Policy Innovations for Improved Agricultural Production in Tanzania

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Foreword

Agriculture has long been recognized as the cornerstone of Tanzania's economy, providing livelihoods for the majority of the population and serving as a critical driver of food security, employment, and rural development. Despite its central role, the sector continues to face persistent structural and systemic challenges that constrain its productivity and resilience. Low levels of mechanization, inadequate access to finance, climate variability, weak market linkages, and insufficient policy coherence have collectively hindered the sector's ability to meet the growing demands of a rapidly changing economy and society. These challenges underscore the urgency of rethinking traditional approaches and embracing innovative policy solutions that can catalyze sustainable agricultural transformation.

It is within this context that *Policy Innovations for Improved Agricultural Production in Tanzania* emerges as a timely and significant contribution to the national and regional discourse on agricultural development. This volume brings together a diverse range of perspectives, grounded in empirical research and informed by practical experience, to explore how policy innovations can unlock the latent potential of Tanzania's agricultural sector. The book does not merely catalog existing problems; rather, it interrogates the underlying policy frameworks, institutional arrangements, and governance structures that shape agricultural outcomes. In doing so, it offers actionable insights and forward-looking strategies that are both contextually relevant and globally informed.

One of the defining strengths of this book lies in its multidimensional approach to agricultural policy. The contributors recognize that agricultural productivity is not solely a technical issue but a complex interplay of economic, social, and environmental factors. Accordingly, the chapters address a wide spectrum of themes, including climate-smart agriculture, value chain development, financing mechanisms, land tenure reforms, and the integration of technology into farming systems. This holistic perspective is essential because agricultural transformation cannot be achieved through isolated interventions; it requires coordinated and synergistic efforts across multiple sectors and stakeholders.

The relevance of this volume extends well beyond the academic community. For policymakers, it serves as a repository of tested ideas and innovative strategies that can inform the design and implementation of agricultural policies. For development practitioners, it provides practical guidance on scaling up interventions that have demonstrated impact in similar contexts. For researchers and students, it offers a rich resource for understanding the complexities of agricultural policy-making in a developing country setting. In short, the book speaks to a broad audience united by a shared commitment to advancing Tanzania's agricultural agenda.

The timing of this publication could not be more opportune. Tanzania is currently navigating a critical juncture in its development trajectory, seeking to accelerate economic transformation while confronting the realities of climate change, demographic pressures, and global market volatility. The agricultural sector, which employs over two-thirds of the population, must evolve to meet these challenges. Policy innovations are no longer optional; they are imperative. This book challenges us to move beyond incremental reforms and embrace adaptive, evidence-driven strategies that can deliver sustainable and inclusive outcomes. It reminds us that agricultural transformation is not an event but a continuous process—one that demands vision, commitment, and the capacity to learn and adapt.

A particularly noteworthy aspect of this volume is its emphasis on context-specific solutions. While global best practices offer valuable lessons, the contributors underscore the importance of tailoring policies to Tanzania's unique socio-economic and ecological realities. This approach reflects a growing recognition that development strategies cannot be transplanted wholesale from one context to another; they must be adapted to local conditions, informed by local knowledge, and responsive to local needs. By grounding its analysis in empirical evidence and real-world experiences, the book provides a credible and practical roadmap for policy-makers and practitioners alike.

The chapters also highlight the critical role of governance and institutional capacity in shaping agricultural outcomes. Policy innovations, however well-designed, cannot succeed in the absence of effective institutions and accountable governance structures. The book therefore calls for strengthening institutional frameworks, enhancing coordination among stakeholders, and fostering a culture of transparency and accountability in policy implementation. These recommendations resonate strongly with ongoing efforts to improve public sector performance and promote good governance in Tanzania.

Another important theme that runs through this volume is the need for inclusive and participatory approaches to policy-making. Agricultural policies affect a wide range of stakeholders, from smallholder farmers and agribusinesses to consumers and development partners. Ensuring that these voices are heard and their interests represented is essential for designing policies that are equitable, effective, and sustainable. The book advocates for mechanisms that facilitate stakeholder engagement, promote dialogue, and build consensus around shared goals. Such approaches not only enhance the legitimacy of policy decisions but also increase the likelihood of successful implementation.

In addition to its substantive contributions, this book exemplifies the value of collaborative scholarship. The editors and contributors have drawn on diverse disciplinary perspectives and methodological approaches to produce a volume that is both intellectually rigorous and practically relevant. Their work reflects a deep commitment to advancing knowledge and informing policy in a manner that is responsive to the needs and aspirations of Tanzanians. It is my hope that this spirit of collaboration will continue to inspire future research and dialogue on agricultural development in the country.

As we look to the future, the challenges facing Tanzania's agricultural sector are formidable, but they are not insurmountable. With the right policies, institutions, and investments, agriculture can become a powerful engine of economic growth, poverty reduction, and environmental sustainability. This book provides a compelling vision of what is possible and a practical guide for how to get there. I commend the editors and contributors for their scholarly diligence and unwavering commitment to advancing this critical agenda. Their work stands as a testament to the transformative potential of research-informed policy-making.

It is my sincere hope that *Policy Innovations for Improved Agricultural Production in Tanzania* will serve as a catalyst for action—stimulating dialogue, shaping decisions, and inspiring innovations that will contribute to building a resilient, productive, and inclusive agricultural sector. The stakes are high, but so too are the opportunities. Let us seize them with courage, creativity, and conviction.

Prof. Rwekaza Mukandala

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We are deeply indebted to the authors of the individual chapters for their diligence, insight, and patience throughout the review and revision process. Their scholarly contributions form the backbone of this volume, and their willingness to engage critically with feedback has greatly enriched the final product.

Our appreciation also goes to the peer reviewers—both named and anonymous—whose rigorous evaluations and constructive suggestions helped sharpen the analytical depth and clarity of each chapter. Their expertise has been invaluable in upholding the academic quality of this work. Special thanks go to Dr. Adagolt Komba and Dr. Cyril Chimilila, our external reviewers who meticulously went through the manuscript and gave useful insights on making the chapters publishable.

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Any errors or omissions that remain are solely our responsibility.

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Chapter 1 Introduction

Paschal B. Mihyo and Jamal B. Msami

1.1. Objectives of the book

This book provides an analysis of agricultural policies in Tanzania over the last six decades. It has benefitted from a group of multi-disciplinary authors with practical experience of the country's agriculture sector policies. It intends to provide research-based insights and evidence regarding factors that support or impede the successful implementation of these policies. It covers a wide range of issues including political, economic, social, environmental, and technological factors that have influenced agricultural production and productivity in various agricultural sub-sectors.

1.2. Legacies of colonial agricultural policy

Since independence in1961, the country's agricultural policies and technological innovations aimed at making sure Tanzania remains a food and nutrition