. Since 2011, frequent institutional changes have negatively impacted agricultural research and its connection to training and extension services. In the wake of the decentralization movement initiated in 1999, agricultural extension services were delegated to local authorities, with coordination at the central level. While agricultural research received low priority from the government, the key role of extension services for agricultural growth in regularly acknowledged.

109. **Both research and extension services largely focus on crops, underservicing livestock subsector despite its major economic potential in Tanzania**. Research is undertaken by 14 agencies and organizations, with Tanzania Agricultural Research Institute (TARI) being the largest structure. 54.4 percent of agricultural researchers in Tanzania worked on crops in 2016 (data ASTI), against 8.4 percent on livestock. Fishery and forestry respectively were studied by 8.6 percent and 2.2 percent of researchers. On the extension side, as of 2020, the Government employed 6,704 crop officers (71 percent men and 29 percent women) and 3,940 livestock officers, slightly over half (53 percent) of its target of having at least one extension agent per village and ward (about 20 000 officers, URT 2009). Figure 25 maps the gap in extension officers (difference between officers available and needed according to MoA estimates) and reflects the dire situation of the livestock sector.

Figure 25 - Gap in crop extension officers and livestock extension officers per region

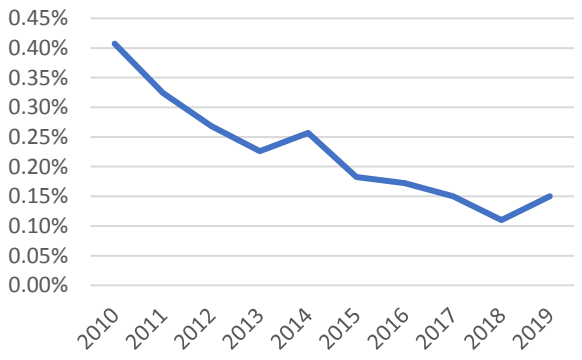


Source: Authors, data MoA and MLDF (2022). A positive value indicates a number in excess of the need (green), and a negative value indicates a shortfall (orange).

110. **The allocation to agricultural research has been declining over the past two decades to reach a low 0.15 percent of agricultural GDP over 2017-2019** (Figure 26), **ranking among the four lowest of the African Continent**. Over 2017/18-2019/20, it amounted to TZS 120.4 billion (TZS 40.1 billion per year in average), which is 5.2 percent of agricultural budget. It is a seventh of the target of the Khartoum Decision on Science and Technology of allocating 1 percent of agricultural GDP to research and development for the period 2015 to 2025. Compared to other African countries (Figure 28), Tanzania's contribution to

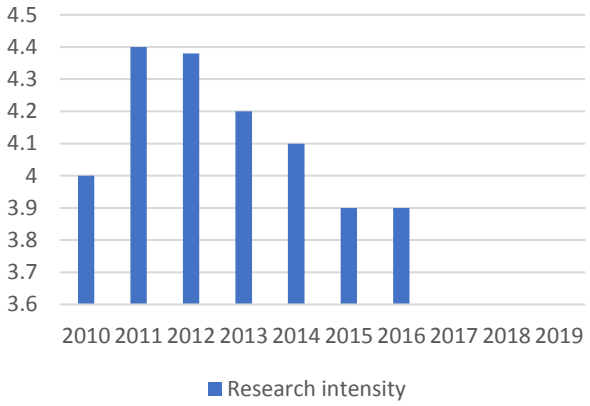
agricultural research is far below its economic peers. Interviews with TARI revealed that the institution receives about a third of the budget it requests. Due to insufficient allocation, two thirds of the budget pay for salaries and wages, leaving scarce and volatile space for program costs and capital investments and plummeting research activity. The Tanzania Livestock Research Institute (TALIRI) hasn't received any development budget over the past six years. Research facilities are thus in a bad shape. Livestock research activities are very low and limited to what international and private-sector partnerships can support. Low budget for agricultural research is partly offset by off-budget donor financing, estimated at about a fifth of the budget (OECD-CRS data). TARI, TALIRI and Soikoine University of Agriculture (SUA) all report that development partners used to be significant (if not major) contributors to their budget, but that their contributions have been contracting. Divergent and changing priorities between donors and the research institutions also affect research activities.

Figure 26 - Evolution of Tanzania agricultural research budget as a share of agricultural GDP



Source: Authors. Data ASTI 2000-2016; PER data 2017/18-2019/20

Figure 27 - Evolutions of Tanzania's Research Intensity



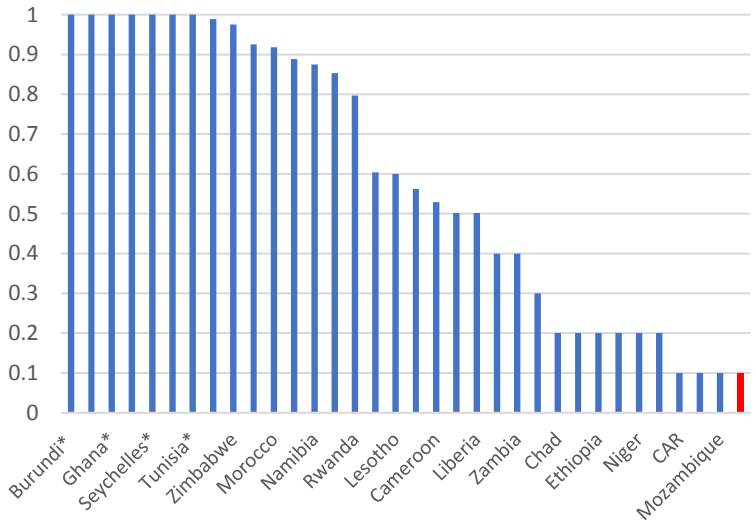
Source: Authors. Data: ASTI (2021)

111. **Decreasing budget led to declining agricultural research intensity over the past decade and drastic lack of capital that plummets research**. Research spending as a percentage of agricultural output (GDP) has been plummeting over fifteen years (figure 26). Agricultural research budget per 100,000 farmers has also been eroding between 2011 and 2016 (Figure 27). While recent data on the national evolution of the numbers and qualification lacks, declining budgets worsened the situation, as confirmed by major institutes. Interviews with TARI and TALIRI highlighted their significant human resources challenge. They struggle to attract and retain well-qualified researchers. Most senior researchers are approaching retirement age and knowledge transfer appears compromised by the lack of young PhDs. The scarce budget translates into a salary-capital cost ratio among the worst of the African Continent, at 3.3 on average over 2017/18-2019/20 compared to the African average at 12.2 (ASTI 2021). In practical terms, this means that research institutes do not have the basic equipment and infrastructure to conduct their missions.

112. **Scarce spending on research appears highly efficient compared to regional peers, but agricultural research is at the verge of collapse without additional funding**. The cost of agricultural research staff is very low in Tanzania, at about 13 percent of the average in African countries and Kenya, 11 of Uganda and 36 percent Kenya (ASTI, 2021). Similarly, spending per published academic article is about 5 percent of the average in African countries, 47 percent of Uganda, 71 percent of Kenya and 66

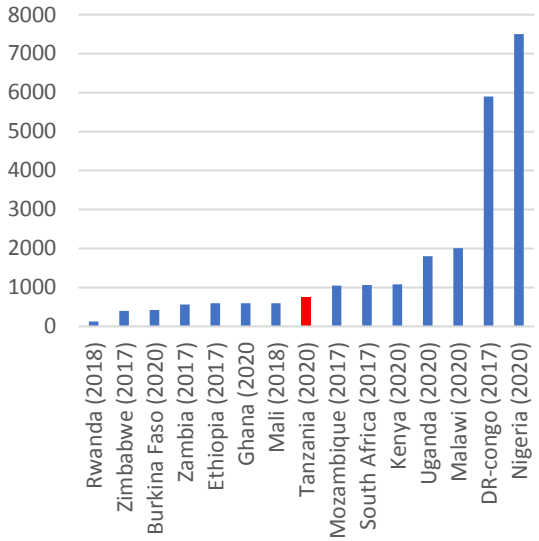
percent of Ethiopia. However, Tanzania's institutes published an increasing number of academic papers since 2012 (data Scimago). The country ranks as 9th over 2014-2016, and at 10th since 2017, in terms of number and impact of published papers in the field Agricultural and Biological Sciences in Africa. Since its creation in 2016, TARI has developed and protected a total of 77 seeds varieties. These are outstanding results in the light of the resources allocated to the sector. They demonstrate the existence of a strong remaining research capacity, which could be rebuild with additional funding, but will soon elapse if senior researchers retire before a new qualified generation of researchers is in place.

Figure 28 - African benchmark of agricultural budget on research and development (based on 2021 CAADP Biennial report)



*Source: Authors's own elaboration. Estimates based on the 2021 CAADP Biennial Report. *These countries spend 1% or more of their agricultural GDP on agricultural research and development.*

Figure 29 - Regional benchmark of the number of farmers per extension officer



Source: authors. Data: TASAI – African Seed Access Index 2020 Dashboard. Tanzania data comes from PER analysis and is per farm household and not farmers.

113. **On the training and extension side, the budget allocation reflects the government's priority but tight capital expenditures limits service delivery.** Extension budget averaged TZS 138 billion over 2017/18-2019/20, representing 18 percent of agricultural budget. Almost two thirds of the allocation are absorbed by personal emoluments and this share increases over time. It leaves little room for needed capital expenditures such as transport means, demonstration plots, etc. 69 percent of the budget is allocated for LGAs, who are responsible for the delivery of this service (which focused 41 percent of their agricultural budget). The extension budget amounts to USD 9 per farm household (TZS 20,688). If we only consider farms that access the service, this amount goes up to USD 129. This compares low to similar estimates in Cambodia (USD 273, World Bank, 2011) but much higher than Ethiopia (USD 13, World Bank 2021). Another measure of efficiency is the ratio of extension budget per number of extension officers, computed at USD 6 501 yearly. As a comparison, FAO (2011) estimated the cost per extension agent at USD 4000-6000 for low-income countries and USD 6000-9600 for low-middle income countries.

114. **The Benefit-Cost ratio of extension is estimated at 9, confirming international results on the high value for money of investing in this service** (Table 5). All factors controlled for (including crop system,

other inputs, irrigation, size, etc.), estimate that extension increased net farm household income by 10.5 percent (Annex xx). The ratio is obtained by relating this benefit to the average annual budget for extension over 2017/18-2019/20. As a comparison point, Goyal and Nash (2017) estimate that in Africa the benefit-cost ratio of extension services ranges between 6.8 and 14.2.

115. **However, spending effectiveness is low as shown by the collapse of access to extension services since 2008, and the lack of correlation between local budget to extension services and service delivery.** In average, Tanzania has one extension officer per 719 farm households (data MoA 2020 and 2019/20 National Sample Census of Agriculture data), which is 39 percent of the government's target to have one officer per village. It remains in the regional range (Figure 29). However, data from National Sample Census of Agriculture shows a drastic decrease of farmers who access public extension services from 67 percent in 2008 to 7 percent in 2020. Findings from the literature review and field interviews confirm this trend. In addition, we find that LGA budget for extension services is fully decorrelated from farm extension receipt (see background paper 2). Put differently, money spent on extension officers does not appear linked to the number of farmers that are provided with this public service. Several explanations can be put forward to explain this decorrelation. A first is that the availability of extension officers might be too low to impact extension access. A second is that insufficient capital expenditures hampers service delivery (ex. lack of motorbikes or budget for fuel). A third is inadequate distribution in the field.

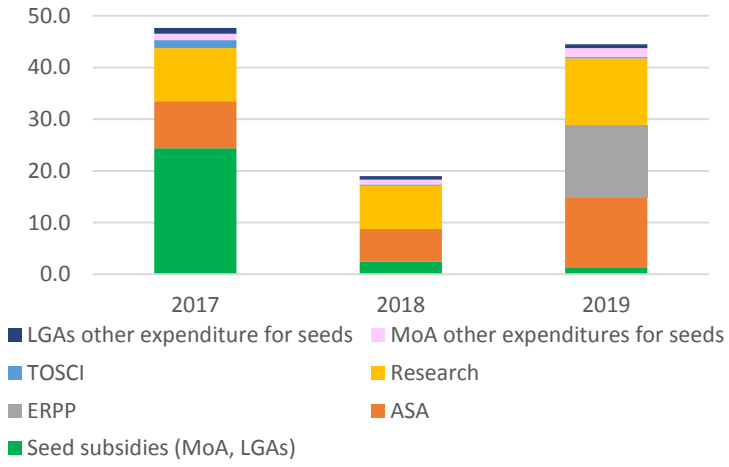
116. **The geographical distribution of extension officers, directly related to budget allocated to LGA, does not align with the rural needs**. The average of 719 farms per extension officer masks a large regional variability, from 542 in Mara to 2,600 in Kigoma and 4,709 in Dar es Salaam. We show that access to crop extension reduces as distance from district capital increases. In other words, while extension officers should be more present in rural areas when needs are higher, they are closer to large cities, which likely contributes to deepening territorial inequalities. This result has also been found by the World Bank Health Public Expenditure Review of Tanzania (2019) for other rural services. Beyond regional inequalities, as delivered today, access to agricultural information also deepens gender inequality between farmers (background paper), with male-headed households being are about 1.5 times more likely than their female counterparts to access extension for both crops and livestock.

d) Spending effectiveness on seed system

117. **Tanzania's Seed System strikes a successful balance between promoting private sector development and maintaining strong public institutions, which translates into growth**. The country has a clear and solid regulatory framework that has been strengthened in 2013-14 to further increase private sector participation, enabling it to join the International Union for the Protection of New Varieties of Plants (UPOV) in 2015. It mostly phased out seed subsidies, while keeping an active role in the seed systems via Tanzania Official Seed Certification Institute (TOSCI), the Agricultural Seed Agency (ASA) and Tanzania Agricultural Research Institute (TARI) (see background chapter 3). As a result, the quantity of improved seeds produced locally has been multiplied by six over the past fifteen years, partly driven by increased partnership between ASA and the private sector as well as the accreditation of the TOSCI laboratory. Local production of improved maize is reported to have covered 34% of the demand for 2017-2018 (CIMMYT 2018). 56 percent of improved seeds used in Tanzania over 2017-19 have been imported. In the field, the number of farms that use improved seeds more than doubled between 2008 and 2020 to reach a share of 38 percent (versus the ASDPII target of 45 percent by 2025). Acreage planted in improved seeds for maize increased from 18 percent in 2008 to 42 percent in 2020, and cassava from 5 percent to 23 percent. However, improved seed supplies (local production and imports) still do not meet the country's needs, and the promising growth of the seed subsector should be carefully nurtured.

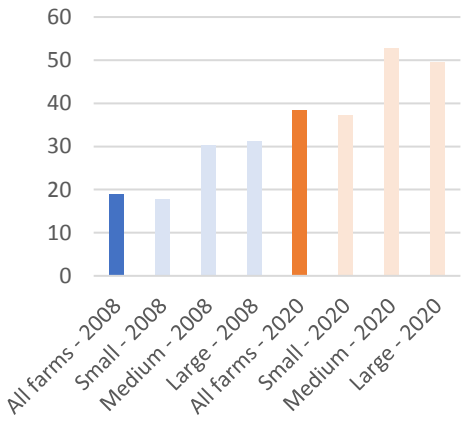
118. **Government's expenditures in the Seed System are good value-for-money, as witnessed by a Benefit-Cost ratio of 17.** Budget to the Seed Systems is here calculated as the allocation to the whole system: the seed main agencies (TOSCI, ASA), dedicated research, seed subsidies (by MoA and LGAs) and specific actions by MoA and LGAs (extension services, demonstration plots, etc.)[7]. The seed system allocation is estimated annually at TZS 37.0 billion (USD 16.3 million) over 2017/18-2019/20, wavering between 3 and 6 percent of total agricultural budget. It indeed displayed considerable variability, with 2017/18 budget dropping by 60 percent, due to the phasing out of the National Agricultural Inputs Vouchers Scheme (NAIVS) and ASA budget cuts. The allocation rebounded in 2019/20 thanks to donor financing (World Bank-supported Expanding Rice Production Project). Over the period, Local budget has decreased, reflecting the phasing out of input subsidies. Analysis on the 2019/20 National Sample Census of Agriculture data shows that, in average nationwide and for all crops, the farms using improved seeds have a land productivity 12.8 percent higher than farms that don't. Once input costs are taken into account and farm characteristics econometrically controlled for, their net land productivity remains 5.2 percent higher. Using this data, the Benefit-cost ratio of the seed system is estimated at 16 (see Annex xx). In average over 2017/18-2019/20, the public cost per tons of certified seeds produced in the country is estimated at USD 287 (TZS 658 thousand), and the public cost per hectare using improved seeds at USD 5 (TZS 11 322).

Figure 30 - Estimation budget of the Seed System (billion TZS)



Source: Authors. Original PER data and ASA data.

Figure 31 - evolution of share of farms that use improved seeds in 2008 and 2020



Source: authors' own elaboration. Data: National agriculture survey 2008 and 2020

119. **Public interventions in the seed system are efficient at maintaining a diversified agriculture, core for climate change adaptation and food security, but budget predictability is needed and public varietal development sharply underfunded.** While the private sector plays an active and increasing role in Tanzania seed system, its action at all levels (varietal development, production, commercialization) is highly skewed on maize. This specialization of private actors on main commercial crops is a common feature across OECD and developing countries (OECD, 2021). Thus, Tanzania public sector plays a key role in ensuring agricultural diversification and productivity improvement in other crops than maize. For instance, it supplies 81 percent of cotton seeds, 93 percent of paddy rice seeds and 100 percent of wheat,

[7] The time spent by local extension officers to perform seed quality controls is not included due to data lack.

nuts and millet seeds. This diversification has been shown to be core in East Africa to strengthen climate change adaptation and resilience, to increase farm income and fight rural poverty, and to diversify diets to scale down malnutrition (Kray *et al*., 2018). In addition, an active local public varietal development is needed to develop crops adapted to the agroecological context, in particular for traits related to climate resilience and pests and diseases resistance (OECD, 2021). Despite its importance, public varietal development is crucially underfunded, jeopardizing this diversification asset. The collapse in public variety released since 2020 likely reflects the scarce and erratic budget allocated over the past years to the research pole of the seed system (see background paper 2). In addition, interviews with key informants have shown that budget unpredictability and drastic budget cuts have affected the performance of ASA and TOSCI.

120. **Budget effectiveness could be increased by scaling up efforts and allocation for seed quality control**. Fake seeds, estimated at 25–30 percent of certified seeds used in Tanzania (USAID 2013), are a significant problem for building farmers' trust in the country's seed market. Despite the growth of improved seed sector, TOSCI's budget has remained stable at about TZS 4.0 billion. Insufficient staff and low allocations to development and operational activities limit the capacity of the institute to correctly perform its missions. For instance, registering new varieties is a lengthy process that slows down the whole system. In addition, TOSCI's seed quality control responsibility is currently partly delegated to extension officers - at the expense of their own missions. TOSCI is developing several digital approaches to fight fake seeds, which could be scaled up with additional resources. International experience shows that seed quality control should also be partly or totally delegated to private agents, as done by South Africa, Zambia and Zimbabwe (TASAI, 2022)

121. **ASA is a key player in the public seed system that needs to strategically position itself so as not to crowd out the development of the private sector.** ASA budget shows a rapid increase since 2018/19, driven by development budget. Yet field interviews point out to inefficiencies increasing seed costs for farmers. While the public sector has a key role to play in public good provision such as varietal development for improved nutrition and climate change resilience, the production of seeds itself is an activity that could be further uptaken by the private sector provided it is given incentives to diversify away from maize.

e) Spending effectiveness on climate change adaptation

123. While ambitious climate change adaptation plans are in place for agriculture, they are not implemented due to lack of public national and foreign fundings. This report estimated the gain of materializing them at USD 1.41 billion by 2040 (USD 74.3 million per year). Extreme weather events, such as record-breaking rainfalls or droughts, are more and more witnessed in Tanzania and projected to increase with climate change (Background Paper 4; Tomalka *et al.* 2020). The predominantly rainfed nature of its agriculture increased its vulnerability, particularly for the poorest farmers. Plant diseases and animal pests represent another significant hazard expected to increase both for crop and livestock sub-sectors. These risks are well acknowledged by the Government, and climate change adaptation has been progressively incorporated into national policies for the last two decades. Agriculture is well integrated in the 2021-2026 National Climate Change Response Strategy. ASDP II includes adaptation actions which, irrigation put apart, only represented 0.4 percent of its planned budget. In addition, Tanzania has an ambitious and well designed 2015-2025 Tanzania Climate Smart Agriculture Programme (CSAP). However, in practice, the budget allocated for climate-smart agriculture (CSA) yearly averaged USD 4.3 million, about a quarter of the planned USD 15.5 million for the 2017-2019 period. Irrigation, which is part of the CSA toolbox, is not included in these calculations but is detailed in Background Paper 1. Irrigation put

apart, climate-smart agriculture budget (beyond irrigation) represented 1.1 percent of total agricultural budget for 2017-2019).

124. Low implementation leads to Tanzania not being on track to meet its international climate change adaptation commitments and jeopardizing future growth. Tanzania lags behind the Malabo expected implementation objectives milestones. According to the 2022 CAADP Biennial, only 3.5% of its agricultural land is under sustainable land management practices (CAADP 2022). The 2019/20 National Sample Census of Agriculture data indicates mild progress in CSA practices adoption since 2008, which would need to be massively scaled up. The current pace of transformation will not allow the fulfillment of Sustainable Development Goals (SDG) by 2030, notably regarding no poverty and zero hunger. The development of irrigation, research, extension services and improved seeds discussed in previous sections are all closely interrelated and could be geared towards facing the climate change adaptation challenge.

125. By all standards, the current allocation to climate smart adaptation is too low to enable the agricultural sector to evolve, with dire consequences for food security. Tanzania's actual yearly budget for agricultural adaptation is far below any existing strategy for adaptation budget. The lowest policy cost is estimated by Sulser et al. (2021) for SSA at USD 13.5 million per year, which is three times higher than the current adaptation budget. Tumbo et al. (2010) determined a cost of adaptation at USD 107 million per year. The current spending thus appears too low to allow for farmers' adaptation to climate change.

126. If Tanzania choses to spend the budget already planned for agricultural climate change adaptation in its own sectoral plans, we show - with highly conservative assumptions - that it would have net yearly gain of USD 74.3 million over 2022-2040, with a Benefit-Cost of 2.3. The benefits of adaptation are calculated as the estimated gains in agricultural production value for six major crops at the 2040 horizon compared to a scenario without adaptation to climate change. Indeed, adaptation is expected to reduce climate change impact on these crop productions by nearly half. These benefits are related to the costs planned in ASDPII and CSAP. The yearly net gain is estimated of USD 74.3 million, despite highly conservative assumptions: the estimation is limited to the impact of climate change on the yields of six crops, does not include land degradation impacts, land losses due to rise in sea level and impacts on livestock, etc. As a comparison point, Markandya et al (2015) considered a larger number of crops in Uganda and obtained a yearly inaction cost ranging from USD 555 million to USD 957.5 million.

4.3 Policy coherence

127. The Second Agriculture sector development program (ASDP II) articulates Tanzania's goals for the sector over 2018-2028 and is thus used to analyze policy coherence. Launched in June 2018, it aims to transform the agricultural sector towards higher productivity, commercialization level and smallholder farmer income for improved livelihood, food security and nutrition. Its targets are to achieve by 2024/2025: (i) inclusive and sustainable agricultural growth of 6 percent per annum; (ii) reduced rural poverty from 33.3 percent in 2011/2012 to 24 percent in 2025; and (iii) enhanced food security and nutrition (reduce food poverty line from 11.3 percent in 2011/2012 to 5 percent in 2025).

128. While Tanzania's agricultural expenditures are mostly targeted towards the provision of public goods and services, which is in line with ASDPII objectives, their levels are beneath what is needed for the country to reach them. Low budget allocation to agriculture (2 percent of national budget and 0.5 percent of GDP, chapter 2.2) hinders the sector's ability to address priorities challenges. ASDP II itself is significantly underfunded, as it received by 2020 only 15 percent of its 2018-2025 planned allocation. Beyond national funding, the level of development partners' contributions is largely bellow what was planned in ASDPII, Tanzania Climate Smart Agriculture Plan and Irrigation Master Plan, contributing to this financing gap. The high benefit-costs found for irrigation, extension, irrigation and climate change

adaptation (Chapter 4.2) support the initial rationale to increase spending on these public goods, among others.

129. **Budgetary support to producers is small but primarily composed of input subsidies, which is misaligned with the objectives of productivity, sustainability and competitiveness.** Considered as most distortive, input subsidies solely incentivize short-term higher production. This mechanism has an adverse impact on competitiveness as it allows inefficient firms to survive and disincentivizes the efficient and competitive ones from scaling up. Support of fixed capital formation and on-farm services are much more in line with the goal of increasing productivity and competitiveness, potentially with the largest positive impact on structural transformation.

130. While the livestock sector has large potential to contribute to the country's all three objectives of agricultural growth, rural poverty reduction and food security and nutrition enhancement, it is a forgotten priority on all accounts. Chapter 2.5 has highlighted the crucially low allocation to the livestock sector: it is estimated at 0.03 percent of the GDP over 2017/18-2021/22, while contributing to it at 7.4 percent. Chapter 4.2 has also shown that livestock research and extension services are quasi-inexistent for the former and very low for the latter. However, herders tend to be located in the poorest areas; Tanzania has the second largest herd in Africa and thus a large capital base for increased production and commercialization; and increase in the availability and affordability of animal protein could significantly contribute to fight malnutrition.

131 Reaching the objective of higher productivity is hindered by extremely low agricultural research funding, inefficient innovation dissemination through extension services, price distortions that disincentivize producers to invest in new technologies and high gender gap. Agricultural productivity and efficiency gains are innovation intensive and require improved human capital as well as existence and access to innovation tailored to the country's agroecological systems. Yet the current allocation to agricultural research is among the four lowest in Africa, representing a seventh of the CAADP recommendation (Karthoum target). Access to extension services plummeted over the past decade to only reach 6 percent of farmers. On the private side, market distortions protect inefficient farmers, while preventing efficient producers from scaling up or investing in new technologies. Productivity gains and investments in value chains development could be wiped out if the climate change, land degradation and water scarcity challenges are not seriously tackled (as seen in the wheat value chain in chapter 4). Finally, half of the population could be more productive is women were empowered through tailored services and programs targeted to maximize their training, access to financing, leadership and decision-making roles in farm related institutions.

132 The achievement of the country's objectives of increased commercialization and rural income and decreased rural poverty appear hindered by trade policies, marketing interventions, commodity taxation (cess) and poor transport infrastructure. While Tanzania moved away from agricultural export bans, its policy instruments remain biased towards distorting trade measures such as export restrictions and import tariffs (e.g. for wheat and rice). Export taxes are shown to not have the desired effect of increasing domestic processing, and the share of government revenue collected from the tax that is channeled back to the sector is very low (Chapter 4.1). Export restrictions (ex. on maize), marketing interventions (ex. on cashews and coffee) and cess (all commodities) lower farmers' prices and thus income without benefiting the sector. Farm gates are also lowered by the high access cost to wholesale markets related to poor transport infrastructure.

133 Reducing rural poverty is closely related to increasing farm income and developing infrastructure. In addition, chapter 4 shows that access to rural services such as irrigation, extension, and improved seeds system is largely correlated to higher income. Public investments in these areas are thus fully aligned with the government's objective, provided they reached the needed levels. However, access

to extension service does not appear geographically optimized, with officers being closer to large cities than to rural areas most in needs of the service.

134. The current set of agricultural expenditures has mixed effects on the objective of improving food security and fighting malnutrition. On the one hand, both remaining research and the seed systems are currently strong assets for Tanzania to have a diversified agriculture that provides the range of food needed to fight malnutrition. The fast development of the fruits and vegetables production is in line with the objective of fighting malnutrition. On the other hand, the low resources allocated to research and varietal development beyond maize might jeopardize on a mid-term agricultural and thus nutritional diversification in the country. In addition, policy distortions lower farmers' income also reduce food affordability for these rural households. In urban areas, import taxes increases the price of imported commodities such as rice and wheat for consumers. Lack of investments on climate change adaptation and the low access to irrigation increase the vulnerability of the country to production shocks related to extreme weather, pests and diseases and thus the negative expected impact of climate change on food security.

135 Sustainability targets, including those expressed in Tanzania's international commitments, ASDPII and the Climate Smart Agriculture Plan, cannot be achieved with the current level of funding, jeopardizing the achievement of all other objectives. ASDP II financing gap is particularly large on the "Sustainable Water and Land Use Management". Tanzania's actual yearly budget for agricultural adaptation is far below any existing strategy for adaptation budget, and allocation to its CSA Plan about of quarter of the estimated needs. While adaptation is highly innovation intensive, public agricultural research is crucially underfunded. Irrigation also suffers from underfunding, particularly on the donors' side, and only reaches 2 percent of farmed area in 2019/20. Policies and expenditures are thus not aligned with the objective of having sustainable agricultural growth. Land degradation is extremely concerning in Tanzania and its related losses in the provision of ecosystem services has been estimated at USD 2.2 billion per annum ((Nkonya et al. 2016, World Bank 2019c), but is not among the policy priorities. Policies and expenditures are thus not aligned with the objective of having sustainable agricultural growth.

136 Finally, while Tanzania engaged on a decentralization path, LGAs development expenditure collapsed over the review period. Two thirds of the agriculture budget is spent at the central level, leaving LGAs with low budget over 2017/18-2019/20 for agricultural development expenditures. The share of LGAs development expenditures decreased from a low 19 percent in 2017/19 to 2 percent in 2020/21 and the share of wages increasing to reach 80% of local agricultural budget in 2019/20. The share of recurrent versus development expenditures between the local and central government reflects the distribution of roles and responsibilities between central and local levels, with the central level taking back project implementation responsibilities which is against the decentralization by devolution policy.

5 Conclusion and policy recommendations

137. This Agricultural Public Expenditure Review sheds light on the evolution and effectiveness of Tanzania's public spending on the sector from 2017/18 to2021/22. Public expenditure in agriculture plays an important role in the provision of key public goods and services and supporting farmers to promote sustainable and inclusive agricultural development. While the absolute value of these transfers is very low in Tanzania, this PER also explores the mechanisms and channels through which this budgetary support is provided and evaluate its alignment with the priorities of the government.

138. While the budget to the agriculture sector has been low and volatile, averaging 2.25 percent of its national budget over 2017/18-2021/22, is has been mostly focused on delivering public goods and is about to be geared up. Tanzania's agricultural expenditures are mostly targeted towards the provision of public goods and services. Combined with bold steps in improving the business environment, they allowed agricultural growth over the past years. Yet this report provides strong evidence that the levels of agricultural public good provision are beneath what is needed for the sector to reach its potential in an inclusive and sustainable way. The 2022/23 budget for agriculture is announced to benefit from historical increases. It appears all the more needed that tight sector budget left little fiscal space for development expenditures and led to insufficient support for critical public services needed to catalyze agriculture transformation. For instance, two thirds of actual agricultural expenditure at central level were spent on recurrent expenditures, which do not support the growth of the sector. In addition, three quarters of agriculture budget was allocated at the central level, contrary to decentralization by devolution policy.

139. This PER also highlights that despite progress, low outturns and execution rates in Tanzania compromise the credibility of the budgeting and planning process and prevent policy implementation. The governance process attempts to make inclusive and participative budget decisions, but progress is slow and hampered by poor budget monitoring. Moreover, access to budget data has been a challenge in recent years and the quality of data collection and budget monitoring deteriorated over the decade.

140. Our analysis shows the high value-for-money of investing in agricultural public good provision and identifies several key areas for improvement, starting with the need for improved climate change resilience. Despite some well targeted interventions that helped strengthen productivity and competitiveness in some value chains, and an overall enabling environment, in net, farmers remain taxed for engaging in agriculture production in Tanzania. Our effectiveness analysis also reveals that agricultural public service delivery deteriorated over the past decade, with the notable exception of access to improved seed. Public investments in seed system, irrigation and extension services have yielded high returns, calling for increased public funding.

141. On the whole, policy coherence—analyzed through the lens of ASDP II—could be improved, with development of the livestock sector and sustainability issues standing out as forgotten priorities. While the livestock sector has large potential to contribute to agricultural growth, rural poverty reduction, and food security, it is a forgotten priority on all accounts. Overall, a number of factors hinder the objective of achieving higher productivity: extremely low agricultural research funding, inefficient innovation dissemination through extension services, price distortions that disincentivize producers to invest in new technologies, and a high gender gap. Similarly, trade policies, marketing interventions, commodity taxation (*cess*), and poor transport infrastructure impede achievement of objectives to increase commercialization and rural incomes and decrease rural poverty. Current agricultural expenditures have mixed effects on the objective of improving food security, with agricultural diversification a strength for Tanzania to foster. Finally, sustainability targets on climate change adaptation and preventing soil degradation cannot be achieved with current low level of funding, jeopardizing the achievement of all other objectives.

142. The key finding of this PER and analysis of policy coherence shed light on potential levers to improve the effectiveness of Tanzania's public incentives to its agriculture sector. The existing agricultural policy toolbox provides a strong basis to speed Tanzania's agriculture sector's ability to contribute to sustainable and inclusive growth, create jobs, and fight rural poverty and food insecurity. We propose three categories of actionable policy options, as Table 6 summarizes and prioritizes.

Table 6 - Time prioritization of detailed proposed actions

RECOMMENDATIONS	SHORT TERM (2022-2024)	MID TERM (2024-2026)	LONG TERM
1. INCREASING PUBLIC FUNDING FOR AGRICULTURAL PUBLIC GOODS	• **Increasing public investments in the development of agriculture and livestock sectors** • Scaling up budget for research, water-efficient irrigation and CSA Plan • Reallocating 20 percent of LGA revenues to agriculture • Evaluating scope and impacts of cess and agencies taxes	• Allocating 0.5% of agricultural GDP to research • Developing alternative funding for research, extension and irrigation • Rationalizing cess and Agencies taxes	• **Allocating 1% of agricultural GDP to research** • Ensuring financial sustainability with private funding
2) BOOSTING THE EFFECTIVENESS OF PUBLIC EXPENDITURES	• **Aligning budget with climate change resilience and soil and water protection** • Improving access to extension • Bridging the gap between area equipped for irrigation vs. used • Reallocating input subsidies to less distortive support • Fast-tracking enabling environment reform (Blueprint) in agriculture • Phasing out *ad hoc* marketing interventions (ex. cashews)	• Optimizing spatial distribution of funds and investments • Building institutional linkages between research & extension • Improving extension coordination at central level • Piloting e-extension • Promoting farmer-led extension and irrigation	• Upscaling e-extension • Improving water use efficiency
3) IMPROVING PUBLIC EXPENDITURE PLANNING, EXECUTION AND MONITORING	• **Improving budget outturn and execution** • Improving coordination with donors • Revitalizing ASDP II basket fund • Improving access and quality of data on public expenditures	• **Rebuilding monitoring and evaluation capacity** • Improving coordination between agencies and line ministries (ex. feeder roads) • Developing early agricultural information system	

1) INCREASING PUBLIC FUNDING FOR AGRICULTURAL PUBLIC GOODS

145. **This report makes a strong case for the need to increase Tanzania' agricultural public good funding to reach sectoral and national objectives, reinforcing the new administration's resolve to support the sector**. While Tanzania's agricultural expenditures mostly target provision of public goods and services, in line with ASDPII objectives, spending is beneath what is needed for these public goods to be actually delivered. Tight fiscal space for the sector currently leads scarce resources to be mainly focused on recurrent expenditures, while growth, productivity, competitiveness, sustainability and food security all require increased development expenditures. The government has already moved in this direction in 2020/21 by increasing spending on development expenditures. On May 2022, Tanzania's Parliament approved a historically high budget for agriculture, doubling, for instance, MoA's allocation. These bold

steps must translate into real action—that is, by increasing actual disbursements to key public services—for agriculture to become a growth engine for Tanzania's economy. It is critical that additional funding continues to target provision of public goods and refrains from reinstating distortive subsidies.

146. **Scaling-up investments on the livestock sector, with a focus on climate change resilience and mitigation, represents another example of "low hanging fruit" to boost agricultural growth and fight rural poverty**. Livestock is mostly forgotten compared to crops in all aspects, including budget allocation, provision of extension services, or dedicated research. Animal production is key to fighting malnutrition, improving food security and contributing to climate change mitigation. The latter will require strong support from veterinary and extension services. The adoption of climate-smart livestock practices requires training of producers, capacity building, and smallholder aggregation. An initial needs assessment would help understand existing initiatives and resources, and its results should drive the design, implementation and monitoring of livestock mitigation pathways (World Bank, 2021a). This can be done by strengthening cooperation, communication and knowledge sharing among relevant stakeholders in the sector, promoting practices that reduce GHG emissions, which will in turn improve productivity and livelihoods.

147. **Tanzania needs to significantly scale-up public funding for agricultural research capacity to rescue existing capacity and knowledge for both the crop and livestock sectors and build climate change resilience**. Investments in the Agricultural Knowledge System have among the highest returns for SSA agricultural productivity, but they need to be tailored to the country and must address environmental challenges such as climate change. While Tanzania still has a solid base and strong partnerships to rebuild agricultural research, significant scale-up of investments in both crop and livestock research are crucially and urgently needed before knowledge creation and transmission comes to a halt due to years of underfunding, deteriorating infrastructure, and insufficient human capital renewal. The Khartoum target (which Tanzania committed to, along its other CAADP commitments) and international guidelines recommend that research budget reach 1 percent of agricultural GDP. While progressive steps could be taken to reach this level, a rapid budgetary flow is crucial considering the state of the country's agricultural research. In this light, the 250 percent increase to agricultural research announced for the 2022/2023 budget is very timely and relevant.

148. **Improved hard and soft infrastructure are required to enhance farmers' connections to markets, as well as their bargaining power**. Excessive transportation costs play a particularly large role in lowering farmers' prices and disincentivizing investments in agricultural value chains. Infrastructure development is a long-term undertaking requiring a concerted financing effort between the government, development partners, and the private sector. Building feeder roads appears to be a priority to improve market connectivity.

149. **Own LGAs' and Agencies' revenues could complement national budget for agriculture development.** Firm steps could be taken to ensure LGAs reinvest a minimum of 20 percent (as per existing directive) of their own revenues, including the agriculture *cess*, back into agriculture. Currently, LGAs own revenues are reinvested in other sectors, particularly the *cess*, resulting in tax on agriculture. In addition, Commissions and Agencies under line agriculture ministries have significant statutory revenue sources, which can bring significant amounts of resources to support their operations. The full scope of these different revenues and taxes is difficult to assess, but avenues exist to increase them in specific and well targeted cases. In particular, TARI could collect royalties and fees for varietal development through the Breeders Right Development Fund. Evaluation would be needed to identify the scope and potential benefits of these taxes and fees to inform streamlining and rationalization (including, for the case of TARI, on the seed market).

150. **Tanzania could further leverage development partners' and private funding to finance agricultural growth**. Donors' contribution to Tanzania's agriculture sector could be increased under the coordination of PMO, MoA, MLFD and MoFP. In the light of the massive financing needs of the sector, it is also very important to leverage private financing, which would require further improvement in Tanzania's business environment.

151. **Tanzania should also explore and boost alternative financing for agricultural research.** The Tea Research Institute of Tanzania (TRIT), which directly collects loyalties and breeders' fees, represents an interesting model. Private sector levies on seeds to better address the needs of farmers have worked well in other countries. Canada, for instance, imposed a mandatory 1 percent levy on the value of the gross sale of all pulse crops and used revenues to fund agronomic research, leading to an impressive 20 percent annual return on investment (Heisey and Fuglie, 2018). Evaluations of the potential for similar approaches for Tanzania's public research institutes could be undertaken. In the longer term, public-private partnerships (PPPs) can—under the right circumstances (Moreddu, 2016)—increase the efficiency of public funding and link this innovation to market demand, leading to wider diffusion. Successful PPPs require careful consideration and implementation of frameworks for intellectual Property Rights (IPRs), governance, and implementation.

2) BOOSTING THE EFFECTIVENESS OF PUBLIC EXPENDITURES

152. **Increasing productivity and reducing rural poverty requires aligning agricultural expenditures with climate change resilience and natural resource protection.** This report outlines a wide body of literature warning of the high costs of climate inaction and of the depletion of natural productive capital (starting with soil and water) in Tanzania. From subsidized value chain development hampered by climate shocks (for example, wheat) to infrastructure made useless by depleted resources (for example, irrigation), it sheds light on how effectiveness of public investments will increasingly depend on the active pursuit of sustainability and climate change resilience. Beyond much needed funding, this PER calls for aligning Tanzania's agricultural budget with the objectives of climate change adaptation and mitigation and for strengthening policy coherence.

153. **Improving geographic targeting of spending can also help increase "value for money".** Tanzania needs to assess criteria for spatial distribution of funds between regions and agro-ecological zones. For instance, investments in irrigation for both large-scale and small-scale farms could be targeted to specific areas and high-value crops beyond paddy rice, such as horticulture. Investments in knowledge to map, assess, and monitor water resource availability and demand appear fundamental to improve targeting of public initiatives. Targeting could also be improved for extension officers, whose current geographical distribution does not seem to match rural needs, particularly for livestock.

154. **The agricultural private sector's own investment capacity could be geared up by fast-tracking enabling environment reform (Blueprint)**. Price distortions, taxation, and excessive access costs generate disincentives for producers to invest in new technologies to improve efficiency and productivity. Reducing or eliminating distortive trade measures and reducing the cost of on-farm fixed capital formation would help increase efficiency. Improving access to rural finance could also foster private farm and cooperative innovation. Protecting innovation also implies fighting counterfeit inputs; this requires development of government laboratories, strengthening TOSCI's role for seed quality control, and scaling-up its current initiatives against fake seeds.

155. **While the Government moved away from export bans on agricultural commodities, more comprehensive reforms are necessary to transform trade openness into growth opportunities**. Beyond remaining trade barriers, such as export and imports restrictions, agricultural trade flows stalled in

Tanzania due to SPS issues (for example, aflatoxin), lack of regional integration due to political interferences, and poor transport and storage infrastructure. Tanzania could tackle these problems by implementing a comprehensive set of investments at different time scales. Further reducing export and import restrictions and *ad hoc* marketing interventions would support farmer prices and market efficiency, while pursuing efficient initiatives—such as enhancing regional trade integration, targeted safety net programs, or monitoring and early warning systems (such as FAO's Global Information and Early Warning System [GIEWS])— can buffer market volatility.

156. **Less distortive and more efficient measures could replace current input subsidies to support producers.** Input subsidies decrease competitiveness, so farm support could be reallocated to fixed capital formation (for example, on farm investments) and on-farm services, which would be much more in line with ASDPII goals and might contribute to structural transformation. However, it is important that these transfers do not become recurrent and are well targeted to achieve desired outcomes.

157. **Over one-half of existing formal irrigation systems appear to be neither used nor functioning, calling for in-depth analysis and corrective actions.** The high cost-to-benefit ratio of irrigation investments calls for increasing government, donors, and private sector investments to increase area under irrigation and irrigation efficiency. The 2022/23 budget, which allocates a large increase for irrigation, represents a laudable, unprecedented positive step. Considering the country's wide needs, public expenditures could leverage farmer-led irrigation as a cost-efficient pathway to develop irrigation. In any case, it is critical that Tanzania pursue efforts to understand and address the roots of the widening gap we observe between (i) area equipped for irrigation (National Irrigation Commission data) and (ii) irrigated area used by farmers (National Sample Census of Agriculture data). The gap could arise from a lack of maintenance, monitoring, and rehabilitation; lack of water resources; or misalignment between infrastructure developed and users' needs or capacity to use the infrastructure—with each calling for different sets of corrective actions. The ongoing "Tanzania Assessment of Governance of Service Delivery in Water Resource Management" (P177498) and "Resilient, Inclusive, Sustainable and Efficient Irrigated Agriculture in Tanzania" (P177178) ASA might contribute to understanding the root causes of Tanzania's irrigation problem.

158. **The effectiveness of spending on the delivery of extension services has large margins of progression**. Chronic lack of capital investments, including in transport, contribute to prevent extension departments from effectively undertaking their mission. Acknowledging this problem, the Government has recently announced a massive increase in the sector budget for extension, in particular for purchase of motorbikes, extension kits, and soil testing kits for extension officers. In addition, support for farmers' groups, demonstration plots, farmers' field study tours, and agricultural shows are key tools to leverage extension knowledge. Linkages between research and extension services appear broken—due to problems on both sides—and need to be actively rebuilt at the institutional level to allow lab innovation to benefit farmers, as in other countries. In Ethiopia, for instance, Research Extension Liaison Committees and Councils at both national, provincial, and district levels have proved effective. The current institutional arrangement stemming from decentralization does not disseminate national priorities at the field level. Evidence, requiring corroboration by additional study, suggests that non-public extension services might benefit agricultural transformation more broadly. These results suggest that extension services might gain from active government promotion to encourage further spread of alternative extension provision by farmers themselves (farmer-to-farmer extension) and cooperatives. Stronger central coordination would be needed to ensure that extension networks complement each other. Further development of nascent extension digital platforms may also represent a promising method for disseminating locally-adapted knowledge at lower cost. On the livestock sector, strong extension services are needed to support

producers— especially smallholders—in implementing climate-smart livestock programs, improving animal health, and adopting practices towards higher productivity of livestock.

3) IMPROVING PUBLIC EXPENDITURE PLANNING, EXECUTION AND MONITORING

159. **Key weaknesses related to public spending for ASLMs and LGAs stem from governance weaknesses in the budgeting process**. These include weak linkages between policies, programs, and the budget process; unrealistic budget estimates not matched with released funding (low outturn and execution rates); late release of funds; a weakening budget consultative process with agriculture stakeholders; and poor access to agriculture budget data. We thus propose the following priorities for public expenditure governance.

160. **Scaling-up budget predictability, budget outturn and execution**. Budget credibility in Tanzania is poor and has been deteriorating, hampering the capacities of line ministries and agencies to conduct strategic planning and prioritization. We observe large gaps between committed resources and resources actually received. Low budget outturn explains extremely low development budget execution rates compared to high recurrent budget, with agriculture lagging all sectors. Without access to promised resources, actions cannot be implemented in the field and development stalls.

161. **Rebuilding monitoring and evaluation capacity for agricultural public expenditures**. Quality, comparability, and accessibility of budget data have significantly decreased over the past five years. The current weaknesses in collecting, compiling, and accessing data hampers monitoring and evaluation of public expenditures, leaving policy makers to “fly blind”. This is particularly true for funding flows to and from the large number of agricultural semi-independent agencies as well as LGAs, despite their theoretically key implementing roles. Information on off-budget financing is scarce, incomplete, and unreliable. This calls for strengthening Government capacity to collect harmonized data and monitoring financial flows. We recommended developing a data gathering mechanism and archiving database to enable some PERs every year and in-depth PER every three years.

Improving foreign funding coordination to support Government priorities and ASDP II. For Tanzania to meet ambitious development goals and transform its agricultural sector into a growth engine, all partners must pull in the same direction. Along with reinforcing the annual budget stakeholder consultation, improved development partner coordination would better align their support with Government priorities and improve off-budget reporting to inform decisions. A critical aspect of this coordination is ensuring that on and off-budget projects implemented at the district level align with District Agricultural Development plans (DADPs). Revitalizing a basket fund to support ASDP II could be highly relevant in this area.

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Annex 1: PER data

Votes included	Agriculture (COFOG+)	Rural development	Comment
003 - National Land Use Planning Commission	yes	yes	
005 - National Irrigation Commission	yes	yes	
024 - The Tanzania Cooperative Development Commission	yes	yes	
037 - Prime Minister's Office			
5306 - Strengthening Climate Change& Early Warning System	yes	yes	
6575 - Strengthen National Disaster Preparedness	yes	yes	
4494 - Market Infrastructure, Value addition and Rural Financing	yes	yes	
043 - Ministry of Agriculture	yes	yes	
046 - Ministry of Education, Science and Technology			
4393 - Free Secondary Education Programme / 22170 Food Supplies And Services	yes	yes	
048 - Ministry of Lands, Housing and Human Settlements Development			
048.2001 - Land Administration Division	yes	yes	
049 - Ministry of Water / Rural Water			
049.4001 Rural Water Supply		yes	
056 - President's office - Regional administration and Local Government Authorities			
056.2003 - Sector Coordination Division / 4486 - ASDP	yes	yes	
056.2003 - Sector Coordination Division/3280 - Rural Water Supply and Sanitation Programme		yes	
056.1009/4169 and 4170 – Infrastructure & Roads		yes	Hypothesis: 50% for rural areas
056.2007 - Health, Social Welfare and Nutrition Services/ 5420 - Basic Health Service		yes	
056.2007 - Health, Social Welfare and Nutrition Services/ 5421 - Health Sector Basket Fund		yes	
056.2004 - Basic Education Coordination Division		yes	
058 Ministry of Energy Rural Energy			
058.3001/3113 - Rural Energy Agency & Fund		yes	
060 - Ministry of Industry and Trade			
060.4002 - Commodity Market Development Division	yes	yes	
064 - Ministry of Livestock Development and Fisheries-Fisheries	yes	yes	
069 - Ministry of Natural Resources and Tourism			
069.3001 - Forestry and Beekeeping	yes	yes	
TFSA	yes	yes	
099 - Ministry of Livestock Development and Fisheries-Livestock	yes	yes	
Regional Secretariats (agriculture)	yes	yes	
LGAs (agriculture and livestock)	yes	yes	No actual

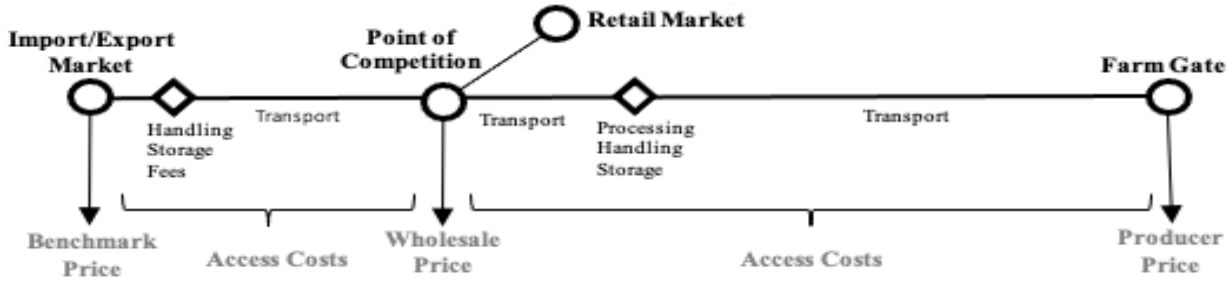
Annex 2: Price incentive analysis: methodology and detailed summary

To gain a deeper understanding of the policy and market influences that agricultural producers are facing, this Annex details the estimates of market price distortions for several commodities.

The approach that is applied compares the price the farmer is receiving at the farm gate to a reference price, which is assumed to be undistorted. This reference price is computed by using the CIF price ("cost, insurance and freight") or FOB price ("Free on Board"[8]), dependent on the trade status of the commodity, and by accounting for marketing margins and exchange rates. A positive price gap indicates that the domestic price of the commodity is higher than the reference price, implying that in net the policies and market functioning are generating incentives for producers to increase production**.** For a net imported commodity, this could be due to distortions such as the existence of import barriers. Similarly, a negative market price gap implies that the reference price is higher than the domestic price, which means that the policy environment and marketing functioning is disincentivizing producers.

The price gaps reveal how agricultural policies in combination with market circumstances affect domestic prices that farmers receive compared to international prices of the same product. This allows quantifying the difference between the possibly distorted domestic price and a price that would be prevalent if no policies or other market distortions were in place. Analyzing these effects helps to understand how policies can be driven towards more efficient and target-oriented solutions. For an exported product, the FOB price is used as basis to calculate the reference price, while the CIF price is used for imported commodities. In a next step, the border prices are adjusted for marketing margins, weight conversion factors are applied, and quality adjustments used to ensure a 'like with like' comparison at the farm gate level.

Figure A.1. Components of the Nominal Rate of Protection



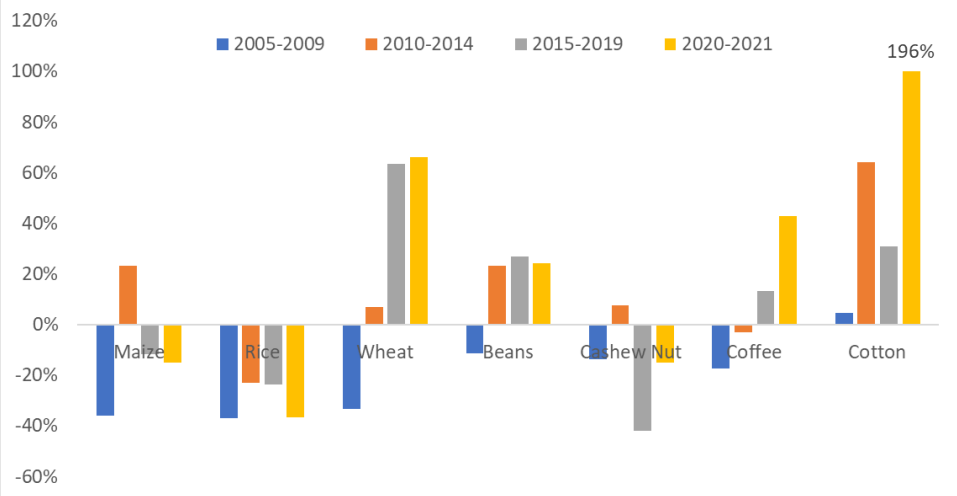
Putting the prices into a ratio allows to compare the domestic farmgate price and the reference price among products and countries. Price gaps at wholesale and farm gate are divided by their corresponding reference price and expressed as a ratio, referred to as the Nominal Rate of Protection (NRP), which can be compared across commodities and countries. If public expenditure allocated to any of the commodities analyzed is added to the price gaps at the farm gate when calculating the ratios, the Nominal Rate of Assistance (NRA) is generated. This indicator summarizes the incentives or disincentives due to policies, market performance and public expenditure. In line with the approach proposed by Krueger et al. (1988,

[8] These are terms are used in international trade in relation to shipping, where goods have to be delivered from one destination to another through maritime shipping

1991), NRPs have been used mainly to examine two types of policies: (i) direct support to the agriculture sector or a specific value chain through direct and sector-specific price policies (or interventions); and (ii) indirect support through trade policies, exchange rates and any other macroeconomic or non-agricultural policies.

The commodities that are analyzed in this report cover the imported cereals rice and wheat, in addition to the exported products maize, beans, coffee, cashew nut and cotton.

Figure A.2 - Nominal Rate of Protection (NRP) at Farmgate for all covered commodities



Overall, figure A.2 shows that price distortions are prevalent throughout the observed period, indicating policy and market influences are driving the wedge between the domestic and border reference price. For the commodities maize, rice and cashew nut, the NRPs are mostly negative, while they are strongly positive for wheat, beans and cotton, and fluctuating for cotton. This implies that agricultural producers are receiving prices in the domestic market that are either lower (if the NRP is negative) or higher (if the NRP is positive) than the respective reference price. While policy measures are important factors influencing this price gap, market inefficiencies also contribute to agricultural producers being implicitly taxed or supported (e. g. functioning as market barriers for imported products).

Analysis at the commodity level NRPs at the farm gate reveals that maize producers faced disincentives of an average -9 percent over the period. This was primarily driven by the intermittent and unpredictable implementation of export bans until 2013, followed by a stringent export licensing system until 2017**.** In order to protect consumers from high and increasing prices, maize export bans were used as protective measures between 2005 and 2012 and reinstated in June 2017 to curb high prices, which had doubled between August 2016 and April 2017. Prices subsequently declined by about 40 percent by July following the two main cropping season harvests concluded in July and August (FAO GIEWS, 2017). The ban was lifted in November 2017 when it became apparent that the bumper harvest in the southern regions could not be absorbed by the domestic market nor the NFRA. However, disincentives continued to worsen in 2018 because of the buildup of surplus. Overall, export restrictions coupled with high market access costs represent major obstacles for market integration and price transmission. Tanzania's recent commitment towards maintaining higher producer prices through a more export-oriented trade policy for cereals in recent years is promising.

The NRA for maize in Tanzania was on average 2 percent from 2011 to 2019, 2 percentage points higher than the NRP during the same years due to the consideration of product specific public expenditure (budget transfer) in its estimation. Thereby, input subsidies under the NAIVS programme and output subsidies through NFRA maize procurement above market prices were accounted for when calculating the price distortions. These policies were phased out since 2017.

Between 2012 and 2021, analysis reveals an overall negative, yet fluctuating incentive environment for rice producers. While producer NRPs average -25 percent over the period, they improve continuously from 2012 to 2016, but remain at or below -30 percent between 2017 and 2021. During the period analyzed, both producers and wholesalers were protected by CET for rice imports from outside of the EAC coupled with other trade protective measures such as a restrictive import licensing regime. However, the dynamic of their respective NRP suggest that, over the period, the benefits of protective measures are largely captured by urban wholesalers in Dar es Salaam rather than rice farmers in Morogoro.

Despite sustained incentives for wheat producers, production and yields have not increased. The majority of wheat is produced in northern Tanzania which has in recent years faced extremes in rainfall variation and desert locust invasions. Large commercial farms are shifting to more profitable crops such as legumes which are more profitable and more suited to local environments, which implies that despite the incentives, wheat production in terms of volume or cultivated land has not increased. Since 2000, wheat production has not been able to cover more than 20 per cent of domestic consumption requirements. Although consumers pay wheat prices that are higher than international prices, this has not led to an increase in domestic production and wheat food import bills remain very high.

Expensive import procedures and the import tariff have raised the domestic prices for wheat. The difference between domestic prices and those that would prevail in the absence of trade policies is significantly higher than the value of the import tariff. This means that traders and farmers receive higher prices partly due to expensive import procedures and importers' margins which are well above ten per cent. However, it is not possible to identify the relative weight of each factor behind the price difference. Reducing the import tariff from 35 to 10 per cent has had little impact on wheat wholesale prices except for the year in which it was implemented. One reason for this was that the lower import tariff allowed domestic millers to benefit from lower wheat costs and increase wheat flour exports. As the cost of import procedures did not change significantly from 2007 to 2008, this difference can be attributed to increased importers' margins. In January 2021, in an effort to reduce Tanzania's dependence on imports, the Ministry of Agriculture requested millers, traders, and processors to start sourcing at least 60 percent of their wheat from the domestic market and thus be allowed to import only 40 percent of total demand.

Cashew nut producers in Tanzania have received unstable incentives over the 2005 to 2020 period, from -20 percent in 2005-2007 up to 12 percent from 2008 to 2013, -45 percent in 2014-2018 and finally -15 percent in 2019-2020. Farmers received disincentives of an average -25 percent until 2008 because traders were able to manipulate the market and offer a price much lower than the international equivalent owing to the lack of a coordinated exchange system. In 2008, a warehouse receipt system (WRS) was established to ensure all cashew production would be sold via cooperatives through an auction centrally managed by the Cashew Board of Tanzania (CBT). The system allows farmers to receive a partial payment of 75 percent immediately to meet cash needs so that they were able to sell when prices are favorable, engaging them in the auction market by providing a bonus payment if the cashews sell for more than was estimated at the beginning of the season. High international prices were passed down through the auction to farm gate until 2014, when prices began to diverge. Reports of collusion and price fixing amongst the relatively few buyers at the auction, especially in 2014 and 2015, could explain why domestic prices are much lower than export prices in those years. In 2016, the Cashew nut Board of Tanzania took

measures to reduce collusion but local government intervention in the sector resulted in excess stock that could not be shipped, reducing domestic prices. Another intervention in the sector in 2018 resulted in over 200 000 tons of raw cashew nuts left in warehouses without buyers because the government insisted on a price that would adequately remunerate farmers, even though this was considerably higher than what the market was offering.

The closed bid auction reinforces existing power dynamics and favors incumbent buyers whose interest is in exporting raw nuts for value addition overseas. Reports of collusion and price fixing amongst the relatively few buyers at the auction, especially in 2014 and 2015, could explain why domestic prices are much lower than the international equivalent price in those years. These power dynamics at auction that reinforce export of raw cashew and create barriers for buyers in the nascent processing industry, may have in part driven the government interventions in the market in 2016 and 2018. To encourage domestic processing, an export tax is levied on raw cashew nut exports and has increased incrementally, from 3 to 8.5 percent in 2005, to 10 percent in 2006, and finally to 15 percent in 2010 (UNIDO, 2011). This tax is fully passed down to farmers and thus reduces their income by the amount of the tax. Despite the effect of the tax on farmers, it has done nothing to stimulate domestic processing. The external competitive market and the closed auction fixes the price that the buyers get through the auction and these prices take into account the export tax. While the revenue generated from the tax was intended to support the industry, it is in practice a self-tax and at 15% is a significant reduction in farmer income. In fact, over the period analyzed, exports of raw cashew nuts versus processed nuts increased and very little was channeled back to the sector. Finally in 2018, the government began retaining 100 percent of revenues from the export levy.

Between 2012 and 2021, the price distortion analysis reveals an overall positive, yet highly volatile, incentive environment for coffee producers. Producer NRPs average 18 percent over the period. Over the same period, coffee traders consistently receive positive incentives, except in 2014 and 2016, with an average NRP of 20 percent. Over the period, the NRA trend indicates that Government direct support to producers tends to slightly attenuate the NRP trend. The Ministry of Agriculture administers this direct support in the form of subsidized seedlings, plantlets and pesticides, and the supply of post-harvest and primary and secondary processing equipment (e. g. storage facilities, pulper, huller, roaster, grinders and packaging plant). The volatility of producer NRPs reflects the combined effect of highly fluctuating international coffee prices, in particular Arabica prices, as well as year-to-year variations in domestic producer prices, predominantly for the Arabica production as well. International Arabica prices are highly sensitive to supply factors related to the biennial bearing cycle of coffee trees, particularly in large Arabica producing countries like Brazil and Colombia. Demand factors also play a role as in late 2020 when the main importing markets stockpiled coffee in anticipation of COVID-19-induced supply chain disruptions, thereby leading to a significant increase in global prices. Domestically, changes in the policies governing the coffee value chain and, in particular, the rules and regulations affecting the marketing of harvested coffee beans have an impact on price transmission. The prohibition of purchase at farm-gate by middle-men and the obligation to sell at auction through AMCOS disrupted established marketing and value-chain financing channels and lengthened the transit time from farm to auction, thereby creating market uncertainty for coffee producers. The temporary suspension of direct export contracts in the 2018/2019 season restricted producers' capacity to negotiate premium prices with roasters and international buyers.

The analysis shows that there have been overall positive price incentives for cotton production in Tanzania over the period analysed, with disincentives in 2005-2006 and 2014-2016, but incentives in all other years averaging 47 percent. Price incentives are mainly driven by the indicative price set by the TCB and strong competition among the ginneries for seed cotton. In 2010–2012, price incentives were high and attributable to a spike in international cotton prices in 2010/11. International cotton prices reached

an all-time high in 2011 at US$ 2.05 per pound, before which, cotton had never traded above US$ 1.15. However, owing to the high international prices in 2011, international demand fell, and the international price dropped off in 2012. Another driver of incentives to production may be the excessive ginning capacity in the country, leading to high demand and increased competition by ginners for seed cotton (GAFSP, 2016; Stariz and Troster, 2015). It should be noted, however, that the indicators presented are based on the indicative price of cotton as published by the TCB, and that producers may receive a different final price.

Between the 2012 and 2021, the analysis of the NRPs for beans reveals a positive incentive environment for beans producers, with producer NRPs averaging 26 percent over the period with significant fluctuations. While the NRP remains relatively stable between 2012 and 2015, it shows large fluctuations in the remaining years, with its highest values in 2017 and 2021 and its lowest values in t 2018 and 2020.

The observed fluctuations in producer NRPs for beans reflect the combined effect of farm-gate prices that show a steady increase over the period and a reference price that shows the reverse trend, with the exception of 2020. The export price of Tanzania dry beans is highly sensitive to demand side factors affecting the nearby Kenyan market which is both a large producer and the largest consumer and importer of pulses in the East Africa region. Dry bean producers from the Northern regions of Tanzania benefit from their geographic proximity to large consumption centers like Nairobi and Mombasa which allows for both formal and informal trade flows. They also benefit from chronically underperforming harvests in Kenya itself and its other suppliers due to lack of rainfalls, as well as reduction of imports from Ethiopia that has turned to lucrative markets in South Asia, like Pakistan, in recent years.,

Market inefficiencies also contribute to price disincentives for farmers, as shown in the Market Development Gap Indicator (MDG). The MDG can be interpreted as the potential increase of the domestic producer price if market inefficiencies were removed. Market inefficiencies can be due to poor infrastructure and logistics that lead to high transportation costs, excessive taxes and regulatory fees, outdated processing technology, asymmetrical distribution of market power among marketing agents leading to excessive margins, and illegal bribes and other informal costs. The portion of market costs considered “excessive” is estimated using benchmarks from other similar (but more efficient) countries9, international standards10, or stylized facts on the effects of taxation on domestic prices.11

For exported commodities, the following analysis focuses on the access cost gap that occurs from farm gate to wholesale, in addition to the wholesale to border segment. For net imported products, the segment from the farm gate to wholesale is analyzed, ignoring the second leg and therewith diverting slightly from the MDG methodology. The MDG would consider the segment from the border to wholesale to be protective if excessive access costs were in place, given that it makes it more difficult for imported products to reach the wholesale market, thereby protecting domestic farmers from this competition. More relevant for this study are the excessive access costs that the farmers face to take their commodities to the wholesale market.

Figure A.3 shows the excessive access cost component of the MDG for the analyzed commodities, subdivided by the trade status of the products, as a share of the domestic farm gate price. The values reported below have been weighted by the value of production of the commodities analyzed meaning

[9] For example, to estimate the excessive costs paid for transportation, we use the Logistics Performance Index of the World Bank to compare Tanzania with the most efficient country in the Region, namely South Africa.

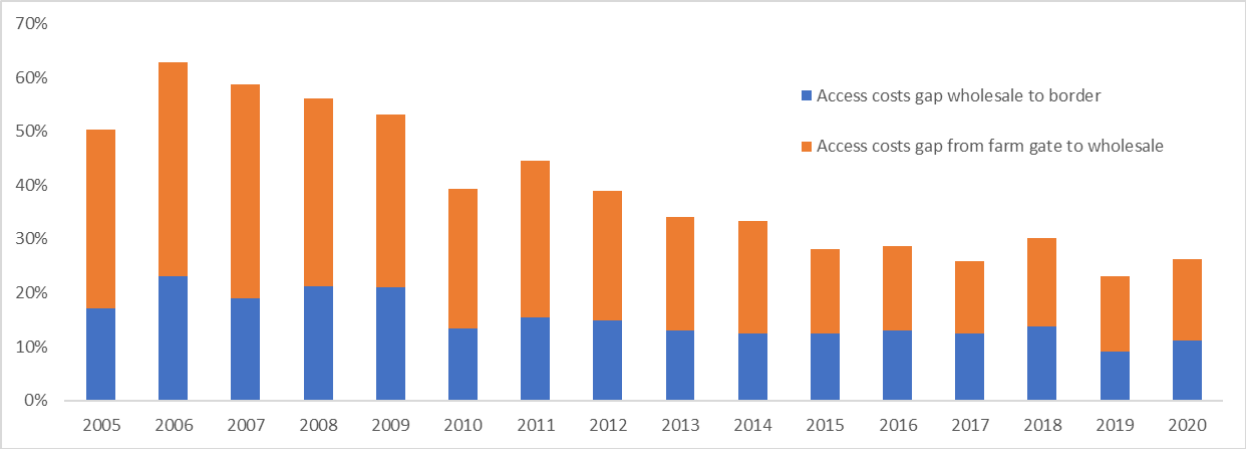
[10] Machinery for processing in Tanzania is often outdated and undermaintained. In the case that the out-turn ratio of processed to raw products is below international standards, this is adjusted where data is available.

[11] For example, we remove cess charged on production and other taxes and fees in the value chain that do not provide a service.

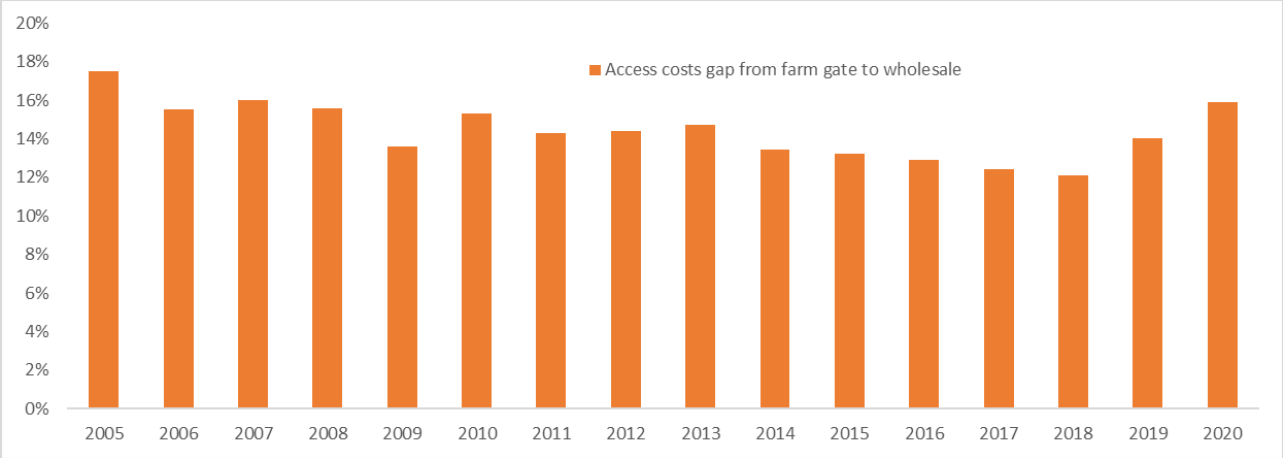
that rice and maize have a strong pull on the indicators in the respective graphs, followed by beans, cotton, coffee, cashew nut and wheat. The access cost gaps are provided for two segments of the value chain for exported products – farm gate to wholesale and wholesale to border, and for one segment, farm gate to wholesale, for net imported products. The figure shows the excessive costs in those segments of the value chain and highlights how these costs if reduced can improve competitiveness of the sector.

Figure A.3: Excessive access costs for exported and imported commodities, weighed by value of production, 2005 to 2021

c) Exported commodities (maize, coffee, cashew, cotton, beans)



d) Imported commodities (wheat and rice)

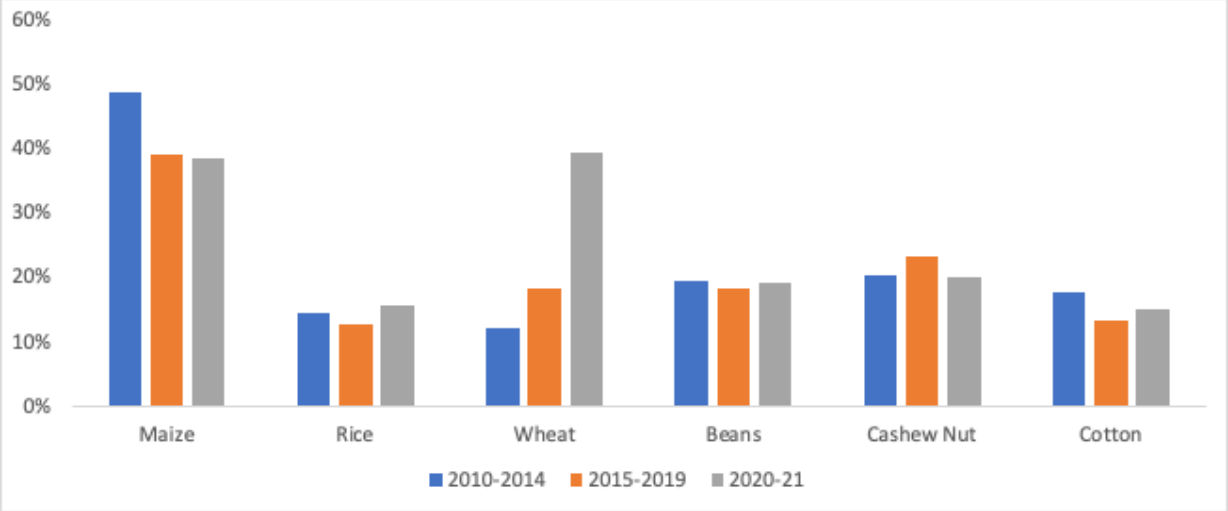


Over the analysed period, excessive access costs, presented as their share of the farm gate price are prevalent in Tanzania throughout all years, indicating that market inefficiencies created disincentives for producers and contribute to the negative NRPs. Excessive transport costs owing to poor infrastructure account for the highest share of the excessive access costs in Tanzania. Comparing Tanzania to the top performer in the region, South Africa, there are significant improvements in efficiency over the period. Tanzania has improved its performance from 60 percent as efficient in 2007 to 80 percent in 2016 for overall logistics performance, and 75 percent for the infrastructure subcategory (LPI, 2018). Therefore, the increasing farm gate prices coupled with improvements in logistics performance have led to the gradual reduction of the excessive access costs over the period for exported products. However, the farm gate price could still increase by 14% for imports and 52% for exports if the excessive access costs would be removed, and by a similar amount for imported products.

In terms of composition, the access costs gap from farm gate to wholesale had a slightly stronger effect on reducing price incentives at 9.2 percent on average versus 7.7% between point of competition and border. Inefficiencies between farm gate and point of competition include processing, post-harvest losses during transport, as well as quality and quantity losses due to lack of standards or outdated processing technology. All commodities are also affected by the taxes collected by local governments, namely produce cess. The produce cess not only creates additional disincentives for producers, but also affects traders adversely since they are often asked to pay multiple taxes when produce is moved to another region. The cess is also charged on small volumes of crops and limits the market access for both smallholder farmers and small traders (PAG/PAC, 2018). The rate for cess fees has changed over the years, but local governments may apply this tax differently.[12]

For imported products, inefficiencies, mostly due to high transport costs between farm gate and wholesale market, still represent a high burden for producers: the access costs gap in this segment accounted for 14 percent of the farm gate price on average over the period. It can also be noted that inefficiencies between the border and point of competition (which are not included in the figure A.3 above), cover high costs for documentation, transport, loading and unloading. It should be noted that although high marketing costs between border and wholesale in theory protect farmers from cheaper imports, the potential to increase farm gate prices is contingent on full price transmission of these efficiency improvements. Furthermore, , inefficiencies reduce the competitiveness of the sector overall.

FigureA.4: Excessive access costs in percent of farm gate price[13], by commodity, 2010 to 2020/21



At commodity level, the highest inefficiencies are found in the maize export value chain in the north at an average 58 percent of the farm gate price over the period 2005 to 2021. Throughout the entire period, the excessive access costs indicate that high transportation costs, excessive fees, bribes and intermediaries' margins along the value chain penalized farmers. While it might be encouraging to see the declining share of these costs as a share of farm gate prices over some years for some products, it is important to note that the absolute value of these costs per ton has increased, indicating worsening

[12] According to the amendments of the Local Government Finance Act, the maximum rates have been 5 percent from 2007 to 2009, 3 percent in 2010, and 3 to 5 percent from 2011 (ACT, 2013). Cess rates on both food and cash crops were reduced to 3 percent in 2018, but there is a view to further reduce the cess on food crops to 1 percent (PAG/PAC, 2018).

13 For exported products, this includes the leg from farm gate to wholesale and from wholesale to the border. For imported products, this covers the leg from the farm gate to wholesale.

market conditions. Assuming related efficiency improvements would be fully transmitted to the farm gate, maize producers could have received on average 50 percent or higher prices over the period, if logistics infrastructure could be improved to reach the level of South Africa, if the margins for traders could be reduced; and if the produce cess were removed in favour of alternative means of revenue generation for local government authorities.

The excessive market access costs for cashew nuts estimate that excessive margins, local production tax, and high administrative fees associated with the WRS, penalize domestic farmers by an additional 20 percent of the producer price, on average over the period. In addition to the produce cess collected by local governments, other taxes and levies faced by cashew farmers include a development levy, an education levy (together 2.2 percent of farm gate price), and the optional Pembejo levy of 3 percent that the government matches in contribution to subsidized inputs.

Inefficiencies in the coffee value chain averaged 22 percent of the farm gate price and are composed mainly of excessive taxes and fees, the majority of which are between the farm gate and point of competition and are composed entirely of the 5 percent local government levy. Like other export crops, coffee is subject to this levy, which is an important source of revenue for the local government. Nonetheless, this creates a negative pull on the farm-gate price. High losses are likely attributable to quality issues between the farm gate and point of competition, however it will require additional analysis to quantify precisely.

Overall, the analysis of the excessive access costs further emphasizes the importance of public goods and services to create an enabling environment. It highlights that spending on provision of public goods and services can play an important role in improving the competitiveness of the sector by reducing market frictions and excessive cost of doing business. Removing these barriers would also incentivize investment in the sector that improves productivity and sustainability.

Annex 3: List of stakeholders interviewed in field work (effectiveness analysis)

S/NO	Name	Organization
1	Jumapili Mpoki	Yangu Macho Group
2	Magaret Swai	TOSCI
3	Kelvin Milinga	TOSCI
4	Emanuel Mwakatobe	TOSCI
5	Zara Mwanamkemwa	TOSCI
6	Sophy Kashenge	ASA
7	Paskalina Hayuma	Ministry of Agricuture
8	Zakaria Gadili	Ministry of Agricuture
9	Savera Mwinyijuma	Ministry of Agricuture
10	Charles Mjema	Ministry of Agricuture
11	Reginald Tsafu Diyamet	National Irrigation Commission
12	Deogratias Lwezaura	TARI
13	Naomi Mcharo	National Irrigation Commission
14	Fatma Mwera	National Irrigation Commission
15	Erick Komba	Tanzania Livestock Research Institute
16	Jonas Kilima	Tanzania Livestock Research Institute
17	Neema Urasa	Tanzania Livestock Research Institute
18	Agnes Woiso	Dodoma Municipality
19	Venance Masawe	TOSCI
20	Mpanda	Moshi District Council
21	Doto Makungu	Uchira Village- Moshi District Council
22	Kamwa Kateta	Uchira Ward- Moshi District Council
23	Mgala Barakaeli	Uchira Irrigators Association- Moshi District Council
24	Godfrey Kavishe	Uchira Irrigators Association- Moshi District Council
25	Rose Ubwe	TARI Selian
26	Zabron Msengi	TARI Selian
27	Amos David	Kibaha Town Council
28	Cecilia Mushi	Kibaha Town Council
29	Gloria Mmbando	Kibaha Town Council
30	Rehema Mhalule	Mvomero District Council
31	Richard Mfikwa	Dakawa Ward -Mvomero District Council
32	Revocatus Leonard	Nyandila Ward- Mvomero District Council
33	Josephat Kaishaigili	Sokoine University of Agriculture
34	Wilbert Komba	Mbeya Municipal Council
35	Amina Msoke Nalicho	Mbeya Municipal Council
36	Maneno George	Iganjo Irrigation Scheme -Mbeya
37	Francis Jonas	Iganjo Irrigation Scheme -Mbeya
38	Hezron Mwakingili	Iganjo Irrigation Scheme -Mbeya
39	Dickson George	Iganjo Irrigation Scheme -Mbeya
40	Mawazo Hezron	Iganjo Irrigation Scheme -Mbeya
41	Steven Demo and John Soda	Iganjo Irrigation Scheme -Mbeya

BACKGROUND PAPER 1 – Deep dive on irrigation

1. WHY FOCUS ON IRRIGATION IN TANZANIA?

Irrigation supports high-value agricultural production by reducing production losses due to dry spells, supporting diversification into higher-value crops, adding a third cropping season and changing the cropping calendar in a manner for produce to be available on the market when prices are higher. Over seven million hectares of land are classified in Tanzania as suitable for irrigation from numerous rivers, lakes, wetlands, and aquifers. Despite these known benefits and public investments over the past decade, Tanzania's agriculture remains mainly rainfed. The World Bank 13th Tanzania Economic Update (2019a) on Transforming Agriculture states that the "future well-being, [and] the resilience to climate change of the livelihoods of at least 70 percent of Tanzanians depends on the relationship between agricultural productivity and soil and water management".

Water resources availability, already low and declining, will tighten with climate change, calling for increased irrigation efficiency and careful planning. Tanzania is constantly alternating between floods and droughts. Total renewable water resources are stable overall at 96.27 million m3/yr, but due to its rapidly growing population, water available per capita in Tanzania halved over the past 30 years to below 1,700 cubic meters. Tanzania is thus today a water-stressed country (World Bank 2019b). Its national demand amounts to 150 percent of accessible water during dry periods (after accounting for environmental flow requirements) and will increase to 216 percent by 2035 (2030 Water Resources Group, 2016). Agriculture is currently responsible for 89 percent of freshwater withdrawals, mainly attributed to irrigation (80 percent) and agro-processing (9 percent). Water availability and its agricultural use vary by location, with the two main water basins (Rufiji and Pangani) already experiencing severe water conflicts (World Bank 2019b). In this context, the critical development and implementation of irrigation system will require careful planning and management of water resources.

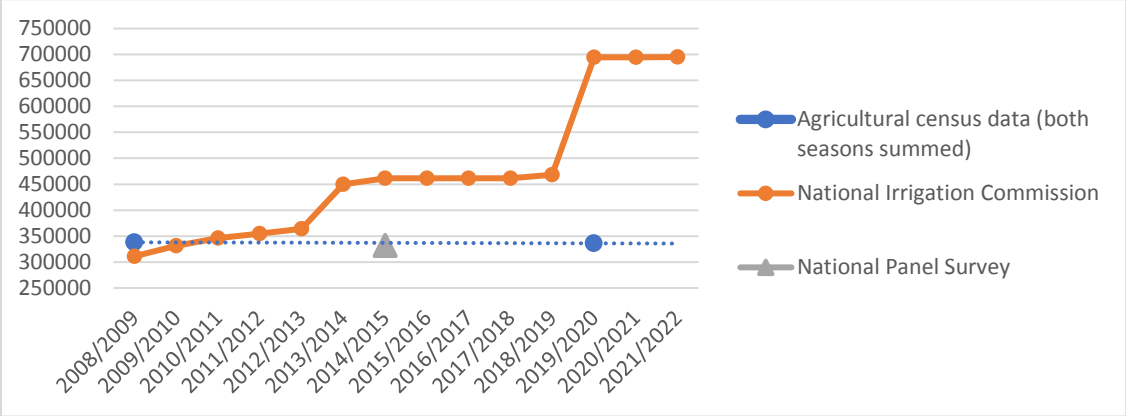
This report complements two on-going complementary studies on irrigation in Tanzania. The "*Resilient, Inclusive, Sustainable and Efficient Irrigated Agriculture in Tanzania*" (P177178) study focuses on sustainability, resilience, and viability of irrigated agriculture. The *"Tanzania Assessment of Governance of Service Delivery in Water Resource Management"* (P177498) assesses governance and institutional constraints to service delivery in the irrigation and water resources management sector. This chapter focuses on the efficiency of public expenditures.

2. IRRIGATION IN TANZANIA

Over half of the formally existing irrigation system appears neither used nor functioning in Tanzania, and the gap between area equipped for irrigation and area actually irrigated is widening. Area under irrigation in Tanzania varies widely depending on data sources. According to the National Sample Census of Agriculture data, the total area under irrigation was 289,385 ha in 2019/20 but the National irrigation Commission (NIC) records an irrigated area of 694,715 ha for the same year. Figure B1.1 displays the evolution of irrigated areas according to the two sources over 2002-2021. The widening gap is all the more striking in that we would expect census data to partially reflect informal irrigation systems, acknowledged as large (particularly during the wet season, World Bank 2019b) in addition to the formal one, and thus to exceed official numbers. We analyze the NIC data as infrastructure built or rehabilitated, which thus increases over years; while the census data reflects current use of irrigation systems. However, the widening gap observed calls for further and careful field investigation on its root causes.

Multiple reasons can explain low exploitation of the irrigation system. First, they may suffer from lack of maintenance, monitoring, and rehabilitation of the irrigation system. Another potential reason could be lack of water resources. USAID reports that weather variability and climate change have diminished water volumes in many water bodies including the Ruaha and Ruvuma Rivers (USAID 2018). A final possibility could be misalignment between infrastructure developed and users' needs or capacity (technical, financial) to use the infrastructure, which might require a shift in their crop system. Further analysis based on farmers' survey would be needed to investigate these hypotheses.

Figure B1.1. Comparison of area equipped for irrigation (National Irrigation Commission data) and area irrigated used by farmers (National Sample Census of Agriculture and National Panel Survey data)



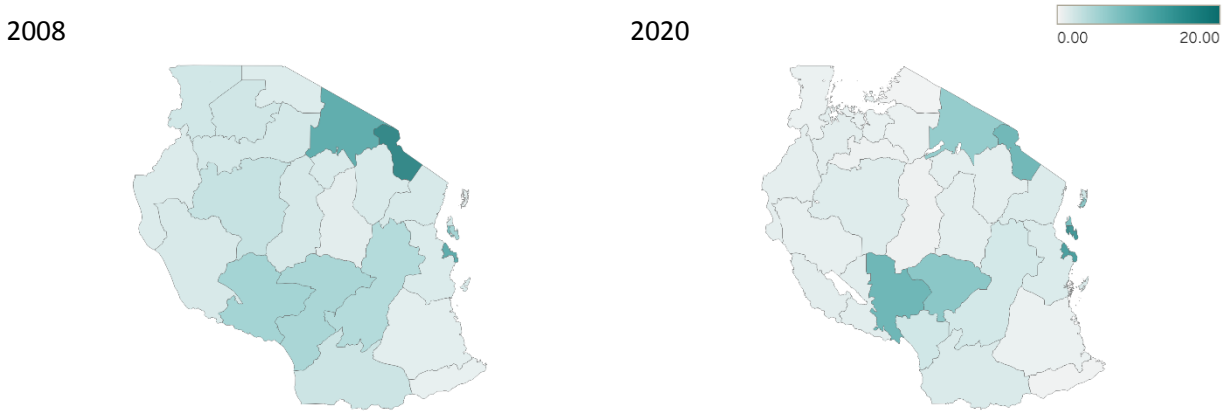
Source: authors. Data NCO, 2008 and 2020 National Sample Census of Agriculture and 2014 panel survey

Irrigated areas shifted between 2008 and 2020 (Figure B1.2). Between the two agricultural censuses, area under irrigation declined in place such as Kilimanjaro and Arusha. Conversely, farmland near Dar es Salaam and in Mbeya appears more irrigated in 2020 that 2008, potentially due to the growth of vegetable farms selling to the urban market. The story of irrigation therefore seems to be one of gaining and losing at the same time.

Despite public investments, the total area farmers irrigate decreased over the past decade, representing in 2020 a dramatically low share of 2 percent of farmed area. According to National Sample Census of Agriculture data, the area irrigated (both seasons summed) decreased from 338,000 hectares in 2008 to 336,000 hectares in 2020 (-0.5 percent), while total area planted increased from 10,523 to 13,908 thousand hectares (+ 32 percent). The share of area irrigated thus decreased from 3 to 2 percent, implying Tanzania's agriculture is overwhelmingly dependent on rainfall. However, 261,920 more farms in 2020 irrigated up to 0.25 ha, with irrigated areas being, on average, smaller per farm. Small farms are more likely to irrigate and are more likely to irrigate a greater share of their farm.

Irrigation methods remain rudimentary, with extremely low efficiency, as displayed in Figure B1.4: over half of it is hand water buckets, and a one-third gravity irrigation. The World Bank (2019b) has shown that over 70 percent of water withdrawn for irrigation in Tanzania is lost or poorly managed. Smallholder irrigation schemes are mainly gravity systems with low transmission efficiencies using rudimentary or dilapidated canal systems and poor on-farm practices. The 10th Tanzania Economic Update (TEU) - Managing Water Wisely (World Bank 2017) urgent called for improved water resources management, water use efficiency, and cross-sectoral coordination.

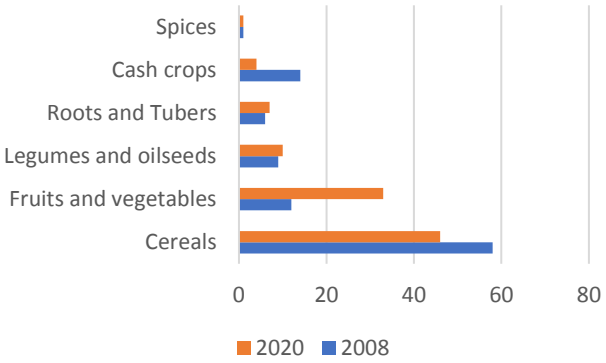
Figure B1. Share of planted land in each region that is irrigated (%)



Source: Authors. National Sample Census of Agriculture data 2008 and 2020.

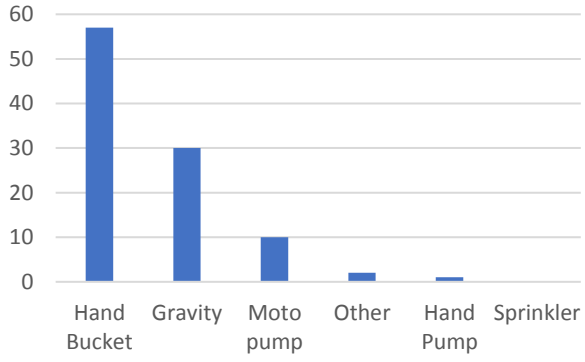
While irrigation remains mostly used for cereals, its uses are shifting from cereals to horticulture, which has higher nutritional and market values and is more climate resilient. 46 percent of crops irrigated are cereals (paddy rice and maize). However, irrigated area under cereals has increased over the past decade while irrigated area under fruits and vegetables has decreased (Figure B1.3). Many farms now irrigate just a small section of their farms (on average, 38 percent in 2020), less than 0.25 hectares — likely gardens for household consumption. Usages have thus shifted since 2008 with irrigation becoming more of a way to tend gardens along with the rising popularity of producing fruits and vegetables. Whilst staple crops such as rice and maize are water-thirst crops with low market values, the shift to fruits and vegetables with higher-value and better nutritional potential is a positive trend for a number of reasons, including that these crops have better climate resilience (World Bank 2019b).

Figure B1.3. Evolution of the area irrigated by crop category (percentage) between 2008 and 2020



Source: Authors. National Sample Census of Agriculture 2008 and 2020

Figure B1.4. Method or irrigation in 2020 (percentage)

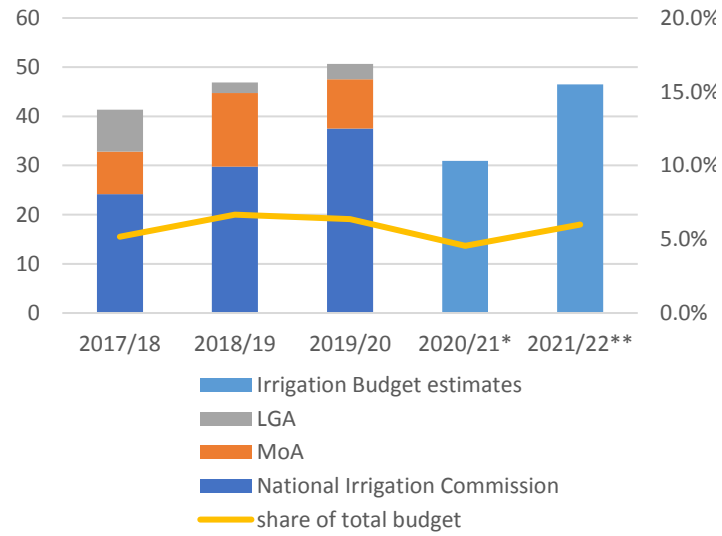


Source: Authors. National Sample Census of Agriculture surveys 2008 and 2020

3. PUBLIC EXPENDITURES ON IRRIGATION IN TANZANIA

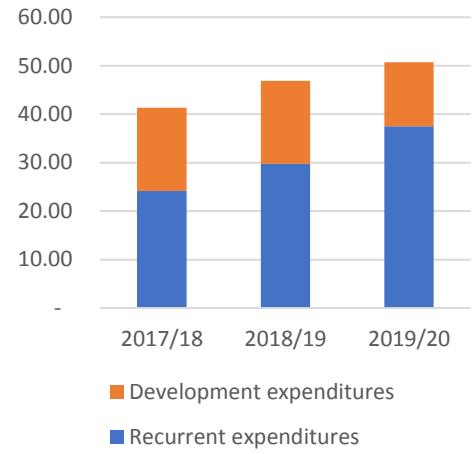
Budget for irrigation averaged 6 percent of the national agricultural budget from 2017/18 to 2021/22. The budget for irrigation amounted to TZS 216.36 billion (US$ 94.7 million), averaging TZS 43.3 billion (US$ 18.9 million) per year. While the budget slightly increased between 2017/18 and 2019/20, its share of the national agricultural budget remained stable at about 6 percent over the period (Figure B1.5). The budget then decreased in 2020/21 before rebounding to the previous level in 2021/22. While we would expect the irrigation budget to be mostly composed of capital expenditures, it only accounted for about 44 percent of the budget between 2017 and 2020, (Figure B1.6). For 2022/23, the Government recently announced a record allocation of TZS 361.5 billion (US$ 156.5 million), significantly exceeding the past five years of annual irrigation budget.

Figure B1.5: Evolution of public budget for irrigation per agency and share of total agricultural budget



Source: Authors. PER database.

Figure B1.6: Composition of irrigation budget



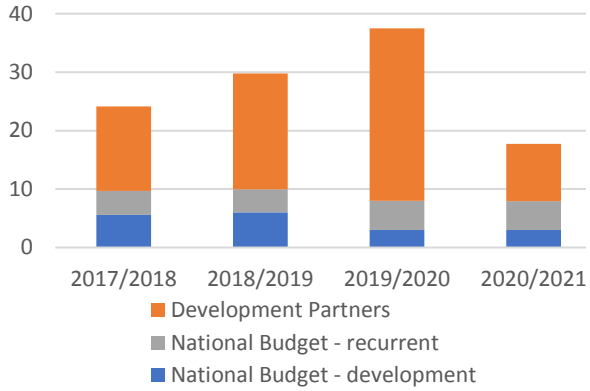
Source: Authors. PER database.

The National Irrigation Commission (NIC) received 66 percent of the irrigation budget for 2017/18-2019/20, reflecting its preponderant role in the subsector. The development of the irrigation subsector remains largely centralized at the level of the NIC. The Ministry of Agriculture is in charge of irrigated agricultural services and received about 24 percent of the irrigation budget, with large fluctuations over the period.

While Local Government Associations (LGAs) are the main implementers of small-scale irrigation (JICA, 2018), LGA budget allocation collapsed over 2017/18-2019/20, averaging about 10 percent of the irrigation budget (Figure B1.5). The President's Office Regional Administration and Local Governments oversees frontline public services with the ultimate users of irrigated agricultural schemes. LGAs remain mostly dependent on grants provided by the national government. in 2018 JICA had already assessed that LGA were understaffed with technical officers in the irrigation sector. For instance, 37 percent of all LGAs (66 out of 180) did not have either an irrigation/agricultural engineer or an irrigation technician and 116 out of 180 LGAs (64 percent) had no irrigation/agriculture engineers. The situation is likely to have worsened since in the light of their budget allocation. However, the announced record allocation for irrigation budget in 2022/23 is expected to be largely funneled to LGAs.

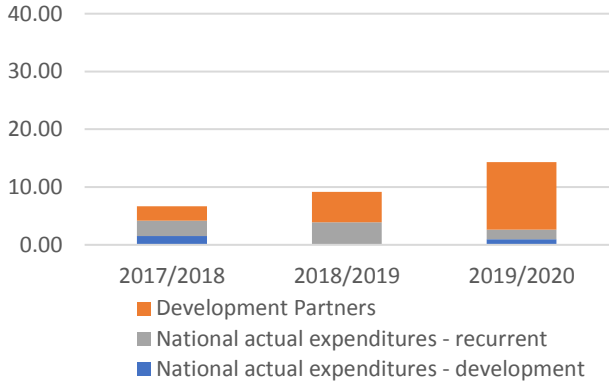
The NIC budget, extremely dependent on donor financing, plummeted in 2020/21 as development partners' assistance dried out. While NIC budget increased over 2017/18-2019/20 by 55 percent, the increase was driven by on-budget donors' financing, which represented up to 79 percent in 2019/20. In 2020/21, its budget was cut by 53 percent due to collapse in donors' funding (Figure B1.7). On-going donors' projects ended and were not replaced or continued by new ones. Budget execution of is low (34 percent), particularly for development expenditures (26 percent). Actual development expenditures coming from donors funding increased from 22 percent in 2017/18 to 69 percent in 2019/20 (Figure B1.8). According to OECD-CRS data, donors funding for irrigation is at 90 percent on-budget.

Figure B1.7: Evolution of budgeted expenditures of the National Irrigation Commission



Source: Authors. Data NIC.

FigureB1.8: Evolution of actual expenditures of the National Irrigation Commission



Source: Authors. Data NIC.

4. EFFECTIVENESS OF PUBLIC SPENDING ON IRRIGATION IN TANZANIA

Over 2017/18- 2020/21, annual budget for irrigation amounted to 12.5 percent of its estimated development needs, with donors' contribution being particularly low. On average over 2017/18-2020/21, annual budget for irrigation amounted to an estimated US$ 18 million (TZS 43 billion), including US$ 8 million in donor financing for NIC (on-budget irrigation foreign financing of MoA and LGAs could not be estimated). According to OECD-CRS data, annual off-budget contribution for the period was about US$ 0.9 million (likely underestimated). For comparison point, the National Irrigation Master Plan (JICA, 2018) estimated the annual financial demand over 2018-25 at US$ 52 million for the Government and US$ 100 million for development partners, in addition to US$ 65 million for the private sector). Public financing would thus represent about 12.5 percent of the need. Government allocated about 34 percent of what was estimated, and donors only 8 percent. We have not estimated private contribution.

Net productivity of irrigated land area averages about two-thirds higher than not irrigated. If this gain could be replicated in all areas equipped for irrigation, the estimated net annual gain for farmers would be US$ 254.8 million. On average, over the entire country and all crops, net productivity of irrigated land is TZS 4.1 million per ha versus TZS 2.4 million per ha when it isn't (2019/20 National Sample Census of Agriculture data). Net land productivity of area planted with rice is 16 percent higher when irrigated (US$ 204 versus US$ 175 per hectare) and 79 percent higher for fruits and vegetables (US$ 574 versus US$ 320 per hectare). For comparison, the Rice Intensification (SRI) system trialed in Rufiji, Pangani, and Wami-Ruvu basins increased rice yields by 15-40 percent (World bank 2019b). However, evaluation of the World-Bank-financed Expanding Rice Production Project (ERPP) (World Bank 2021) showed that in Morogoro, rice yields increased by approximately three times, from baseline of 1.8 tons/ha to 5.7 tons/ha. Underlying

the yield increase was the combination of irrigation with Good Agricultural Practices (GAPs), including improved rice seeds, fertilizers, and SRI. Indeed, factors other than irrigation could by the reasons behind the difference between land productivity between irrigated and non-irrigated area. For instance, farms that grow vegetables (an increasingly irrigated crop) have higher land productivity. Yet if the area officially equipped for irrigation (695,045 hectares) was actually used (instead of 335,996 ha as per census data) and realized the same productivity gain estimated here, the net yearly gain for farmers would be TZS 583 billion (US$ 254.8 million).

Controlling for all factors, despite its low efficiency, irrigation is estimated to have a public benefit-to-cost ratio of 16. Table B1.1 shows that all factors controlled for (including crop system, other inputs, size, among others), irrigation increases overall net farm household income 6 percent. Using the average annual budget for irrigation over 2017/18-2019/20, we estimate a benefit-to-cost ratio of 16.

Public spending per newly equipped area appears extremely high. We estimate at two years the time lap between budget allocation and infrastructure development. Budget allocated in 2017/18 and 2018/2019 for irrigation development averaged to USD 7.5 million. The new area built over 2020/21-2021/22 was 330 ha. Public expenditure per new irrigated hectare is thus US$ 22,728/ha, a rough estimate above all comparison points. ASDPI evaluation (2006/07-2018/09) assessed the yearly cost of developing a newly irrigated hectare at about US$ 3500/ha. JICA (2018) estimated this cost at US$ 850/ha for the National Irrigation Master Plan 2018-2025. The World bank considers at an annual US$ 8000/ha the amount needed for a national irrigation development fund. In average in Sub-Sahara Africa (SSA), the cost per hectare of irrigation is about US$ 50 to US$ 2500/ha for small and simple irrigation systems (shallow wells, small hillside canals, and others) US$ 1500 to US$ 3000/ha for more sophisticated small irrigation, and over US$ 12000/ha for new public large-scale irrigation (Denison, 2017; You *et al*., 2010).

Table B1.1 – Econometrical analyses of correlates of land productivity in Tanzania

VARIABLES	(1) Value of harvest	(2) Net value of harvest	(3) Land productivity	(4) Land productivity (net)	(5) Land productivity (net) 2
Female-headed household	-0.20***	-0.23***	0.00	-0.03	-0.07**
	(0.000)	(0.000)	(0.962)	(0.309)	(0.019)
Area planted (ha)	0.24***	0.24***	-0.05***	-0.05***	-0.04***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Produced cereals	0.06	-0.06	-0.51***	-0.61***	
	(0.364)	(0.280)	(0.000)	(0.000)	
Produced roots/tubers	0.44***	0.55***	0.60***	0.70***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Produced spices	0.47***	0.46***	0.12	0.10	
	(0.000)	(0.000)	(0.134)	(0.273)	
Produced legumes	0.25***	0.26***	-0.01	-0.01	
	(0.000)	(0.000)	(0.671)	(0.772)	
Produced fruits/vegetables	0.01	0.05*	0.40***	0.44***	
	(0.658)	(0.066)	(0.000)	(0.000)	
Produced cash crops	0.33***	0.40***	0.07***	0.14***	
	(0.000)	(0.000)	(0.009)	(0.000)	
Received extension	0.17***	0.19***	0.06*	0.09***	0.10***
	(0.000)	(0.000)	(0.084)	(0.009)	(0.009)
Accessed credit	0.16***	0.09*	0.11***	0.03	0.00
	(0.000)	(0.051)	(0.005)	(0.499)	(0.997)
Used improved seeds	0.11***	0.04*	0.13***	0.05**	0.05**
	(0.000)	(0.067)	(0.000)	(0.018)	(0.032)
Used inorganic fertilizer	0.12***	-0.03	0.02	-0.13***	-0.28***
	(0.000)	(0.191)	(0.475)	(0.000)	(0.000)
Used some organic fertilizer	0.03	0.06**	0.13***	0.16***	0.31***
	(0.242)	(0.016)	(0.000)	(0.000)	(0.000)
Used herbicide	0.29***	0.24***	0.16***	0.12***	0.07**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.020)
Used insecticide	0.15***	0.10***	-0.03	-0.08***	-0.03
	(0.000)	(0.000)	(0.268)	(0.001)	(0.242)
Used irrigation	-0.05	-0.02	0.04	0.06	0.40***
	(0.284)	(0.683)	(0.443)	(0.243)	(0.000)
Used tractor or draft animal	0.25***	0.19***	-0.13***	-0.19***	-0.53***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Practiced conservation agriculture	0.05***	0.05**	-0.01	-0.02	0.04*
	(0.002)	(0.017)	(0.487)	(0.351)	(0.058)
Practiced any soil erosion control	-0.07***	-0.09***	-0.09***	-0.11***	-0.12***
	(0.006)	(0.002)	(0.003)	(0.002)	(0.001)
Has access to district capital	-0.00	0.01	-0.09***	-0.09**	-0.09**
	(0.988)	(0.853)	(0.008)	(0.012)	(0.019)
Has access to primary market	0.05**	0.04*	0.06***	0.05**	0.05*
	(0.021)	(0.090)	(0.004)	(0.022)	(0.059)
Has access to all-weather road	0.06	0.01	0.13***	0.07	0.13***
	(0.384)	(0.915)	(0.002)	(0.105)	(0.006)
Constant	12.53***	12.52***	13.90***	13.88***	13.82***

5. RECOMMENDATIONS

In light of the high benefit-to-cost ratio of irrigation, massive investments are needed from the Government, donors, and the private sector to increase both area under irrigation and irrigation efficiency. The need for development of efficient and water-smart irrigation in Tanzania is long documented, but financial allocation to the sector to date is not enough to meet Tanzania's irrigation challenges. The current development partners contribution represents a fraction of estimated needs in the National Irrigation Master plan (JICA 2018) and could be significantly scaled up. On the Government's side, further public funding for irrigation and maintenance will be needed to ensure sustained operations and functionality of irrigation schemes. The 2022/23 budget, which plans a steep increase in irrigation allocation, aligns with this need and should be underlined as an unprecedented positive step. The *"Tanzania Assessment of Governance of Service Delivery in Water Resource management"* World Bank study further focuses on how to increase financing sustainability of irrigation development.

Considering the country's wide needs, public expenditures could leverage farmer-led irrigation as a cost-efficient pathway to develop irrigation. A growing body of evidence highlighting the high rates of return of farmer-led irrigation in SSA (Shal *et al.* 2020). Government could:

- Develop programs and support to proactively promote farmer-led irrigation.
- Introduce incentives to make motor pumps and flexible pipes affordable and support pilot demonstrate projects for alternative technologies and institutional models.
- Liberalize imports of irrigation equipment.
- Investment in knowledge to map, assess, and monitor water resource availability and demand to better target public action.

Low irrigation efficiency translates into low yield increases compared to what could be achieved. A range of interventions could improve irrigation efficiency and service delivery, including using new technologies, adopting irrigation agronomy, and strengthened institutional arrangements for local service delivery. On the technical side, promising technologies and techniques that may be harnessed to improve production while reducing water-use inefficiencies include:

- System of Rice Intensification (SRI).
- Drip and sprinkler irrigation systems.
- Sprinkler irrigation system; on-farm water storage.
- Improved motorized or solar pumps (World Bank, 2019b).

The "*Resilient, Inclusive, Sustainable and Efficient Irrigated Agriculture in Tanzania*" study further explores how to increase the efficiency and climate resilience of water management for agriculture in Tanzania.

The low efficiency of past spending calls for careful and in-depth evaluation on how to best spend future irrigation investments in Tanzania. In particular, further analysis is needed to understand the reasons for the increasing gap between area equipped for irrigation and area used. It is striking to see that, despite significant public investments over the past decade, the area used for irrigated stagnated in the country. In addition, the analysis finds very high cost per hectare of irrigation development. While this is beyond this work, our findings call for in depth evaluation of recent irrigation projects.

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BACKGROUND PAPER 2 – Deep dive on the knowledge system

The concept of Agricultural Knowledge System (AKS) encompasses research, training, and extension services and how these are linked. It describes the ways people and organizations (authorities, farmers, scientists, advisers, enterprises, NGOs, and others) interact within a country or a region to generate, share, and use agriculture-related knowledge and innovation and promote mutual learning (OECD 2012; EIP-Agri 2018). Research and training and extension services are two key elements of the Agricultural Knowledge System, along with education. Linkages between them are core to ensure that research findings are translated into field implementation, and to foster bidirectional learning between farmers and scientists. A well-functioning Agricultural Knowledge System allows "doing things differently and doing existing things more efficiently" (Jayne and Sanchez 2021).

1. KEY ASPECTS OF THE AGRICULTURAL KNOWLEDGE SYSTEM IN TANZANIA

- **Research**

The institutional landscape of agricultural research, constantly shifting in Tanzania over past decades, is marked by decentralization and scaling down. During the early 1970s, research focused on commodities with donors' support. After 1976, the Government progressively created four semi-autonomous parastatals to take charge of crops and livestock research. Capacity and recruitment issues along with poor extension and training led to their dissolution and establishment of the Commission of Research and Training in 1990. The creation of seven research zones based on agro-ecological systems accompanied a cut in the number of research centers by half. Since 2011, frequent institutional changes have had negative repercussions on agricultural research in Tanzania, with research on crops and livestock and training regularly being either separated or combined. Since 2010, the National Research and Development Policy guides all research in the country, including in agriculture. The Commission for Science and Technology is responsible for promotion, coordination, and monitoring of technological development in the country and coordinates the work of the main agricultural research institutes.

The research pole of Tanzania's agricultural knowledge system encompasses 14 agencies, with the Tanzania Agricultural Research Institute (TARI) employing about half of its researchers. TARI, created in 2016 under the Ministry of Agriculture, focuses on crops research and has a network of nine research Centers and eight Sub-Centers, with each having a commodity-focus. As of 2016, it employed 376 full-time equivalent researchers (FTE), about half (48%) of all agricultural researchers in Tanzania (data ASTI 2021). Other government agencies include the Tanzania Livestock Research Institute (TALIRI, 60FTE), the Tanzania Fisheries Research Institute (TAFIRI, 51FTE), the Tropical Pesticide Research Institute (TPRI, 31.5FTE), and the Tanzania Forestry Research Institute (TAFORI, 22FTE). In addition, the Tanzania Coffee Research Institute (TaCRI, 20FTE), the Tea Research Institute of Tanzania (TRIT, 11.4 FTE), and the Tobacco Research Institute of Tanzania (TORITA, 5.6FTE) are non-profit agencies with staff supported by the Ministry of Agriculture. Since 2000, growth in the higher education sector has strengthened the roles of universities in creating agricultural knowledge. Sokoine University of Agriculture (SUA) is now the second largest agricultural research pole in terms of researchers (155.1 FTE, 20% of all FTE). Other active universities include the Dar Es Salaam's Department of Zoology and Wildlife Conservation (5.6 FTEs), its Institute of Resource Assessment (9.5 FTEs), and its Department of Botany (5.6 FTEs).

Research budget and staff mainly focus on crop improvement; in 2016, over half agricultural researchers (54.4) in Tanzania focused on crops (data ASTI). The percent of researchers studying livestock, fishery, and forestry respectively was 8.4%, 8.6%, and 2.2%. By order of researchers working on them, the main crops studied in 2016 were maize, cassava, bananas, and plantains. Plant breeding and genetics (including biotechnologies) is the first field of research in the country in terms of number of researchers, with about

one in seven researchers working on it (114FTE). Academic publications by Tanzania's research institutes in the Agricultural and Biological Sciences field show more diversity (data SCImago 2022): the largest area of publication is Ecology, Evolution, Behavior, and Systematics, followed by Agronomy and Crop Sciences. Publications in Forestry and Aquatic Sciences represent about one-quarter of Crop Sciences publications but proportionally have higher impact (as they got more cited).

While we lack recent data on the national evolution of agricultural researchers, the number of researchers and their and qualifications appear to represent a worrisome bottleneck to increasing research effectiveness. Over 2011-2016, the number of agricultural researchers stagnated, decreasing the country's research intensity (number of researchers per 100,000 farmers). Since 2016, decreasing research budgets most likely did not improve the situation. A critical mass of qualified researchers is crucial for implementing a viable research agenda. Flaherty and Lwezaura (2010) note that over 2000-2008, qualifications deteriorated and many experienced staff retired along with the disproportionate employment of junior staff. Data from ASTI shows that the proportion of agricultural researchers with BSc and PhD degrees increased over 2010-2016. Data lacks to assess this trend, but anecdotal evidence points to the contrary. TARI, for instance, reports counting about 10 percent of PhDs among its research staff in 2021, down from 16 percent in 2016. Interviews with TARI and TALIRI highlighted that they face significant human resource challenges as both struggle to attract and retain well-qualified researchers. Most senior researchers are approaching retirement age and knowledge transfer appears compromised by the lack of young PhDs.

- **Extension services and training**

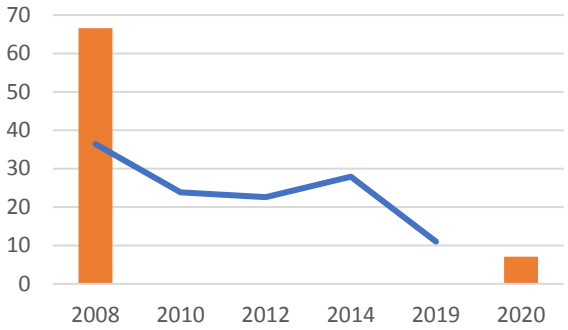
Decentralization initiated in 1999 delegated agricultural extension services to local authorities, with coordination at the central level. Over the 1990's, extension services delivery used "top–down" approach based on "Training and Visit" technology transfer. The Ministry of Agriculture was responsible for providing extension services with personnel stationed at the ministry, region, and district levels (Rutatora and Mattee, 2001*)*. This arrangement was criticized for being non-responsive to farmers' needs (Lameck 2017). The Local Government Act No. 6 of 1999 decentralized extension services to the local governments (district, ward, and village levels). In practice, the Ministries for Agriculture, Livestock, and Marketing transferred their field staff to local government authorities and remained solely responsible for technical support and national coordination (Alex and Davis, 2019). Since that time, the Government has regularly renewed acknowledgment of the key role of extensions services for agricultural growth. In 2009, it committed to having at least one extension agent per village and ward and estimated that about 20,000 officers would thus be needed by 2020 (URT 2009).

ASDP II reiterated the role of extension services as a key factor to increase crop yields by using available resources and technologies more efficiently. It advocated for greater private sector greater participation to support local government provided technical services (URT 2013). As of 2020, the Government employed 6,704 extension officers, slightly more than half of government planned at least one extension officer in each village, which would require at least 12,319 extension officers.

Farmers' access to public extension services drastically collapsed from 67 percent in 2008 to 7 percent in 2020. There is wide academic consensus that most villages in Tanzania have limited access to extension services (Ley 2015, Abed *et al*. 2020, Hella 2013). Yet, while data sources differ significantly on the absolute numbers (Figure B2.1), they concur on the dramatic collapse that occurred over the past fifteen years. According to the National Sample Census of Agriculture, 7.1 percent of farms received crop extension and 5.80 received livestock extension in 2019/2020. Local interviews and several studies document this trend and current low rate, such as Ndimbwa *et al.* (2021) in the Mbeya Region; the farmers

they surveyed perceived that the role of extension officers in delivering agricultural information and knowledge to smallholder farmers had diminished the last few years.

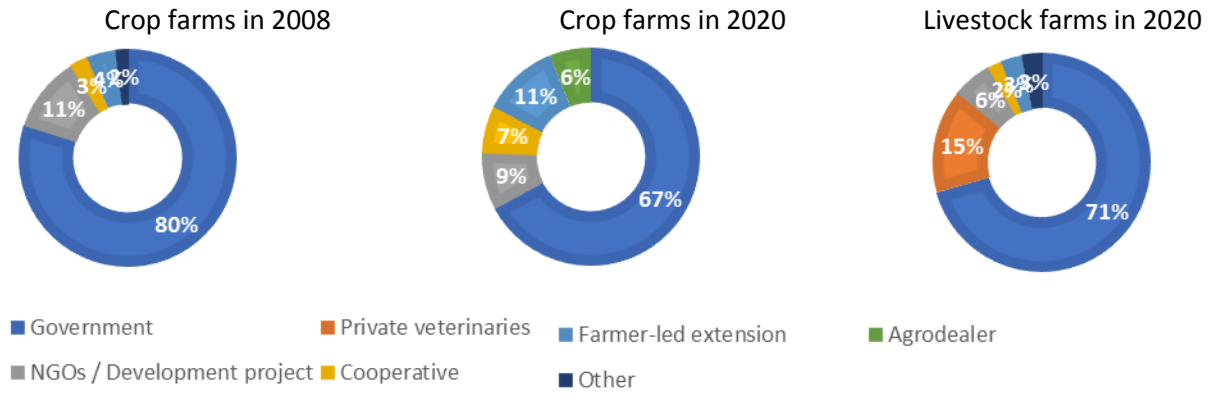
Figure B2.1 - Evolution of the number of farmers accessing extension services over 2008-2020 according to the National agriculture census (bars) and to the National Panel Survey (line)



Source: authors' own elaboration based on National Sample Census of Agriculture 2008, 2020 and NPS

Three-quarters of farmers receiving extension services obtained it from public officers in 2020, but access is more "pluralistic" than in 2008. International guidelines for training and extension services, followed by most developed economies, recommend a pluralistic ecosystem in which public and private services complete each other (World Bank 2006, OECD 2019). According to the 2019/20 National Sample Census of Agriculture, 74 percent of crop farms and 77 percent of livestock farms receive extension services from public officers, down from 88 percent of crops farms in 2008. Over the past fifteen years, the role of public officers and NGOs in deliver extension services diminished, while the role of farmer-led extension and cooperatives expanded. Figure B2.2 shows that 14 percent of crop farms access extension services through farmer-led extension (including extension services provided by lead farmer and by larger farmer), up from 4 percent in 2008; and about 9 percent of receive extension services from NGOs and development projects (down from 13 percent 2008).

Figure B2.2- Evolution of access to extension services from 2008 to 2020



Source: Authors' own elaboration. Source: National Sample Census of Agriculture data 2008 and 2020

Table B2.1. Characteristics of crop farms that either received government crop extension, received non-government extension, or did not receive any extension (% of farms or average value)

	2008			2020		
	Received government crop extension	Received other (non-government) crop extension	Did not receive crop extension	Received government crop extension	Received other (non-government) crop extension	Did not receive crop extension
female-headed household	19.21	20.17	22.35	15.96	18.18	23.19
small crop farm	91.48	91.15	93.89	85.14	83.37	92.33
medium crop farm	8.16	8.48	5.86	13.63	14.35	7.19
large crop farm	0.37	0.37	0.25	1.23	2.28	0.48
Size (ha)	2.36	2.25	1.96	3.11	3.38	2.01
produces cereals	93.58	91.08	89.66	91.50	90.50	87.94
produces tubers	37.71	42.46	42.15	49.05	44.26	46.48
produces spices	0.70	0.97	0.80	2.57	1.48	1.14
produces legumes	59.79	61.63	52.28	58.49	56.01	53.98
produces fruits/vegetables	10.33	12.84	7.10	25.42	27.10	21.04
produces cash crops	23.56	25.75	20.61	34.84	32.73	21.51
use improved seed	24.66	22.55	7.65	61.59	68.81	36.45
use inorganic fertilizer	12.98	16.09	4.20	37.33	53.23	21.71
use organic fertilizer	16.97	14.71	6.17	38.21	36.07	21.19
use herbicide	3.00	3.15	0.85	22.48	21.40	10.93
use insecticide/fungicide	13.62	14.99	5.28	48.74	54.24	26.90
use irrigation	9.22	11.10	4.72	17.87	17.06	8.73
use nonmanual traction	33.05	22.87	18.01	42.81	37.07	34.25
practice conservation agriculture				55.72	58.91	38.32
implement erosion control	11.39	10.57	4.85	21.65	19.80	10.50
access credit for agriculture	2.74	4.78	1.13	8.58	18.14	3.34

Farms receiving extension services are more likely to be large, to invest in their farms, and use sustainable practices. Analysis of the characteristics of farms that did or did not receive extension services in 2008 and 2020 (Table B2.1) use statistical correlation and statistical tests. Results indicate that receipt of extension correlates with size, practices of agricultural intensification, and conservation agriculture. Farms that receive non-public extension services tend to be even larger. These relationships used to be stronger in 2008. By 2020, the relationship had weakened somewhat for government extension and strengthened for non-government extension.

Level of education and agricultural training of extension officers and farmers is a key component in efficient and safe innovation dissemination. The education, capacity, and experience of extension officers deeply influence the quality of their service. Regular trainings are needed for them to provide relevant, up-to-date information. More broadly, literacy and vocational agricultural education, for extension officers but even more for farmers, is a key component of the agricultural knowledge system and adoption of innovation in safe conditions. For instance, in a survey of 300 farmers in the Kilimandjaro Region, Mkenda *et al.* (2020) highlighted that they regarded almost all insects as pests (including ladybirds and bees). More concerningly, several studies reported that many farming communities in northern Tanzania were not aware of the hazards associated with chemical pesticides due to poor training, leading to inappropriate use (incorrect dosage, leaking application equipment, use of mixes of several pesticides, tongue testing of concentration, absence of protective equipment, and others) causing health and environmental risks (Mkenda *et al.,* 2020). Interviews implied that public extension officers are originally overall well trained but lack regular training to update knowledge and some resources needed, such as transport.

- **From lab to field: linkages between research and extension services**

Several Government initiatives in place foster dissemination of agricultural research information to farmers. The linking research with extension is one of the missions of the agricultural research institutes. The National ICT (Information and Communications Technology) policy, elaborated in 2013 and amended in 2016, aims to transform the agricultural sector from subsistence to a commercialized sector. The creation of Community telecentres (Ward Agricultural Resources Centers) in several locations intended to help disseminate agricultural information to smallholders, but they no longer operate dure to budget cuts. Beyond, Ministries use various slogans—for example, “green revolution”, “Kilimo Kwanza” (Agriculture First))—transmitted through mass media, and frequently organize dedicated seminars, workshops, and special festivals.

Farmers access agricultural information through a mix of channels among which radios played a key role far before extension officers. Mtega’s (2021) meta-analysis of research published between 2000 and 2020 on communication channels farmers use in Tanzania found that, by order of importance, radio, mobile phones, television, fellow farmers, agricultural extension agents, and newspapers appeared as the commonly used communication channels for transferring agricultural information. Farmers mentioned radio in all reviewed studies as the among most-used communication channels (across studies, between 42.5 percent to 93.6 percent). The channels’ influence, availability, affordability, and communication network coverage stood out as key factors influencing their choice. Agricultural information is increasingly communicated through phones, with the support of mobile phone companies. Finally, interpersonal communication, field demonstration, and farmers groups remain essential for innovation adoption.

ICT plays an increasing role in provision of extensions services, with Government support. Digitized farming started with the *M Kulima* platform developed by Vodacom Tanzania to facilitate easy communications and transactions between off-takers, the Government, and farmers. In 2020, a new platform, *M Kilimo*, extends and deepens the approach to provide extension services. Farmers register by

ward or village extension agent; once registered, a farmer can post by SMS at no-charge any question into the platform, which is transmitted to extension officers. Regional agricultural advisers (DAICO) from the Ministry of Agriculture's extension department monitor answer rates. Over 5.5 million farmers registered after one and one-half years following g platform launch. A limit of the system is that it requires a smartphone to access the extension officers.

Participatory research initiatives, carried out by agricultural research centers in partnership with international actors, also show positive results when driven by farmers' demand. A show-case example is the collaboration between the International Potato Centre and TARI Selian (ex-Selian Agricultural Research Institute), based on Lushoto farmers' demand and and supported through the CGIAR Research Program on Climate Change, Agriculture and Food Security. This participatory research developed more resilient potato varieties that can grow in both the long and short rainy seasons and at higher yields. The approach involved training-of-trainers and participatory varietal selection (PVS) experiments in five villages (Harahagazwe *et al.* 2016).

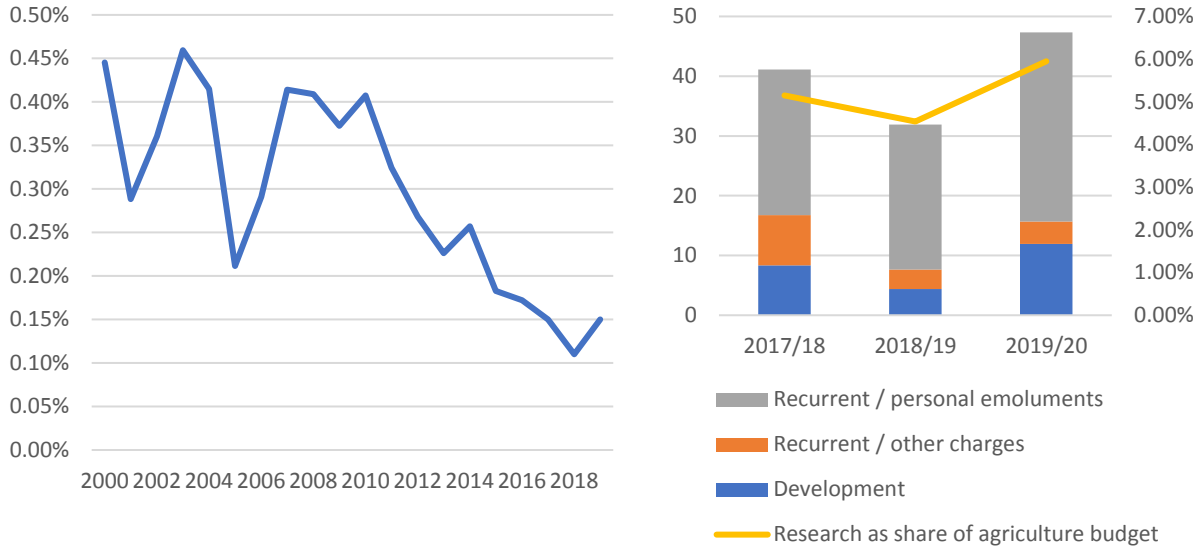
Despite these efforts, barriers in the field hinder delivery of agricultural knowledge to smallholder farmers, starting with the lack of extension officers. Most studies point to insufficient extension officers in the field (ex. Mubofu and Elia, 2017). Another strong barrier is access to capital, as access to agricultural information is often due to inability to afford the purchase of radios, televisions, or phones or to pay to attend trainings (see Kaliba *et al.* 2018 for an example on sorghum variety adoption). Other barriers include the nonavailability of electricity, illiteracy, irrelevance of content, timeliness of information dissemination, languages barriers, and the absence of [community-based] information centers (Mubofu and Elia 2017; Ndimbwa *et al*. 2021). Mubofu and Elia (2017) also mention political interference, noting cases of village or community leaders advocating against innovation adoption and preventing extension officers' interventions in the Iringa region. As a result of these multiple barriers, most smallholder farmers mainly depend on informal channels to access agricultural information (Ndimbwa *et al*. 2021).

2. Effectiveness of spending on research

Budget allocation to agricultural research has been declining over the past two decades, reaching a low 5.2 percent of agricultural budget over 2017/18-2019/20. Figure B2.3 shows that after a phase of erratic allocation to agricultural research over 2000-2010, the budget plummeted over the past decade. Over 2017/18-2019/20, it amounted to TZS 120.4 billion, averaging TZS 40.1 billion per year. Actual expenditures are not available, are probably much lower, as outlined in the main report findings on budget execution. Interviews with TARI reveal that the institution receives about one-third of the budget it requests (reported funding gap of 64 percent).

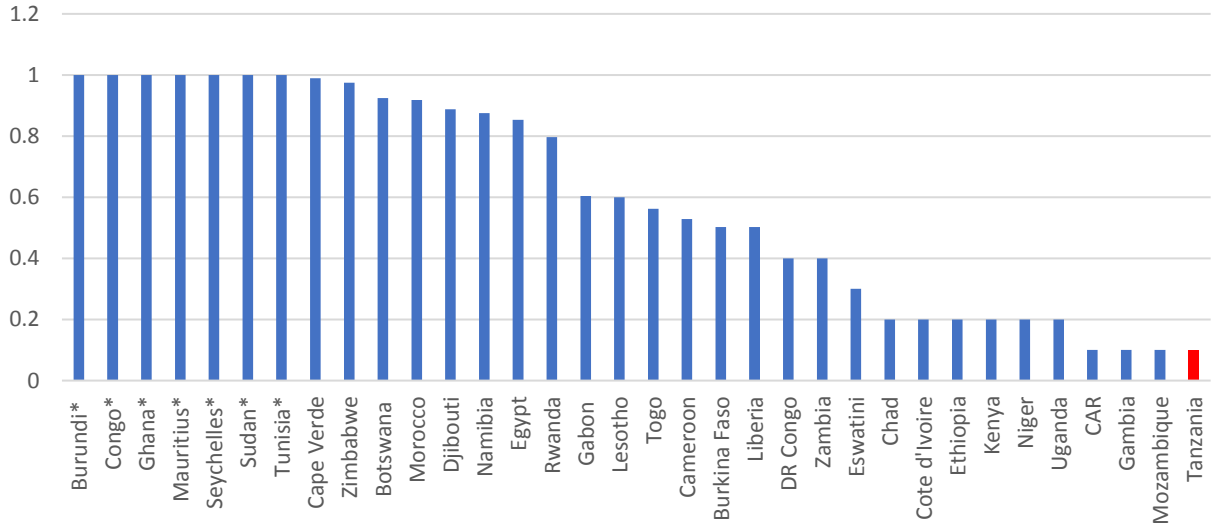
At 1.4 percent of agricultural GDP over 2017-2019, allocation to research and development ranks among the four lowest on the African Continent. This budget is one-seventh of the Khartoum Decision on Science and Technology target of allocating 1 percent of agricultural GDP to research and development for 2015 to 2025 (known at the "Khartoum target"). Tanzania thus ranks among the countries with the lowest allocation to agricultural research, as shown in Figure B2.4. The 2022 CAADP Biennial Review Report thus considerers that Tanzania is *not* on track to meet its commitment by 2025.

Figure B2.3 - Evolution of Tanzania agricultural research budget as a share of agricultural GDP (left) and of its economic composition (right, TZS billion)



Source: authors' own elaboration. Data ASTI for 2000-2016; PER original data for 2017-2019

Figure B2.4 - African benchmark of agricultural budget on research and development (based on 2021 CAADP Biennial report)



*Source: Authors's own elaboration. Estimates based on the 2021 CAADP Biennial Report. *These countries spend 1% or more of their agricultural GDP on agricultural research and development.*

Off-budget donor financing is also volatile, reaching a low of one-fifth of budget over the period. According to OECD-CRS data, off-budget development partners' contribution to agricultural research amounted to TZS 23.5 billion over the period, averaging of TZS 7.8 billion per year, about 20 percent of national budget for the sub-sector. However, this share fluctuated from 10 percent (2019) to 29 percent (2018) with similar volatility back to 2014. Field anecdotal evidence hints that this off-budget is higher than reported in CRS data. TARI, TALIRI, and Soikoine University of Agriculture (SUA) all report that development partners used to be significant (if not major) contributors to their budget, but that their

contributions have been contracting. Divergent and changing priorities between donors and the research institutions also affect research activities.

Due to insufficient allocation, two-thirds of the budget pays for salaries and wages, leaving scarce and volatile resources for program spending and capital investments, and leading to plummeting research activity (Figure B2.3). Over 2010-2014, the share of personal emoluments averaged 40 percent in the agricultural research budget. As the overall envelop has been shrinking, spending on staff pay mechanically increased to reach 67 percent over 2017/18-2019/20. Insufficient capital and program resources crucially affect the capacity of research institutes to achieve their mission. For instance, TARI cannot finance greenhouses, preventing the institute from effectively developing Open Pollinated Varieties. Laboratories do not have the resources to get needed international accreditations. Most research farms lack irrigation and suffer intermittent power interruptions, continuously jeopardizing the storage of parent seed stock (germplasm). The situation is much worse in some cases. TALIRI has not received any development budget over the past six years, placing research facilities in a precarious situation. Livestock research activities are very low, limited to what international and private-sector partnerships can support.

As a consequence of budget evolution, agricultural research intensity has been declining over the past decade in Tanzania. A first measure of research intensity, agricultural R&D spending as a percentage of agricultural output (GDP) has been plummeting over the past fifteen years. Another common indicator is agricultural R&D spending per 100,000 farmers (ASTI 2021), which has also been eroding. The cost of agricultural research staff is very low in Tanzania, at about 13 percent of the average in African countries and Kenya, 11 percent of Uganda, and 36 percent Kenya (ASTI, 2021; Table B2.2). Similarly, spending per published academic article is about 5 percent of the average in African countries, 47 percent of Uganda, 71 percent of Kenya, and 66 percent of Ethiopia.

Table B2.2 – Regional comparison of the cost of research in Tanzania

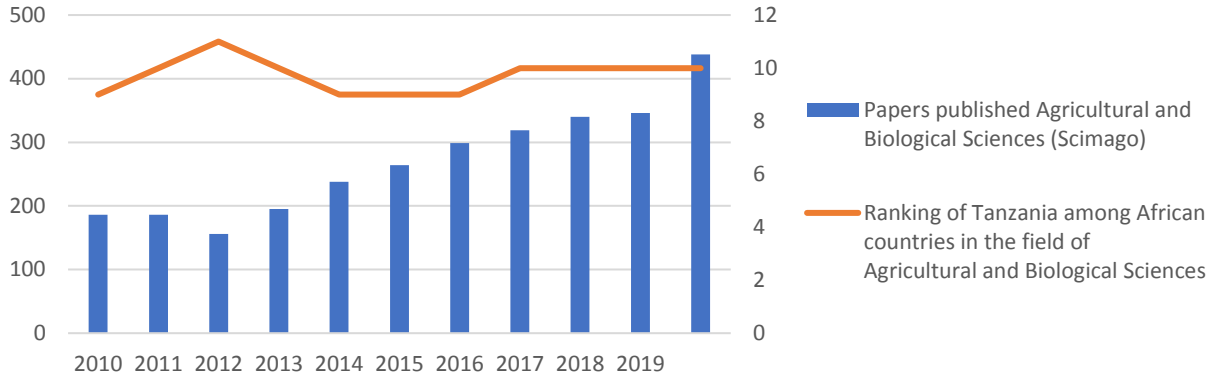
	Budget	FTE(2016)	Cost per research staff (USD)	Papers published per year 2014-2016	Cost per published articles
TARI	TZS 40.1 billion	376	45,859		
TALIRI	TZS 944 million	60	6,765		
All Tanzania*	68.5 MUSD	785	19,610	269	254,647
Ethiopia *	162.1 MUSD	3,024.6	53,593	419	386,874
Kenya *	222.7 MUSD	1,157.6	192,380	625	356,320
Uganda *	99.4 MUSD	558.7	177,913	184	540,217
Average performance score of African countries**			151,100 (2011$)		5.7 million US

*Source: Authors. Data: TARI, TALIRI. *Data ASTI 2016. **Data ASTI 2021*

However, agricultural research outputs attest to remaining strong human research capacity that could be supported to rebuild Tanzania's beleaguered agricultural knowledge system. Tanzania's institutes have published an increasing number of academic papers since 2012 (data SCImago, Figure B2.5). While publications stagnated over 2018-2019, they increased again in 2020. Tanzania ranked by SCImago as Africa's 9th country in terms of number and impact of published papers in the field Agricultural and Biological Sciences over 2014-2016, maintaining a 10th ranking since 2017. In addition, since its creation in 2016, TARI has developed and protected a total of 77 seeds varieties. Considering the cuts in agricultural

research budgets, these achievements testify to strong remaining research capacity that could be rebuilt with additional funding.

Figure B2.5 - Evolution of Tanzania's academic papers published and Africa country ranking in the field of Agricultural and Biological Sciences

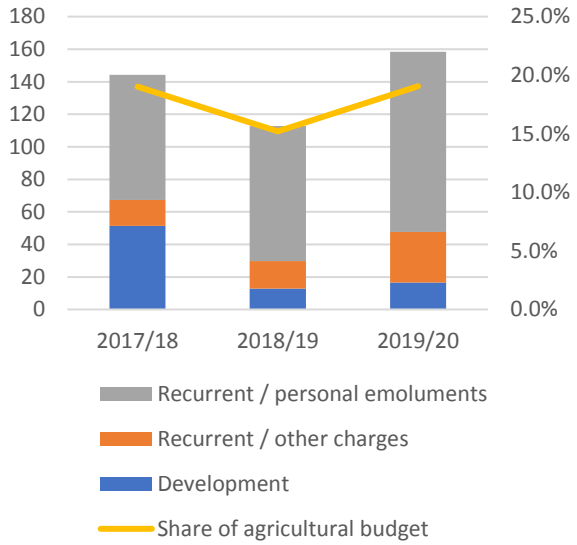


Source: authors' own elaboration based on SCImago data (retrieved April 2022)

3. EFFECTIVENESS OF SPENDING ON EXTENSION SERVICES AND TRAINING

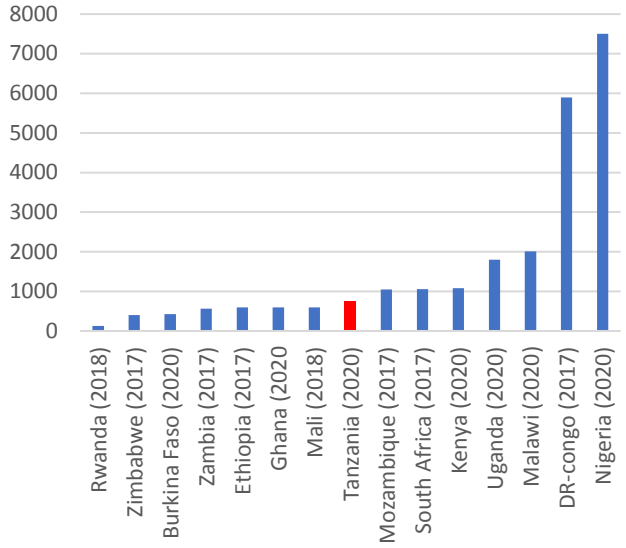
Budget allocation to extension services and training activities averaged 18 percent of agricultural budget over 2017/18-2019/20 and 41 percent of local agricultural budget. The total budget for training and extension services varied from TZS 144 billion in 2017/18, down to TZS 113 billion in 2018/19 and up to TZS 158 billion in 2019/20 (Figure B2.6). Extension represents 89 percent of the allocation over the period. Personal emoluments absorb almost two-thirds (65 percent) of the budget, and its share has increased over time. With extension services being the responsibility of LGAs, 69 percent of the budget is allocated for the local level and 14 percent for the Ministry of Agriculture. At the LGA level, extension and training represented 35 percent, 38 percent, and 49 percent of the budget over 2017/18, 2018/19, and 2019/20 respectively.

Figure B2.6 - Evolution and economic composition of agricultural extension services and training budget (TZS billion)



Source: authors. Data: original PER data.

Figure B2.7 - Regional benchmark of the number of farmers per extension officer



Source: authors. Data: TASAI – African Seed Access Index 2020 Dashboard. Tanzania data comes from PER analysis and is per farm household and not farmers.

The number of Tanzanian farm households per extension officer is only just over half of the government objective, but still in the range of its regional neighbors. On average over the 26 regions, there was one extension officer per 1068 farm households (as per MoA data and 2019/20 National Sample Census of Agriculture data), about 58 percent of the government objective to have one officer per village. Extension officer coverage varies widely by region, from 542 farm household per officer in Mara to 2600 in Kigoma and 4709 in Dar es Salaam (median 1159). Figure B2.7 benchmarks Tanzania against other African countries and shows that countries such as Rwanda or Zimbabwe have much lower ratios. However, Tanzania appears in the regional average.

The extension budget amounts to US$ 9 per farm household (TZS 20,688). If we only consider farms that access the service, this amount goes up to US$ D 129. This is low compared to similar estimates in Cambodia (US$ 273, World Bank, 2011) but much higher than Ethiopia (US$ 13, World Bank 2021). Another measure of efficiency is the ratio of extension budget per number of extension officers, computed at US$ 6501 yearly. For comparison, FAO (2011) estimated costs per extension agent of about US$ 4000-6000 for low-income countries and US$ 6000-9600 for low-middle income countries.

National averages mask regional variability. The cost of providing public extension services to a farm household in 2019/2020 ranges from US$ 62 (in Simiyu) to US$ 244 (in Mara) (median US$ 109). Similarly, the annual cost of one extension officer varies widely by region from a low of US$ 4327 in Tabora to a high of US$ 15600 is Dar es Salaam (median US$ 8113). Figures B2.8 and B2.9 compare the distribution of area cultivated with crops with the number of agricultural extension officers per crop farm households over the country, highlighting some disconnect between resources and needs. Figures B2.10 and B2.11 shows the same comparison for livestock. Another way to assess the value-for-money of extension services is to compare to them to farmers' willingness to pay. Abed et al (2020) estimated willingness for farmers to pay for four types of agricultural extension services in the cereals' value chains as a part of two

USAID-funded Feed the Future initiatives in Tanzania. Average figures for the 595 surveyed farmers ranged from TZS 20,000 to TZS 24,000 (US$ 8–US$ 10) depending on the type of service.

The benefit-to-cost ratio of extension is about 9 in Tanzania, confirming international results on the high value for money of investing in this service (Table 5). Controlling for all factors (including crop system, other inputs, irrigation, size, etc.), we estimate that extension increased net farm household income by 10.5 percent. We obtained the ratio by relating this benefit to the average annual budget for extension over 2017/18-2019/20. For comparison, Goyal and Nash (2017) estimate that the benefit-to-cost ratio of extension services in Africa ranges between 6.8 and 14.2.

Figure B2.8. Area of land cultivated with crops – double-counting over both seasons (hectares)

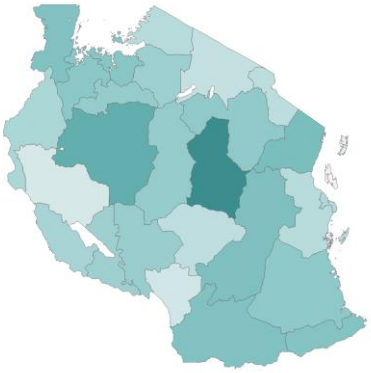


Figure B2.9. Extension officers per crop farm

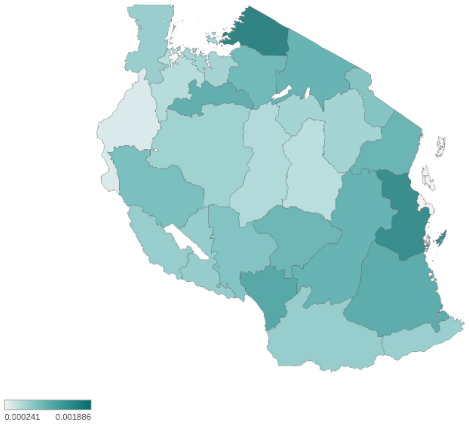


Figure B2.10 Number of Tropical Livestock Units (TLUs) by region

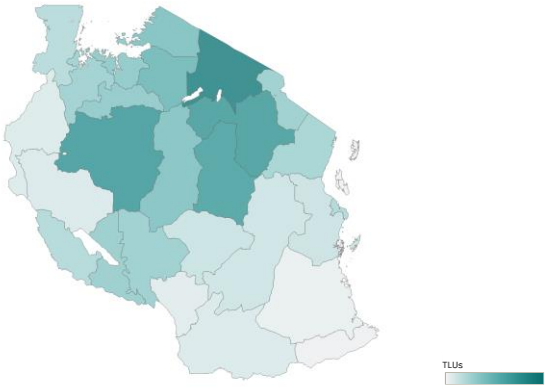
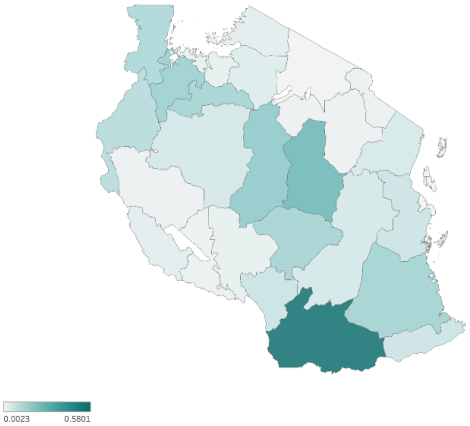


Figure B2.11. Extension officers per farm Livestock

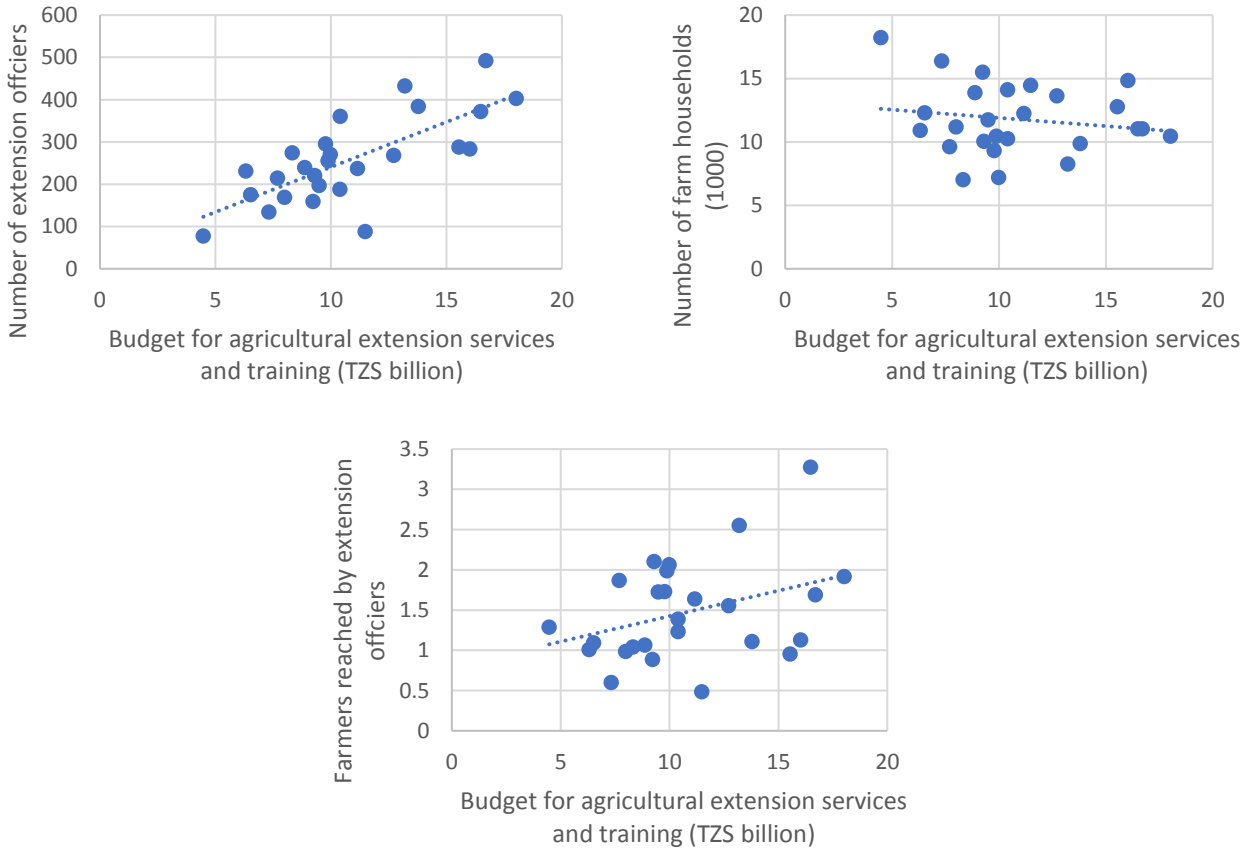


Source: Authors. National Sample Census of Agriculture data.

Despite being about one-fifth of agricultural budget, allocation to extension services does not correlate with the number of farms public extension officers reach. The regional budget for agricultural extension and training services correlates closely to the local number of extension officers (Figure B2.12, top left), and more loosely correlates to the number of farm households in the region (Figure B2.12, top right). Comparison of maps B2.8 and B2.11 nonetheless indicates that extension officers are not as present in productive rural areas as in in areas well connected to large urban centers. However, extension budget

allocation is fully decorrelated from farm extension receipt (Figure B2.12, bottom). Put differently, money spent on extension officers does not appear linked to the number of farmers receiving this public service. Several explanations are possible: (i) availability of extension officers might be too low to affect extension access, (ii) inadequate extension officer distribution in the field, and/or (iii) inefficiencies in how the services are provided in the field due to lack of investments. For instance, interviews conducted for this analysis pointed to a crucial lack of transport for reaching farmers; and even when extension officers receive motorcycles, the budget for fuel and maintenance is lacking.

Figure B2.12 - Correlation between 2017/18-2019/20 budget for agricultural extension services and training for the 26 regions and (top left) the number of extension officers, (top right) the number of farm households (bottom) the number of farm households that access extension services



Source: authors' own elaboration. PER original data for 2017/18-2019/20; MoA (extension officers in 2020). National Sample Census of Agriculture 2019/20.

Contrary to 2008, farms that received public extension services in 2020 are not significantly different from those that do not; but farms that receive extension from other sources are more likely to run more intensified systems. Using National Sample Census of Agriculture data from 2008 and 2020, we performed statistical tests to better understand farm characteristics that did and did not access public or non-public extension services. Overall, farms that access extension services are significantly more likely to be large, to invest in their farms, and to use sustainable practices. By 2020, farms that received non-government extension were, on average, the largest. However, other differences appear between farms that receive public versus non-public extension services. In 2008, farms that received government (public) crop

extension were somewhat more likely to use improved seed, organic fertilizer, and nonmanual traction. By 2020, farms that received non-government extension were more likely to use improved seeds, inorganic fertilizer, insecticide, and access credit for agriculture. However, the situation changed regarding use of public extension services; the relationship between agricultural intensification practices and use of government extension weakened somewhat between 2008 2020 while the relationship strengthened for use of non-government extension.

As delivered today, access to agricultural information deepens inequality between farmers, including the gender gap. Analysis of National Sample Census of Agriculture data shows that male-headed households are about 1.5 more likely than female counterparts to access extension for both crops and livestock, confirming prior evidence. Kabura (2014) had already shown that delivery of extension services was male-biased, reinforcing the gender gap in Tanzanian farming. A recent study of gender disparities in Iringa also highlighted that women had about one-third less access to agricultural information through phones than male counterparts, despite their high interest (Quandt *et al*., 2021). Other surveys in specific regions point to several type of inequalities in access to information, which, in turn, deepen productivity and income gaps. For instance, wealthier households in northern Tanzania were three times more likely to receive extension from any provider (Jensen et al 2019). Finally, members of farmers groups have better and more timely access to agricultural information than isolated individuals (Ndimwa *et al*., 2021).

The geographical distribution of extension officers, directly related to budget allocated to LGA, does not align with rural needs. As mentioned, average of 719 farms per extension officer masks a large regional variability, from 542 in Mara to 2,600 in Kigoma and 4,709 in Dar es Salaam. We show that access to crop extension reduces as distance from district capital increases. In other words, while extension officers should be more present in rural areas where needs are higher, they are closer to large cities, which likely contributes to deepening territorial inequalities. This result has also been found by the World Bank Health Public Expenditure Review of Tanzania (2019) for other rural services.

Table B2.3 – Correlations between access to extension and distance from urban poles

	Accessed crop extension	Accessed government crop extension	Accessed other crop extension
Has access to district capital	0.0088	0.0108*	-0.001
Has access to regional capital	0.0157***	0.0146**	0.0057
Distance to district capital (km)	0.0024	0.0085	-0.0098
Distance to district capital (km)	-0.023***	-0.0006	-0.0424***

Source: Authors. Data: National Sample Census of Agriculture 2019/20. Only households that reported they did have access to something were then asked to estimate the kilometers, so the number of observations is lower in the bottom two rows.

Field evidence highlights several shortcomings of public extensions services that could explain low effectiveness. Anecdotical evidence and academic papers point out that delivered extension services are not in line with farmers' needs. For instance, Abed *et al.* (2020) found that expected close collaboration between farmers and extension workers resulting from decentralization did not sufficiently take place, and in most cases farmers' preferences did not shape local programs. The authors note that extension officers need to deliver relevant advice along a wide range of crops and agro-ecosystems, but this requires sufficient funding. Field interviews reveal that extension officer multi-tasking detracts them from their core mission. For instance, their work often includes administrative roles when the ward or village

executive officer is not present, as well as inspection of inputs (seeds, pesticides, and fertilizer), preparation of budget for the department, and collection of produce *cess*.

4. RECOMMENDATIONS

Investments in the Agricultural Knowledge System have among the highest agricultural productivity returns in the SSA. Over the past two decades, overwhelming academic evidence have demonstrated the effectiveness of investments in agricultural research to increase productivity and reduce poverty (Alene and Coulibally, 2009; Goyal and Nash, 2017).Alene and Coulibaly (2009) showed that a 1 percent increase in agricultural research public spending in SSA result in about a 0.38 percent increase in agricultural productivity, 0.95 percent growth in per capita income, and a 0.60 percent reduction in poverty. More recently, Ouru *et al*. (2018) estimated that over 2000-2014, a 1 percent increase in agricultural R&D increased agricultural output by 0.85 percent in the East African Community (Burundi, Kenya, Rwanda, Tanzania, and Uganda). In 2016, Pardey *et al*. reviewed 113 studies published between 1975 and 2014 spanning 25 African countries to find that rates of return to food and agricultural research averaged 42.3 percent per year, and the benefit-to-cost ratio averaged 30.1.

To yield high results, agricultural R&D has to be tailored to country needs and address environmental challenges, in particular climate change. Farmers cannot adopt agricultural innovations and improve their productivity unless the innovations are tailored to their needs, resources, and capacity and are appropriate for local agroecological and economic conditions. Adaptation of agricultural research to the field requires bi-directional learning between farmers and scientists. This is particularly important when farming systems are changing, as with climate change (Jayne and Sanchez, 2021). Tanzania, as in most of SSA, is highly vulnerable to climate change and increasingly experiences extreme weather, plant diseases, and pests. Bannor *et al.* (2021) have shown that the yearly growth rate of maize productivity was negative in 14 SSA countries, and that climate variability (proxied by rainfall variability) mostly explained it. They also found that increase in research and development could partly offset it.

A crucial lack of resources, particularly for research, undermine the effectiveness of Agricultural Knowledge Systems in Tanzania. This "deep dive" indicates that, while Tanzania still has a solid base and strong partnerships to rebuild its agricultural research, significant scale-up of investments are crucially needed before transmission of knowledge creation halts. Immediate development of agricultural research capacity vital for Tanzania develop locally-adapted solutions to sustainably boost agricultural productivity. While public allocation is needed for agricultural research, the country should explore alternative financing. The Tea Research Institute of Tanzania (TRIT) has developed an interesting model, by which it directly collects loyalties and breeders' fees. Similarly, public research institutes such as TARI could collect fees from seeds and patents they develop to direct invest in the sector. In addition, linkages between research and extension services appear broken due to problems on each side. Efforts to rebuild these linkages at the institutional level are necessary to allow lab innovation to benefit farmers, as in other countries. For instance, Ethiopia's creation of Research Extension Liaison Committees and Councils at national, provincial, and district levels, have improved these linkages, involving small farmers in selecting research and extension priorities and in research planning and implementation through establishment of Farmer Research Groups. Tanzania could foster and replicate some promising initiatives involving farmers participating in research, such as the ones led by CGIAR.

While capital investments are needed for extension, evidence points to low efficiency of the existing public system partly due to existing institutional arrangements. Chronical lack of capital investments, including in transport, contribute to preventing extension departments from performing their mission. The Government, acknowledging this limitation, recently announced a massive increase in the sector (in

particular, purchase of motorbikes for extension officers). In addition, supporting farmer groups, demonstration plots, farmers' field study tours, and agricultural represent key tools to speed agricultural information and knowledge dissemination to rural smallholder farmers. Further, the current institutional decentralized arrangement does not allow for national priorities to be disseminated at the field level. For instance, extension services do not foster climate change adaptation and current methods for sharing knowledge contributes to the gender gaps. Evidence—to be tested—suggests that non-public extension services might more broadly transform agriculture than the existing public one. These findings suggest that active government promotion of extension services may encourage further development of alternative extension provision by farmers themselves and cooperatives. Stronger coordination at the central level would be needed to ensure complementarities between extension networks. Further development of the nascent digital platforms for extension services may also represent a promising path to disseminate locally-adapted knowledge at lower cost.

Despite its economic significance and potential, the knowledge system appears particularly weak for the livestock sub-sector. Tanzania has among the highest livestock herds in Africa, with potential to become a major meat and dairy producer for the region; but research resources for the sector are negligible, along with access to extension services, whether public or the private.

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BACKGROUND PAPER 3 - Deep dive on Seed system

The seed system encompasses all vehicles for seed production and all channels through which farmers access seeds. This includes both formal production and marketing of certified seeds by private firms and governments and informal(production by farmers and communities, as well as dedicated research to the sector. The frontier between formal and informal systems is highly porous, as seed's genetic resource or seeds farmers use often rely on exchanges between the two (Westengen et al. 2019). In practice, Tanzanian farmers appear to acquire seeds from both formal and informal seed systems, mainly depending on the type of crops and their usage (McGuire et Sperling 2016).

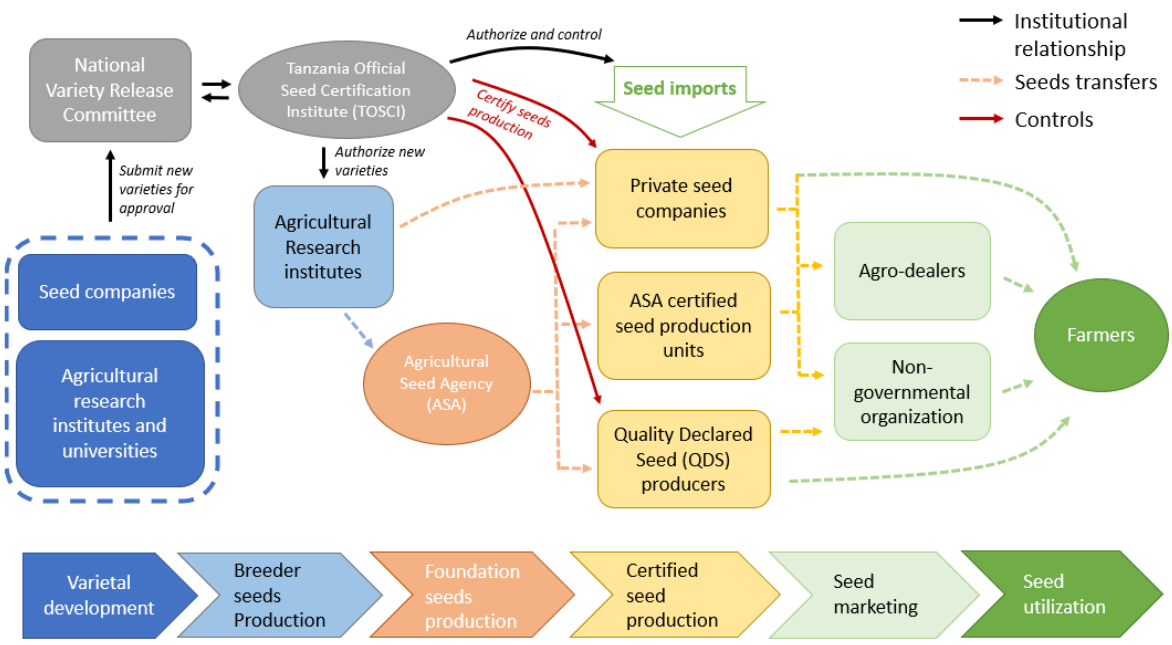
Smallholders' adoption of improved seeds has many benefits. First, improved seeds improve productivity, associated with fertility management (Jayne et Sanchez 2021). Improved seeds use enhance smallholders' food security in different contexts when looking at crops such as maize or wheat (Kassie et al, 2014; Shiferaw et al. 2014; Sinyolo 2020). Studies also show that improved seed adoption can reduce poverty in farming households in Tanzania, Malawi, and Uganda (Kassie et al 2011; Asfaw et al. 2012; Bezu et al. 2014). Furthermore, climate-smart seed varieties could play a critical role in smallholder adaptation to climate change (Challinor et al. 2014; Challinor et al. 2016). Improved seeds are designed to adapt to extreme climate events, such as drought or flooding, and allow farmers to maintain yields despite increased frequency of these events. These known benefits justify the Government's interest in strengthening Tanzania's seed system and motivate this deep dive.

1. Description of Tanzania's seed system

Tanzania's strengthened its clear, solid regulatory framework for its seed system in 2013-14 to further increase private sector participation. The Protection of New Plant Variety Act in 2002 established a system of plant variety protection compliant with the Agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization, enforcing minimum standards to protect intellectual property rights for plant breeders. In 2003, the Seed Act instituted seeds certification and sales laws. The act created several public institutions to operate within the seed system, opened the sector to private actors, and created the Tanzania Official Seed Certification Institute (TOSCI). The Act also created the Agricultural Seed Agency (ASA) to multiply foundation seeds for the private sector and distribute improved seeds for public varieties. The Act also adopted the Quality Declared Seed (QDS) system, allowing farmers to multiply and sell improved seed. The 2007 Seeds Regulation harmonized the existing framework with the East African Community (EAC) and Southern African Development Community (SADC) (Westengen et al. 2019). These acts were amended in 2013-14 to strengthen existing institutions and deepen private sector participation. They enabled Tanzania to join the International Union for the Protection of New Varieties of Plants (UPOV) in 2015. Discussions are on-going on further regional harmonization of regulations of seed and plant varieties to create a larger seed market and facilitate private participation in the sector.

Multiple actors, private and public, are involved in seed production in Tanzania. Figure B3.1 displays key steps in the seed value chain and the institutions involved in each of them, before we further detail these steps and actors.

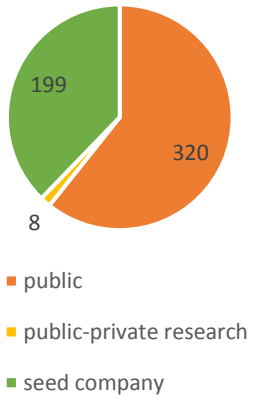
Figure B3.1 - Formal seed system operation in Tanzania



Source: authors' adaption from Kangile et al. (2018)

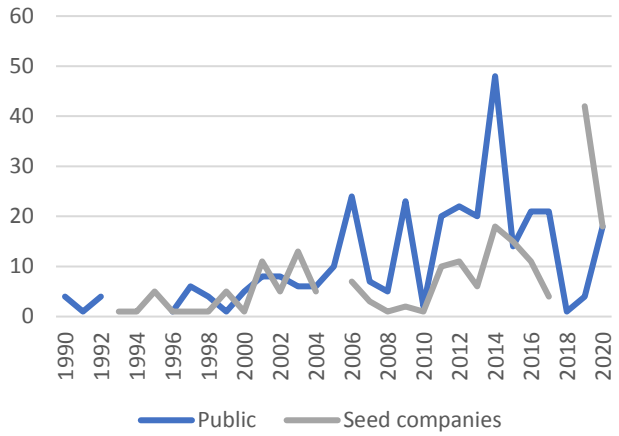
Varietal development in Tanzania has increased over the past decades, two-thirds driven by public research institutes with a wide focus; and one-third by private seed companies that concentrate on maize. Thanks to both public and private research (including agricultural research institutes and Sokoine University), registered varieties have increased over the last decades (Figure B3.2). Public breeders have released nearly two-thirds of all varieties since 1945 and 71 percent of all varieties over 2006-2016 (Figure B3.2). Yet, public variety release collapsed in 2020-21 (Figure B3.3). Over the 585 registered varieties in Tanzania (for 33 crops), 32 percent are maize. Private local and multinational companies released 72 percent of existing maize varieties (Figure B3.4). The private sector also drives varietal development in the small volumes of sunflower seed and sorghum. Commodity specialization through the Agricultural Research Institutes leads to a wider range of public varietal development beyond maize. For instance, TARI Uyole and Selion respectively released 21 and 14 beans varieties. The Tanzania Coffee Research Institute is the only organization who developed and registered coffee varieties (23). Multiple public research institutes developed varieties of vegetables, fruits, and herbs. In 2017, 41 of the 46 active breeders reported in Tanzania for maize, beans, soya beans, and pigeon peas (Mabaya et al. 2017) were public.

Figure B3.2 – Number and share of all varieties released in Tanzania since 1945



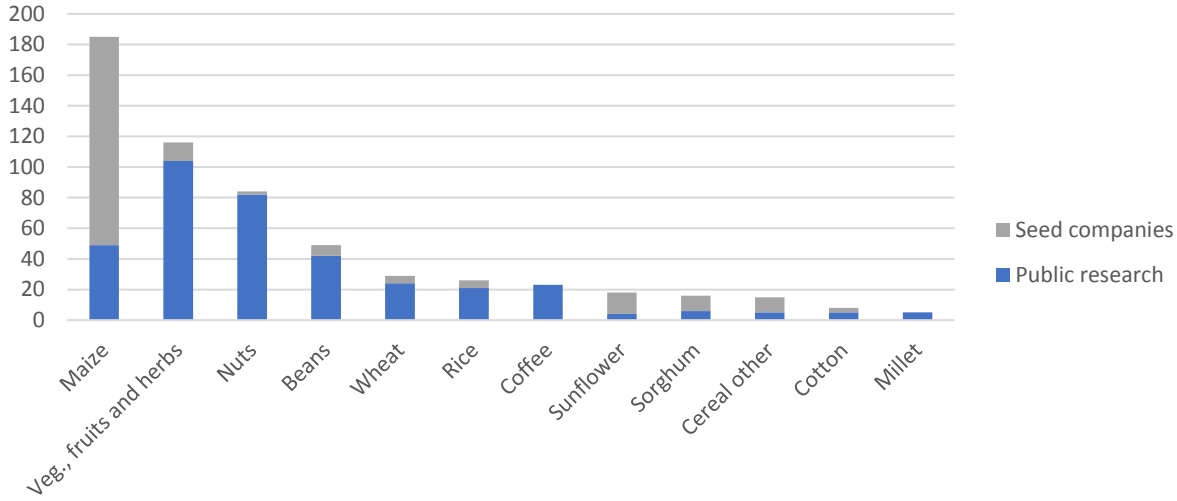
Source: authors. Data: TOSCI

Figure B3.3 – Evolution of number of varieties released by the public sector and private seed companies



Source: authors. Data: TOSCI

Figure B3.4- Varieties distribution per crop category and owner/maintainer



Source: authors' own elaboration. Data: TOSCI (2022)

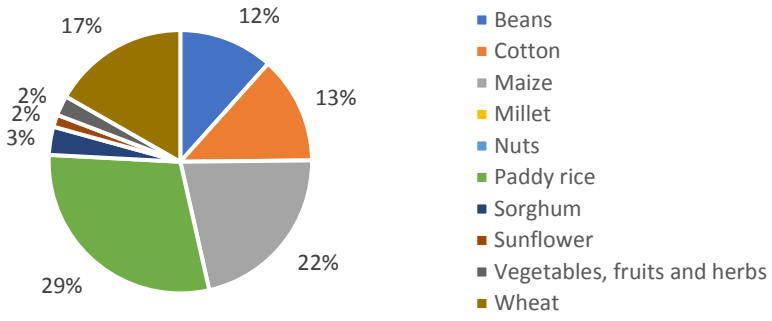
Overall, the rate of variety release is low in Tanzania, even more so for climate-smart varieties (World Bank 2019). Varieties release peaked in 2014 with 66 varieties. Otherwise, the median number of varieties released per year from 2015 to 2020 was 32. On the 585 varieties registered in Tanzania, 11 percent (60) have drought tolerance or resistance characteristics, 24 are early-maturing, and 7 are both. Maize is the crop with the most drought-tolerant varieties, followed by vegetables, fruits, and herbs categories. Half of the varieties presenting climate-smart features have been released in the last ten years, showing growing research focus on the subject.

Registering new varieties, a TOSCI responsibility, is a lengthy process. The National Variety Release Committee review new varieties submitted. TOSCI is in charge of variety release and registration, seed certification, and training, and authorizes and controls seed imports. Variety registration lasts three years on average and involves multiple steps. The Plant Breeders Rights Advisory Committee, formed in 2005,

collects fees for registering new varieties and supports the Plant Breeders Rights Development Fund (PBRDF), which provides grants to private and public breeders. Public agricultural research institutes are not exempt from these fees. TARI reports that, in the face of its recurrent lack of funding for operational costs, these fees are accumulating arrears (TSH 300 million as of 2022), reducing protection of varieties it develops. Mabaya *et al.* (2017) reported overall positive private sector satisfaction for the variety release process (70 percent). In the light of other countries experience, World Bank (2019) nonetheless considers that further reduction of time required for new varieties release and registration could be achieved.

Once registering a variety produced by public research, ASA is responsible for multiplication of foundation seeds. ASA, a semi-autonomous institution, is the trustee of nine government farms across Tanzania for seed production. The agency is also supposed to catalyze other seed actors to supply farmers, but supply capacity of the agency is limited by lack of necessary tools such as irrigation equipment. In addition to ASA, adoption of licensing contracts between the Ministry of Agriculture and private companies liberalized breeder seeds production for public varieties in 2011. However, only 4 of 27 companies had been approved for breeder seeds production in 2016 (USAID 2016). In addition, most do not have their own seeds farm and rent land from ASA. Available information suggests that ASA leases 24 percent of its land to the private sector. Multinational seed companies usually obtain foundation seeds from breeding programs outside Tanzania. Locally produced foundation seeds are relatively diverse (Figure B35).

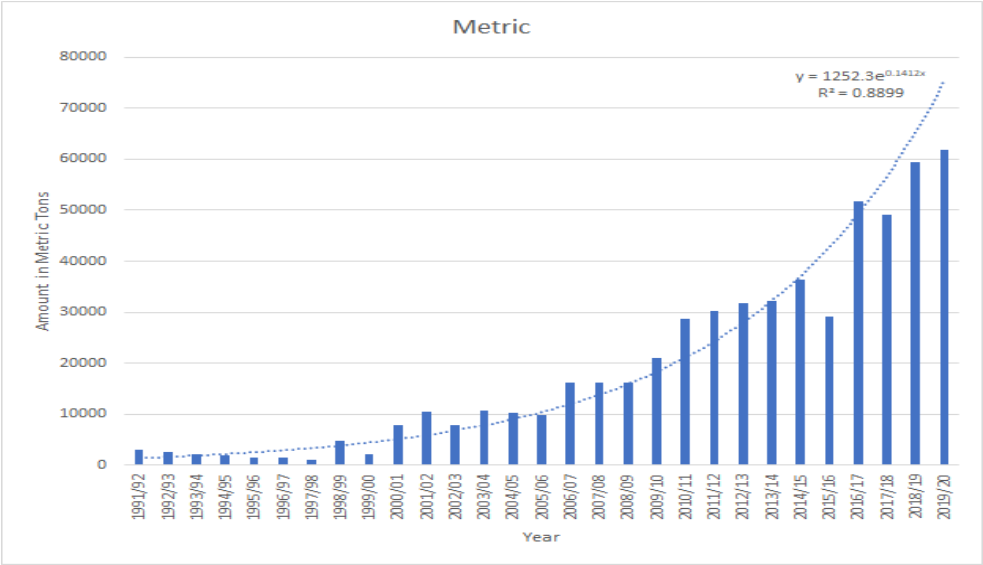
Figure B3.5 Basic seeds locally produced by types of crops



Source: authors' own elaboration. Data: TOSCI (2022)

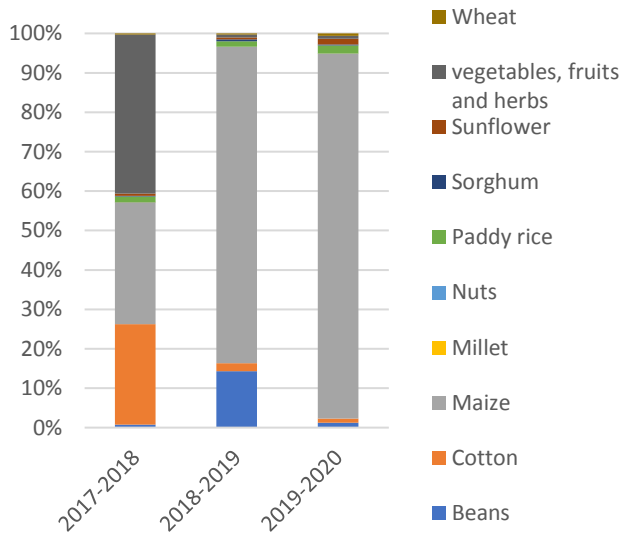
The quantity of improved seeds produced locally has multiplied six-fold over the past fifteen years, driven by private firms (Figure B3.8). Three different types of actors produce certified seeds out of foundation (also called basic) seeds: ASA certified seed production units, licensed private seed companies, and quality declared seed (QDS) producers. The increase in the number of seeds produced locally from about 10,000 metric tons in 2005/06 to over 60,000 metric tons in 2018/19 (Figure B3.6) partly stems from increased partnership between ASA and the private sector, as well as accreditation of the TOSCI laboratory. About 50 firms locally produce or import seeds in Tanzania (CIMMYT 2018), including a few multinationals (Monsanto, Pannar, Pioneer, Syngenta) and many local companies. Privately-produced maize seeds increasingly dominate other crops (Figure B3.7). The public sector supplies most seeds for other crops, such as 81 percent of cotton seeds; 93 percent paddy rice seeds; and 100 percent wheat, nuts, and millet seeds.

Figure B3.6 - Evolution of the volume of seed production in Tanzania



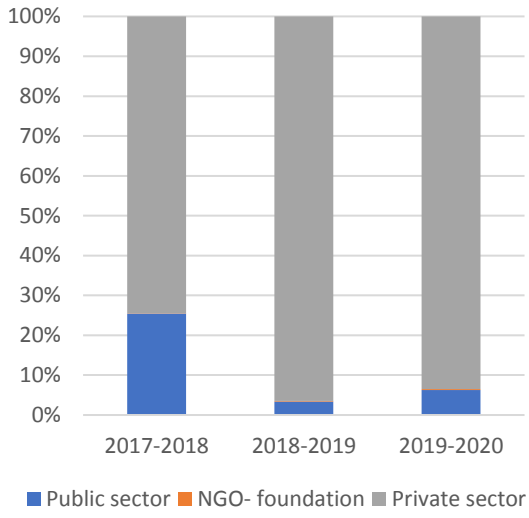
Source: Authors. Data: Agricultural Seeds Agency (2021)

Figure B3.7. Seed production by crop category



Source: authors' own elaboration. Data: TOSCI (2022)

Figure B3.8. Tanzania seed production by actor type

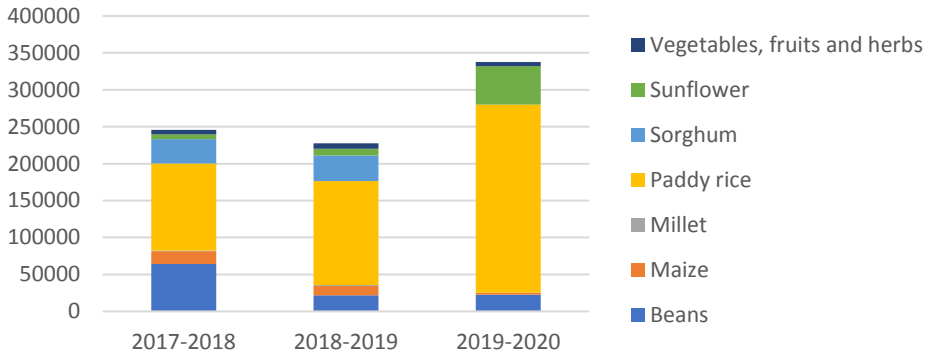


Source: authors' own elaboration. Data: TOSCI (2022)

Despite QDS's importance in bridging the gap between formal and informal seed systems in Tanzania, their production volume remains at 2.5 percent of local production and focuses on paddy rice. FAO introduced this system in the early 2000s. Figure B.39 displays crops produced through QDS over the 2017-2020 period. Paddy rice dominates this production channel, followed by sunflower, sorghum, and beans. To commercialize QDS seeds, farmers must send a harvest sample for quality assessment to TOSCI. If the seeds meet regulatory standards, TOSCI awards a certificate showing the lot number assigned and allowing sale of the seeds. District administrations provide training to QDS producers relative to QDS

production, seed marketing, and post-harvest handling, such as storage (TOAM 2015). As for improved seed produced by ASA or the private sector, farmers that purchase and use QDS in Tanzania are wealthier and more involved in farmers' associations (Mghweno, Mishili, et Nchimbi-Msolla 2020). The World Bank report (2019) underlines the need to evaluate the effectiveness and impact of this seed production scheme.

Figure B3.9 - QDS production by crop



Private firms commercialize 93.5 percent of improved seeds and 98 percent of improved maize seeds, under strong public institutional regulation. From 2003 to 2011, the private sector produced or imported between 79 percent and 99 percent of improved seeds to the Tanzanian market (WB report 2012). This share has not changed as the private sector commercialized 93.5 percent of improved seeds in the country in 2020 (Figure B3.8). From 2017 to 2020, the share of seeds provided by seed companies ranged between 75 percent and 97 percent. The public sector—including the ASA, Agricultural Research Institutes, and local administration—accounted for most of the rest, and NGO-Foundations accounted for for a small share. Consistent with all steps of the seed system, private sector efforts focus on maize: over the last three years, 74 percent of commercialized private-sector seeds were maize and 18 percent vegetables, fruits, and herbs.

Seed quality control is very limited due to insufficient TOSCI resources, and thus is delegated to LGA extension officers. Seed producers can directly market their seeds to farmers or through agro-dealers and NGOs. About 1,500 active agro-dealers are reported in Tanzania (USAID 2016). TOSCI controls a portion of them to certify the seed production process, including for a portion of QDS producers. It is also in charge of combatting counterfeit seeds. However, Mabaya et al. (2017) indicate that the agency only had 48 public seed inspectors in 2017 and that private services providers impose no controls. Resources are thus insufficient to effectively control seed quality and agro-dealers shops, and to conduct field inspections. TOSCI relies on LGA extension staff to perform this duty.

Between 2017 and 2019, Tanzania imported 56 percent of improved seeds. A World Bank report (2012) found the same share in 2011. A slight downward trend appears over the studied period, with 60 percent of imported seeds for the 2017/18 season, 55 percent for 2018/19, and 51 percent for 2019/20. Further data points are needed to confirm the trend. Imports are here again predominantly maize seeds (91 percent); followed by beans seeds (7 percent); vegetables, fruits, and herbs (1.5 percent); sunflower (0.5 percent); and other crops. Over the 2017-2020 period, only 4 percent of basic seeds were imported, showing the dominance of locally-developed and produced foundation seeds (TOSCI). Put differently, most imported seeds are final products that can be directly commercialized.

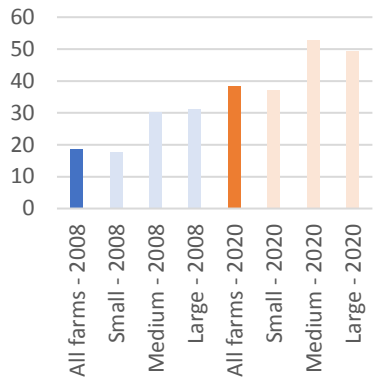
Several development programs include a component on seed access to smallholders. However, the volume of seeds corresponding to these projects remains under 1 percent of total seeds marketed

(TOSCI). A USAID report (2016) describes the activities of four actors. Mennonite Economic Development Associates of Canada (MEDA) implemented a cassava project to develop new varieties and bridge the gap between research and farmers. One Acre Fund, an NGO, supports smallholder purchasing of improved maize seeds in Iringa and Mbeya regions. The Alliance for a Green Revolution in Africa (AGRA) supports research and development activities with $48 million grants awarded between 2007 and 2015 to both the public and private sectors. The Consultative Group on International Agricultural Research (CGIAR) has also been active by investing in varietal development, policy and capacity building programs, notably through its key organizations in the countries (ICRISAT for sorghum and millets, IITA for cassava and sweet potato, CIAT for common beans, and CIMMYT on maize and wheat). Thus, 2.3 percent of households using improved seeds obtain them from development projects (National Sample Census of Agriculture 2021).

However, improved seed supplies (local production and imports) do not meet Tanzania's needs. Improved seed supply is estimated to be below 15 percent of requirements for the 2015-2020 period for paddy rice, maize, cassava, sorghum, and sunflower (ASR report). Local production of improved maize is reported to have covered only 34 percent of demand for 2017-2018 (CIMMYT 2018). Farmers access seeds through different channels; local markets provide 72 percent of improved seeds to Tanzanian households; the Government supplies 4.6 percent; cooperatives 2.8 percent, and neighbors 2.6 percent (National Sample Census of Agriculture 2021).

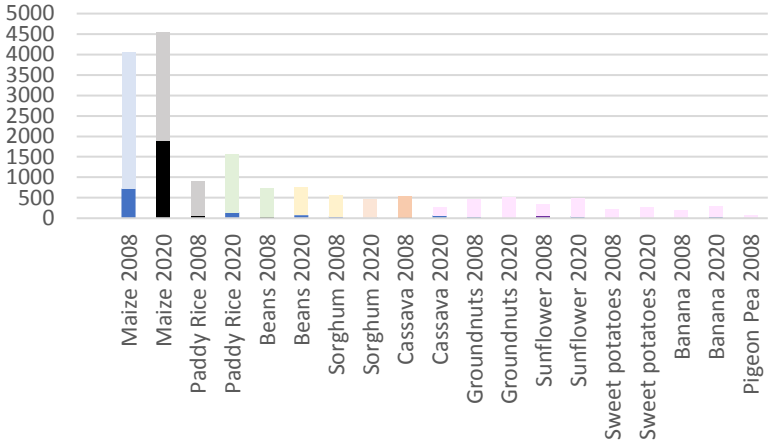
The number of farms that use improved seeds more than doubled between 2008 and 2020, but still only amounts to 38 percent of them. According to the National Sample Census of Agriculture, the share of Tanzanian farms using improved seeds increased from 19 percent in 2008 to 38 percent in 2020 (Figure B3.10). The increase comes from all categories of farms, with small farms witnessing the fastest progress (108 percent). However, this share remains lower than the 45 percent target for improved seeds utilization ASDP II set. Averages mask varietal and local variability. Figure B3.11 shows the rapid evolution of acreage planted in improved seeds for maize from 2008 (18 percent) to 2020 (42 percent), in line with the varietal development and production effort documented in this chapter. Rapid progress is also notable for cassava (from 5 percent to 23 percent) and pigeon peas (from 4 to 16 percent).

Figure B3.10 - evolution of share of farms that use improved seeds in 2008 and 2020 per farm category



Source: authors' own elaboration. Data: National agriculture survey 2008 and 2020

Figure B3.11 - evolution of area planted (1000 ha) for key commodities with improved seeds (dark colors) and normal seeds (light colors) between 2008 and 2020



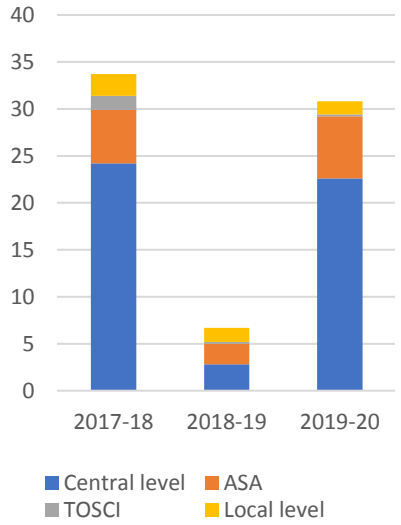
Source: authors' own elaboration. Data: National agriculture survey 2008 and 2020

2. Effectiveness of spending on seed system in Tanzania

ASA and TOSCI budget aside, the allocation to the seed system is not ear-marked and is closely intertwined with support to research, extension, and irrigation. Activities directly supporting the seed-system have thus manually been identified in the agricultural Public Expenditure Review (PER) dataset. The resulting seed system budget detailed in this section presents some overlap with research, extension, climate change resilience, and irrigation budgets discussed in other chapters, as these activities are interrelated. Interviews conducted with ASA and TOSCI provide quantitative and qualitative data on their roles and budgets. Both agencies rely mostly on Ministry of Agriculture (MoA) transfers, but they both also have their own resources. This section combines these data sources with to provide the best possible estimation of public allocation to the seed system.

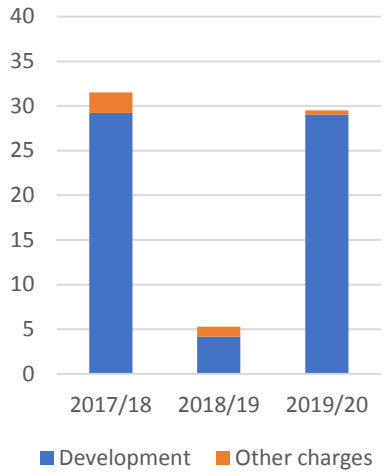
Budget for the seed system is low and varied considerably over the period, creating uncertainty. Budget to the seed system is estimated at TZS 71.5 billion from 2017/18 to 2019/20 (US$ 31.6 million): TZS 33.8 billion for 2017/18, TZS 3.0 billion for 2018/19, and TZS 30.9 billion for 2019/20 (Figure B3.12). Most allocation to the seed system occurs at the central level (93 percent). From 2017/19 to 2019/2020, seed budget represented between 3 and 4 percent of central agricultural budget (2.7 percent for MoA), with a drop in 2018/19 to 0.8 percent (Figure B3.13). The year 2017/18 indeed witnessed a full collapse in seed budget, particularly at MoA and ASA levels. All stakeholders interviewed confirmed drastic budget cuts, along unpredictable budget outturns. Analysis of the economic classification of seed budget at central and local levels (Figures B3.13 and B3.14) shows that wages and salaries related to the seed system are unknown as these were lumped into general personal emoluments. The presented seed budget thus likely underestimated. In particular, these figures do not account for time local extension officers spend on seed control missions, which we could not quantify.

Figure B3.12 - Breakdown of agricultural budget for the seed system per agency (TZS billion)



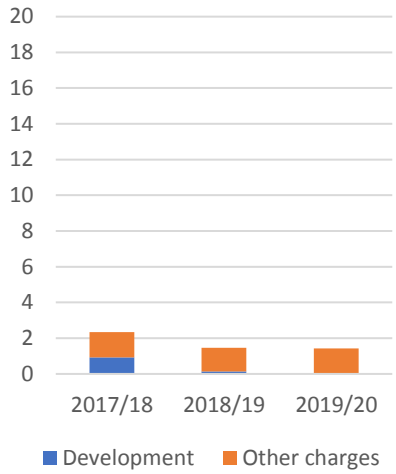
Source: original PER data.

Figure B3.13 - economic classification of seed budget at central level (TZS billion)



Source: original PER data.

Figure B3.14 - economic classification of seed budget at local level (TZS billion)



Source: original PER data.

The high budget variability is explained the phasing out input subsidies and dependance on donor project. Figures B3.15 and B3.16 detail the composition of local and central budget on seeds. It shows that wavering central budget for seeds is mostly a result of: (i) the phasing out of input subsidies; and (ii) contribution of the World Bank-supported the Expanding Rice Production Project. Local budget has decreased, reflecting a similar decrease in input subsidies. Indeed, the Government phased out the National Agricultural Inputs Vouchers Scheme (NAIVS) and ended the subsidy program nationwide. It still provided subsidies to specific crops under special arrangement over 2017/18-2018/19. For instance, the national oilseed development strategy included distribution of palm oil seedlings to farmers through LGAs. Sunflower value chain development also encompassed sunflower seeds supply at a subsidized price.

Figure B3.15. Allocation to seed system at central level

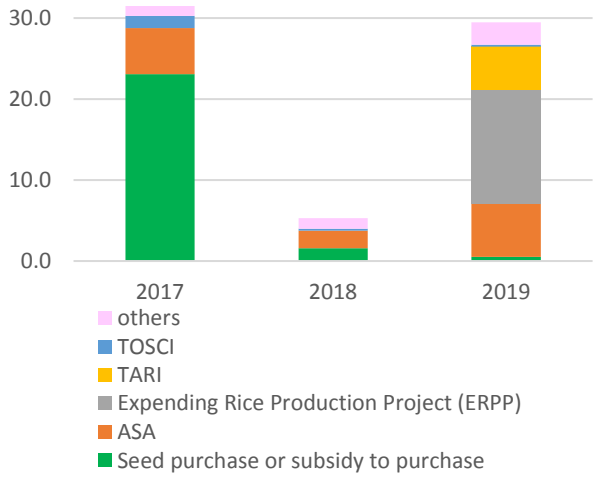
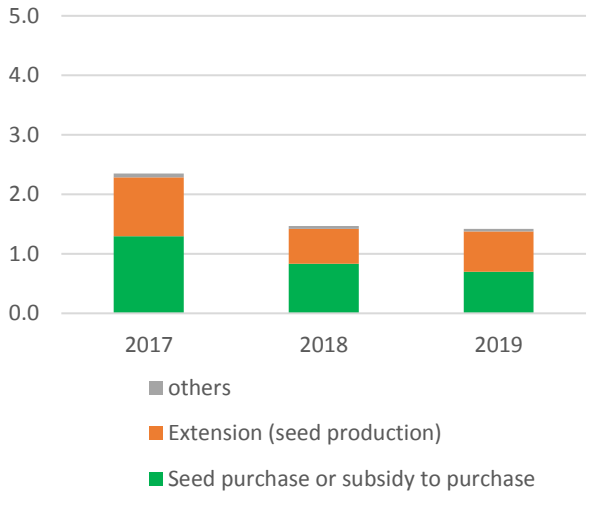


Figure B3.16. Allocation to seed system at local level



Source: original PER data. Source: original PER data.

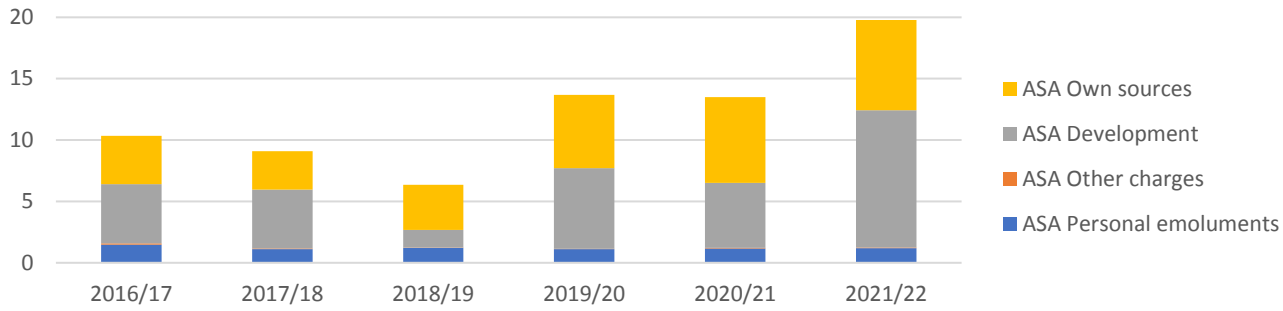
Donors' both off and on- budget contributions for the seed system are not clear, with the exception of the World Bank Rice Extension Project (ERPP). The OECD-CRS datasets trace marginal commitments to the Tanzanian seed system. But the seed support is often one component among others in wider projects, suggesting that development partners' contribution to this sub-sector might be much larger. The World Bank ERPP project, which makes up 43 percent of the budget we estimated for the seed system at central level in 2019/20, is an example.

Public varietal development is underfunded and budget predictability needs to improve. As detailed in the Knowledge System deep dive, agricultural research is deeply underfunded in Tanzania. Research institutes face budget shortages. On average, for instance, TARI receives only 36 percent of the total budget the institute requests. This limits their access to critical materials to develop new varieties and maintain existing ones. For instance, insufficient greenhouses facilities in some centers means that they cannot produce breeder seeds, especially for Open Pollinated Variety (OPV). Researchers are obliged to set up trials in isolated areas far away, thus increasing research costs. Current legislation does not allow research institutes such as TARI to charge royalties for basic seed varieties they supply to ASA or for certified seed multiplication for private companies.

Considering the extremely low and erratic budget recently allocated to seed system research, varietal development achieved has been satisfactory; but it is likely to collapse without significant budget increase. Tanzania's public varietal development has been relatively active over the past fifteen years, with the exception of 2018-2020 (Figure B3.2). Its diversity in terms of crops and focus is an asset for Tanzania to improve its food security and chronic malnutrition, as well as a key tool for crop diversification and related climate change resilience. Considering the time needed to develop and release a new variety, variety release reflects public investments that occurred over the past three to five years. The recent collapse in public variety release likely relates to the collapse in MoA development and operational costs budget.

ASA, a key player in the public seed system, needs to be cautious in positioning itself so as not to crowd out the private sector. ASA budget was TZS 9.1 billion for 2017/18, TZS 6.3 billion for 2018/19, TZS 13.7 billion for 2019/20 and TZS 13.5 billion for 2020/21. Its budget shows rapid increase since its low at 2018/19, driven by development budget (Figure B3.17). Field interviews point to inefficiencies that increase costs for farmers. As an example, under the national oilseed development strategy, ASA contracted a private firm, Yangu Macho Group, to multiply palm oil seeds. It then bought back the seedlings to re-sell them to farmers. While cost-efficiency of the operation has not been assessed, multiplying intermediaries in a value chain tends to push costs upward for farmers. Based on the share of public seed production, a very rough estimate is that ASA budget amounted to US$ 1179 per ton of improved seed it produced. While the public sector has a key role to play in provision of public goods, such as varietal development for improved nutrition and climate change resilience, the private sector could be more active in the production of seeds.

Figure B3.17 - Evolution of the economic classification of the budget of ASA (TZS billion)



Fake seeds are a significant problem in terms of undermining farmers' trust in the Tanzanian seed market, which TOSCI could more forcefully address with higher budget. The TOSCI budget has remained stable over the same period with an average budget of TZS 4.0 billion, despite the growth of improved seed sector. Its primary item cost is wages and salaries at around 60 percent, followed by supplies and consumables for 25-28 percent, and purchasing property plant and equipment between 3 and 12 percent over the period. Insufficient staff and low allocations to development and operational activities limit the capacity of the institute to perform its mission. Interviews confirm this lack of means to perform day-to-day activities, such as vehicles to undertake field inspections. Yet USAID (2013) estimated that 25–30 percent of certified seeds used in Tanzania were fake. Counterfeiting led TOSCI to create a more advanced system, still at the pilot stage, which introduces serialized labels on seeds packages. Further Batch numbers generated electronically are connected with a unique number from the Tanzania Communication Regulatory Authority (TCRA) using a mobile phone network (Tanzania Telecommunication Corporation Limited). These numbers are only revealed upon scratching, and the procedure for verifying whether the seed is genuine or fake is displayed on the bag. Results from this system are expected in the coming years. Meanwhile, TOSCI's role is vital in building farmers' trust in the seed system and should be strengthened to fight fake seeds. Beyond needed budget increase, TOSCI could more effectively fight fake seeds by enabling inspectors to instantly fine identified violation, which is currently not the case.

Despite rapid progress over the past fifteen years, farmers' adoption of improved seeds faces various constraints that require addressing. At the farmer level, the Agricultural Sector Review (United Republic of Tanzania 2021) shows that 15.6 percent of farmers find prices to be a limitation for purchasing improved seeds, while 3.9 percent of farmers find the availability of quality seeds to be the problem. About 50 percent of farmers do not report any issue regarding seeds, suggesting that this share has no intention of using this type of input. The authors thus conclude that perception, community taste, and customary practices appear to hamper improved seed adoption. However, Westengen et al. (2019) find that farms using improved maize seeds are significantly better off than those not using them, based on data from Tanzania, Malawi, and Ethiopia. Training, farmer-led extension, farmer field schools, and demonstration plots are among the tools that can help boost farmers' interest in improved seeds. Kangile, Gebeyehu, and Mollel (2018) studied the adoption of new rice varieties in Tanzania's Kyela, Kahama, and Kilombero districts. In their study, the main limitations for improved seed use were lack of awareness about improved seeds, lack of availability, and low rice production specialization.

3. Recommendations

Policy options to strengthen Tanzania's seed system based on the findings of this deep dive include:

- **Seed varietal development:** Significantly increase budget for public research before existing capacity is lost (see deep dive on knowledge systems). Facilitate and accelerate new variety registration.
- **Seed Production: ASA could devise a more aggressive business model that will ensure an increase in local production of diversified and climate-smart seeds** addressing malnutrition and climate change resilience challenges, which the private sector might not invest in. Partnership with the private sector is critical to ensuring cost effectiveness and efficiency;
- **Seed uptake:** Strengthen extension services and particularly farmer-led extension, demonstration plots, farmer field schools and other initiatives to demonstrate the benefits of improved seeds (see deep dive on knowledge system).
- **Fake Seeds:** To strengthen the fight against fake seeds, support the TOSCI batch numbering initiative to counter fake seeds, including evaluation of the pilot phase and rolling out the system to all types of seeds countrywide. TOSCI could further promote the batch number approach to farmers using different media outlets including SMS delivery through mobile phones. Working closely with extension agents and training agro-dealers may help spread the message and educate farmers about fake seeds and how they can avoid them.

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BACKGROUND PAPER 4 - Deep dive on climate change: estimating inaction costs in agriculture

As emphasized by the 2022 IPCC report on Impacts, Adaptation, and Vulnerability, climate change has already started to affect livelihoods across the globe, and adaptation is an urgent matter. Tanzania's high reliance on the agricultural sector, both in terms of employment and GDP shares, makes it particularly vulnerable to these long-term changes and potential increase in natural disasters. Therefore, agricultural public policy adaptation is critically important. This section aims to review the implementation of climate change measures for agriculture in Tanzania and estimate the cost-effectiveness of taking further action.

1. Climate change and soil erosion risks for the Tanzanian agricultural sector

Climate change and increased weather variability are already taking place in Tanzania. The incidence of extremes temperatures and climate-related disasters, such as floodings or droughts, has increased over the last decades (Shemsanga, Omambia, et Gu 2010). Weather-related disasters account for 69 percent of Tanzania's recorded disasters since 1872, and 73 percent of these events have occurred between 2000 and 2019 (Msemo et al. 2021). A record-breaking number of rainfall intensity and distribution anomalies occurred between 2015 and 2020 (NDC 2021). Chang'a et al. (2021) find that from 1961 to 2015 the mean temperature anomaly increased by 0.69°C, the mean percentage of warm days increased by 9.37 percent, and the mean percentage of warm nights increased by 12.05 percent. A majority of extreme weather events, such as record-breaking rainfalls, took place from 2015 to 2020 (United Republic of Tanzania 2021). Finally, November and December 2021 were respectively the first and third-warmest months ever recorded in Tanzanian History (Mwangonde 2022).

Experts predict further rise in temperatures, change in sea level, and increased probability of extreme weather for the coming decades (Tomalka *et al*. 2020). In Tanzania, temperature increase should range between 1.4° and 3.6° Celsius by 2080, depending on climate change scenarios. Under medium-to-high emissions scenarios, sea level is expected to rise by 41 centimeters by 2080, threatening coastal communities and possibly causing saline intrusions in waterways and groundwater. For the same period, precipitation trends show significant variability under the different scenarios, predicting either increasing or maintaining rainfalls levels with high uncertainty (ibid). Regarding climate-related extreme events, Gyilbag et al. (2021) find that the spatial extent of heatwaves should expand from 34 percent to 73 percent by the end of the century, and their duration will increases from one to five days to a range of eight to 35 days. These predictions will have varying effects across the country, with some regions being more affected than others. The central, northern, western, southwestern, and northeastern highlands will experienced an increase in maximum temperature of between 2.4°C and 2.6°C or 2°C and 2.2°C, depending on the scenario, for the 2041-2070 time period (Luhunga et al. 2018). The study predicts higher increases in maximum temperature of up to 3.5° Celsius for the western parts of the country, southwestern highlands, and Lake Nyasa's eastern parts for the 2071-2100 time period.

The predominantly rainfed nature of Tanzania agriculture makes it particularly vulnerable to climate changes. Though still challenging to predict, the risks of rainfalls variability and droughts directly threaten agricultural production. According to projections, the surface exposed to at least one drought per year will multiply five-fold by 2080 (Tomalka et al. 2020). Rising temperatures and CO2 concentrations in the air will affect most crop yields, either negatively or positively. Maize, Tanzania's most important crop, is predicted to maintain or undergo a yield decrease of between 5 and 7.7 percent, depending on the scenarios (Tomalka *et al.* 2020; CIAT and World Bank 2017). On the other hand, yields for millet, sorghum, rice, groundnuts, and cassava will increase by 20 to 30 percent if climate change predictions occur (CIAT

and World Bank 2017). Plant diseases and animal pests represent another significant hazard for agricultural production under climate change, as warmer temperatures foster their development and spread. Livestock will be vulnerable to this risk as well as pasture quality and acreage changes. Rangelands vital to livestock producers and communities are already shrinking (Arce et Caballero 2015). Lastly, agricultural exposure to climate change presents multiple dimensions: vulnerability of farming systems, communities, households, and individuals (IFPRI 2013). Hence, these environmental changes in production conditions will affect farmers differently across Tanzania, and vulnerable ones will likely be hit the hardest.

2. Agricultural climate change adaptation policies and related budgets

National Tanzanian policies have incorporated climate change adaptation for the last two decades. Following the UNFCC requirement, Tanzania produced a National Adaptation Programme of Action (NAPA) in 2007**.** This document identified five vulnerable sectors—agriculture, water, energy, health, and forestry—and existing and potential adaptation actions for each of them. Tanzania also integrated climate change goals into National Development Policies starting in the 2010s. In 2011, the Tanzania Planning Commission identified climate change adaptation as an urgent priority to reach country development goals. The most recent Poverty Reduction Strategy Paper (PRSP) in 2010 also included climate change adaptation within Goal 4 for "*better integrating climate change adaptation into agriculture to promote* economic *growth and ensure food security*". The country then adopted a National Climate Change Strategy (NCCS) in 2012 that went beyond the 2007 NAPA's strategy (ibid). The same year, the country released its National Climate Change Communication Strategy and Guidelines for Integrating Climate Change Adaptation into National Sectoral Policies, leading to progressive mainstreaming of climate change interventions within sectoral policies.

Agriculture is well integrated in the 2021-2026 National Climate Change Response Strategy (NCCRS). This plan aimed to provide a new framework for climate action after the end in of 2012-2018 National Climate Change Strategy. The strategy, based on a consultative process, seeks to improve public and decision makers' climate risks awareness; strengthen knowledge, data acquisition, and monitoring of climate change issues; and scaling-up of capacities and resources to tackle them. It covers adaptation action for a range of priority sectors, including agriculture, livestock, fisheries, forest, and beekeeping. It also includes freshwater resources, water sanitation and hygiene, coastal marine environment, wildlife, human health, tourism, energy, industry, infrastructure, human settlements, and land use. Mitigation activities include efforts in the livestock, and forest and mangroves sectors, as well as energy, industry, transport, waste management.

The Agricultural Sector Development Programme Phase II (ASDP II) included climate adaptation actions for 2015-2025. The first component of the program focuses on sustainable management of productive resources, which accounts for 15 percent of total spending for the first five years. Investment areas under this component include promoting Climate-Smart Agriculture (CSA) technologies and practices as the sub-component 1.3. For the program's first five years, the specific cost items of this sub-component are: (i) promoting and developing Climate Smart Agriculture and Conservation Agriculture technologies for TSZ million 41,424; (ii) promoting Ecosystem Approach to Fisheries and Aquaculture Management for TSZ million 5,989; and (ii) strengthening Comprehensive Agricultural Early Warning System and Emergency Preparedness for TSZ million 4,918. However, these amounts represent only 3 percent of funds allocated to component 1 and thus 0.4 percent of total spending. On the other hand, the priority given to increasing irrigation areas in sub-component 1.2. also fits within adaptation to climate change and received 88 percent of funds allocated to component 1 (TSZ million 1 776) and 13 percent of the total budget. It

includes rehabilitating and developing irrigation infrastructure; promoting micro-irrigation systems; strengthening irrigation schemes management and operations; developing water infrastructure for livestock productivity; and promoting and constructing modern integrated water facilities for crops, livestock, and fisheries.

In addition to ASDP II, Tanzania has developed specific action plans to promote climate-smart agriculture over the last decade. The first is the Agriculture Climate Resilience Plan (ACRP) 2014-2019, built in line with the NCCS 2013, which called for a sectoral breakdown of climate policies. It revolves around four priority actions: (i) improve agricultural land and water management (US$ 76 million, increase yields through climate-smart agriculture (US$ 2 million), protect the most vulnerable against climate-related shocks (US$ 46 million), strengthen knowledge and systems to target climate action (US$ 2 million). The estimated total cost for implementing the plan was US$ 126 million over five years. This budget relied on an average of 80 percent external funding that had not been leveraged when the plan was conceived. The second plan is the 2015-2025 Tanzania Climate Smart Agriculture Programme (CSAP), which aligns with ACRP 2014-2019 without explaining their articulation. A Climate-smart agriculture guideline produced in 2017 support CSAP implementation. CSAP has an estimated budget of US$ 32.158 million projected over ten years, much smaller than ACRP for five years. Table B4.1 compares the two programs.

Table B4.1 - Comparison of budget items in USD$ between the ACRP 2014-2019 and the CSAP 2015-2025

	CSAP over 10 years (2015-2025)			**ACRP over 5 years (2014-2019)**		
Focus areas	Component	Budget allocated/year	% total budget	Component	Budget allocated/year	% total budget
Irrigation	1.2	208 500	6%	1.A - 1.B	12 700 000	50%
Climate-smart practices adoption	5	355 000	11%	2	400 000	2%
Disaster prevention - weather forecast	2.4	84 000	3%	3	9 200 000	37%
Insurances	2.3	70 800	2%			
Research	4	247 500	8%	4	400 000	2%
Nutrition	1.1	506 000	16%			
Value chain	1.3 - 3.1 - 3.2	272 300	8%			
Environment preservation	2.1 - 2.2	330 600	10%	1.C	2 500 000	10%
Income/productivity	1.4	382 000	12%			
Mitigation	2.5	46 000	1%			
Supporting implementation	6	713 100	22%			
		3 215 800	**100%**		**25 200 000**	**100%**

Source: authors' own elaboration based on CSAP and ACRP

Despite extensive programming of climate change action for the agricultural sector, budgets remained at about one-quarter of planned expenditures for 2017/18-2019/20. US$ 13 million was budgeted over three years for climate-smart agriculture (US$ 4.3 million per year). In comparison, the implementation of the two programs should have resulted in yearly budget of US$ 28.4 million in climate change adaptation for the agricultural sector for the 2017-2019. When deducting budget allocated to irrigation

from this amount, it still represents only US$15.5 million per year. Thus, climate change adaptation budget corresponds to only 28 percent of need, according to CSAP and ACRP. Overall, Climate Smart Agriculture (CSA) budget represented 1.1 percent of total agricultural budget for 2017-2019**,** 53.4 percent of this budget allocated to agroforestry practices, 19.2 percent to conservation agriculture, 17.4 percent to knowledge and capacity building, 5.8 percent to pasture management, and 3.6 percent to grazing management.

3. Climate-smart adoption by farmers in Tanzania

Tanzania is not on track to meet its 2025 commitment regarding resilience to climate variability within the 2014 Malabo declaration. Among the seven commitments integrated into the Malabo declaration, one specifically addressed climate change adaptation based on three indicators: the share of agricultural land under sustainable land management practices; the existence of government budget-lines to respond to spending needs on resilience-building initiatives; and the percentage of farm, pastoral, and fisher households that have improved their resilience capacity to climate and weather-related shocks. While the last indicator is not monitored due to lack of data, for the first two, Tanzania lags regarding implementation of milestones. According to the 2022 CAADP Biennial, only 3.5 percent of Tanzania's agricultural land is under sustainable land management practices (CAADP 2022). Despite efforts in certain areas, such as the respect of the CAADP process, most indicators are below expectations.

The 2019/20 National Sample Census of Agriculture data indicates some progress in adopting CSA practices since 2008, but progress varies depending on the practice. About 38 percent of farms implement some conservation agriculture practices, the larger farms being at the forefront (56 percent). Figure B4.1 displays conservation agriculture practices' frequency of use. Over half of farmers involved in conservation agriculture plant legumes. The use of crop residue represents the least frequently adopted CSA practice, with only 17 percent of farmers. From 2008 to 2020 Agricultural Censuses, the share of farmers using soil erosion measures increased slightly from 9 percent to 11 percent. Again, this increase was more significant for larger farms (11 to 16 percent). Terraces and drainage ditches became more common (**Error! Reference source not found.**B4.2), as well as the use of organic fertilizer (from 13 to 22 percent), farmyard manure (13 to 24 percent), and compost manure (1 to 4 percent).

Figure B4.1 - Frequency of use of agriculture conservation practices (among farmers who implement them)

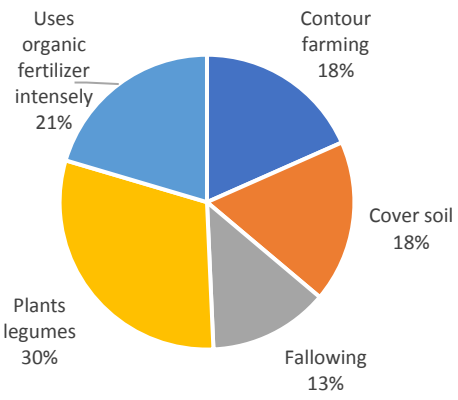
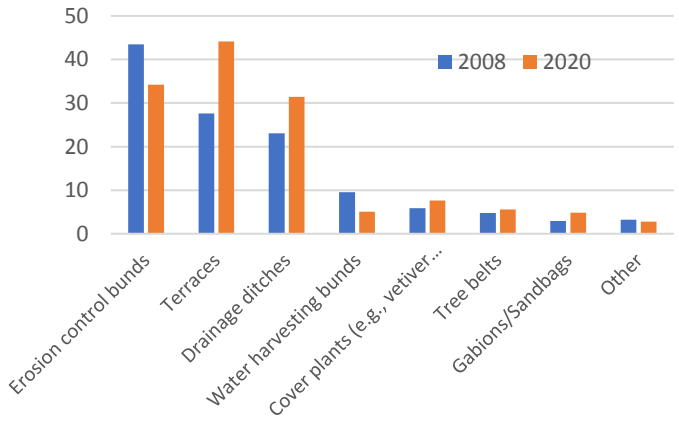


Figure B4.2 - Evolution of soil erosion measures among farmers implementing them from 2008 to 2020



Source: Authors'own elaboration based on National Sample Census of Agriculture data 2020

Adoption rates vary across practices and regions. CSA practices are highly context-dependent, thus being specific to production types and geographical areas of interest. For instance, different agroforestry practices can be adopted across various agro-ecological regions, such as the central plateau and medium-altitude plains of western Tanzania or the high plains and plateaus (Kitalyi et al. 2010). Thus, Kurgat et al. (2020) find an adoption rate between 25.1 percent and 31 percent for four CSA practices—crop diversity, livestock diversity, irrigation, and agroforestry—across various farming systems in Iringa, Zanzibar, Dodoma, and Tabora. Nyasimi et al. (2017) observe adoption rates ranging from 85.2 percent for agroforestry and 67.9 percent for scientific weather forecasting to 1 percent for biogas digester in Lushoto, Northern Tanzania. Another study based on data from Lusotho, Ogada et al. (2021) finds an adoption rate of 63 percent for crop diversification. Furthermore, some international development projects support CSA adoption, thus resulting in pockets of adoption due to specific project implementation locations (Kurgat et al. 2020).

4. Estimated costs of climate inaction in agriculture in Tanzania

- **Methodology and discussion**

Estimating the cost of inaction for climate change involves many choices and assumptions. These factors include types of climate and socio-economic scenarios, issues with valuation, spatial and temporal variations, uncertainty and irreversibility, coverage of climate parameters, and impact categories (Watkiss et al. 2007). The difficulty in assessing the economic costs of climate change also stem from accurately estimating future climate change physical effects and how to value them economically. Various modeling methods allow for long-term projections and feedback. All predictions based on climate scenarios and estimated socio-economic results rely on simplifications and assumptions that have limitations. Furthermore, climate change has varying effects across sectors, locations, and times, thus making national-level aggregation complex . Despite all this, we attempt to calculate inaction costs to compare a baseline climate change scenario without adaptation to a scenario that includes climate change and adaptation actions. This type of study and analysis can infer total social costs, marginal social costs, cost-benefit analysis, or cost-effectiveness of adaptation actions (ibid).

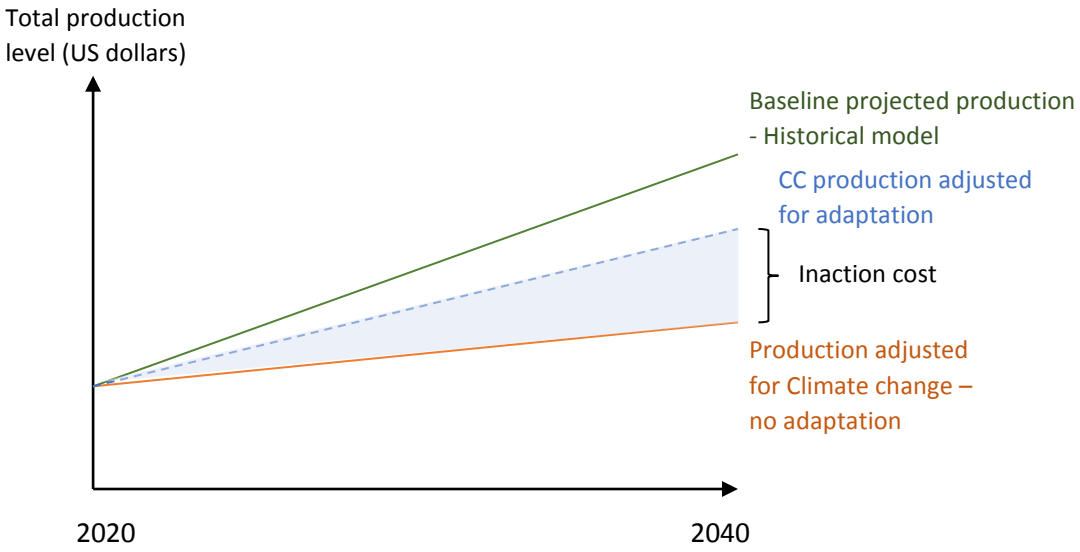
Our estimates of inaction costs focus on losses in agricultural production for a select number of crops. Climate change will have numerous repercussions—including loss of ecosystems, food security, changes in livelihoods, among others—not considered in this analysis. Thus, we estimate inaction costs based on the methodology used in K·Coe Isom (2021) and following Watkiss et al. (2007) guidelines.

We calculate and compare three scenarios of total agricultural production value (US$) based on yearly values:

1. Historical baseline without climate change: *projection of production based on historical patterns * projected prices*
2. A climate change scenario including yield adjustments: *CC yield adjustments * projection of production based on historical patterns* acreage adjustment * projected prices*
3. A scenario including adaptation to climate change: *adaptation rate * CC yield adjustments * projection of production based on historical patterns* acreage adjustment * projected prices*

Inaction cost is then calculated from the agricultural production value lost between the scenario with and without adaptation. Figure B4.3 below illustrates the method once the three scenarios are calculated.

Figure B4.3. Cost of inaction estimation method (source: authors)



We used yield adjustments to climate change data from a 2017 CIAT and World Bank report on climate-smart agriculture in Tanzania to calculate these scenarios. Their work relies on modeling generated with a global partial equilibrium food and agriculture model, the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) (Robinson et al. 2015). IMPACT comprises several modules, including water demand, crop models, macroeconomic trends, and climate models. The 2017 report computed four Earth Systems Models (ESM) using the Representative Concentration Pathway 8.5 (RCP8.5, maximum Green House Gas emissions scenario), a specific Shared Socioeconomic Pathway (SSP 2), and a no climate change reference pathway, based on work developed for the IPCC fifth assessment report. From the four ESMs, we chose the Hadley Centre's Global Environment Model's results as they display a more extensive range of effects on yields.

The perimeter of our estimation is limited to six crops and 2040 as a time horizon. Our calculations are constrained by CIAT and World Bank report (2017) data availability. Thus, the crops selected for these estimations are maize, rice, cassava, beans, sorghum, and banana. The objective was to integrate breeding into the analysis; however, the results from the modeling indicated almost no adjustment to climate change on cattle production or the number of animals. We use price data from Sulser et al. (2021) to estimate the projected value of the different products over the years**.** We applied a social discount rate of 5 percent to adjust the future values to today's preference.

To build the adaptation scenario, we drew yield adjustments related to specific adaptation policies were from Sulser et al. (2021). These authors estimated yields adjustments under different policy scenarios within a climate change baseline. They also use the IMPACT model using driver assumptions drawn from RCP8.5 and the UK Met Office Hadley Centre Earth System Model (HGEM). This data is thus produced under similar scenarios as CIAT and World Bank (2017). Sulser *et al.* (2021) consider five alternative

investment spending scenarios: (i) increased research and development investment across the CGIAR portfolio, including faster and more efficient adoption of new technologies; (ii) expansion of irrigated area coupled with increased water use efficiency; (iii) improved soil water-holding capacity; (iv) infrastructure improvements to improve market efficiency; and (v) a comprehensive scenario made up of a combination of these policy measures (COMP). We chose this latter scenario to estimate our agricultural production scenario under climate change with an adaptation policy. We applied the yield gains for the COMP public policy scenario to the yield values under climate change for our six crops. They account for an adaptation rate average of 32 percent.

Table B4.2 Results of the cost of inaction estimation in million US$ (source: authors)

	Total by 2040 in MUSD (19 years)	**Cost in MUSD /year**
Cost without adaptation	2 791.8	146.9
Cost with adaptation	1 381.0	72.6
Cost of inaction	1 410.8	74.3
Policy cost (COMP scenario)	257.3	13.5
Ratio policy cost/inaction cost	5	

We estimate costs of inaction to reach US$ 1.4 billion by 2040 (Table 4.2). It corresponds to five times the cost of adaptation put forth in the public policies Sulser *et al.* (2021) evaluated. The initial cost of the COMP scenario policy was calculated for Sub-Saharan Africa (SSA) as a whole. We disaggregated this cost for Tanzania by applying a ratio of Tanzania's share of SSA's agricultural GDP to SSA's total COMP policy cost. A similar inaction cost analysis conducted by Markandya, Cabot-Venton, et Beucher (2015) on the agricultural sector of Uganda considered a larger number of crops than in our estimation (11 staple crops and livestock), and they obtained a higher inaction cost ranging from US$ 555 million to US$ 957.5 million per year, almost 10 times more than our results (US$74.3M per year). Bunn, Schreyer, et Castro (2018) estimated the cost of inaction for the cocoa sector in the Ivory Coast, and also found a much higher cost estimate at US$ 1 billion per year for this value chain alone. Both these studies used different modeling methods, on different crops, and in different contexts, which explains the extensive variance in results. However, it also indicates that, if anything, our results likely represent a low estimate compared to similar studies.

This estimation provides an order of magnitude regarding climate change projected effects on the Tanzanian agricultural sector. We have conducted several sensitivity tests of our results related to the choice of social discount rates and underpinning models and scenarios (available upon request) and consider our estimate robust in this light. However, the reduced number of crops considered within the analysis and an approach focused only on climate change yield effects (excluding land degradation or losses due to sea level rise) narrows the scope of our results. Furthermore, as Sulser et al. (2021) highlighted, the IMPACT model does not account for potential future changes in trade that could affect import costs. Lastly, as mentioned in section **Error! Reference source not found.**, natural disasters affect agricultural production considerably and are likely to become more frequent. However, the ability for ESM models to predict such weather events and the results from IMPACT do not consider extreme events' effects on yields (Robinson et al. 2015). Therefore, our estimation does not account for costs related to

extreme events. In other words, our results provide robust low-boundary estimate of the cost of climate change inaction for Tanzanian agriculture.

Our estimated yearly cost of inaction is more than twice the planned budget for climate smart agriculture. The implementation of CSAP and ACRP should have resulted in yearly budget of USD 28.4 million, which is about one-third of the estimated yearly cost of inaction.

The loss of agricultural production projected by 2040 further indicates that without adaptation action, Tanzania will not be able to meet its CAADP commitment by 2025. Indeed, agricultural value loss due to yield and acreage adjustments to climate change corresponds to a decrease in the production of food security crops by 1.1 percent. While this might appear to be a small decrease, it is alarming for an increasing population already sometimes subject to food insecurity. Trade and food imports will determine its effects on Tanzanian food security. Decreased production levels would also jeopardize other country commitments, such as meeting the Sustainable Development Goals (SDG) by 2030, notably regarding achieving no poverty and zero hunger.

5. Recommendations for adaptation policy in agriculture

The estimated cost of inaction emphasizes current ACRP and CSAP underfunding, and calls for their fast and effective implementation. Irrigation apart, the agricultural adaptation budget amounted to US$ 4.34 million per year between 2017-2020, despite planned amounts of US$ 15.507 million per year in ACRP and CSAP. Table B4.5 compares different policy costs and shows that this actual yearly spending is far below any existing budget for adaptation strategy. Sulser et al. (2021) data for the COMP scenario estimates the lowest policy cost at about US$ 13.5 million per year, which is probably not very accurate as it was estimated from SSA figures. Nonetheless, it remains three times higher than Tanzania's current adaptation spending. Tumbo et al. (2010) determined a cost of adaptation at US$ 107 million per year. Current Tanzanian spending appears too low to allow for farmers' adaptation to climate change. However, the two programs for adaptation to climate change, ACRP and CSAP, present comprehensive policy strategies and actions on which to build.

Table B4.5 - Comparison of policy costs

	Yearly cost (MUS$)
Planned yearly spending (ACRP + CSAP)	28.4
Actual yearly spending (without irrigation)	4.3
Cost of inaction per year	74.3
Cost of adaptation for Sulser et al. (2021)	13.5
Recommended from Tumbo et al. (2010)	107.0

Source: authors

An essential part of Tanzania's adaptation policy focus has been on irrigation development solutions. By removing most dependence on rainfall water, irrigation enables adaptation to climate change-induced drought or shift in rainfall patterns. It represents US$ 12.7 million per year and 45 percent of yearly spending planned within ACRP and CSAP. This predominance aligns with the recommendations of Tumbo et al. (2010). However, Sulser et al. 2021 find that investments in this sector have limited cost-effectiveness on the adaptation of agriculture compared to other policy solutions.

Investment in research and extension services provision appears to be the most efficient way to support farmers' adaptation to climate change. Research only represented respectively 8 percent and 2 percent

of CSAP and ACRP budgets at less than US$ 1 million per year. Sulser et al. (2021) found that investments in climate-smart research and extension in SSA allow a GDP increase of 1.73 percent, an agricultural supply increase by 6.29 percent, and a per capita Kcal availability increase by 4.19 percent. The improvements brought by alternative policy solutions are marginal in comparison. Many scientific publications emphasize the importance of research and extension agriculture sector adaptation (Baldos, Fuglie, et Hertel 2020; Global Center on Adaptation 2021). These results call for a larger allocation of adaptation funding to research and specific research for climate change adaptation.

Improvement of extension services could both support dissemination of CSA practices and development of weather and climate information services. These areas represent priority adaptation solutions in many climate change strategies (Tumbo et al. 2010; Sulser et al. 2021; Global Center on Adaptation 2021). While disaster prevention and weather forecasting represented 33 percent of yearly spending budgeted in CSAP (Result Area 5 "CSA Knowledge, Extension and Agro-weather Services") and ACRP, investments in these fields did not materialize. Extension services have the potential to disseminate CSA practices and facilitate their adoption (Abegunde, Sibanda, et Obi 2019). They could also contribute to implementing local weather data collection systems (Tumbo et al. 2010). Investments in equipment and technology for weather forecasting would be needed. The Global Center on Adaptation (2021) report estimates that the ratio of inaction costs to action costs for Climate information services is 10.86 for SSA countries, making it a very efficient adaptation solution. According to Tumbo et al. (2010), the cost of developing climate forecasts systems in Tanzania would be US$ 10.3 million by 2050. Building on existing advisory systems to deliver rural climate services should include developing other broadcasting channels, such as radio or phone messaging (Hansen et al. 2019).

Weather-based index insurance represents another new important adaptation solution, as there has been no significant development in this area. Component 3 of the CSAP addressed the implementation of insurance and safety nets in advancing crop and livestock weather-indexed insurances for a budget of US$ 70,800 per year. This amount is low and yet, to the best of our knowledge, these measures were not carried out. These financial mechanisms can help farmers manage risks and uncertainty and adapt to climate change (Kelsey et Wilkinson 2022).

Investment in infrastructure development also represents an important adaptation strategy, but its implementation is more challenging to track within the MoA budget. The CSAP addresses this adaptation solution through the value chain integration result area, with total budget of US$ 0.272 million per year. Planned actions involve improving road networks and storage and transportation of agricultural products. Again, the corresponding measures do not appear to have been implemented. Tumbo et al. (2010) estimate the cost of additional investment on rural roads for adaptation of between US$ 13.2 and US$ 14 million per year. The Global Center on Adaptation (2021) report finds that the ratio of inaction to action cost for infrastructure and market access is 16.56, the highest ratio with compared to other solution areas. Tanzania should thus move this category of investment forward as planned in the CSAP.

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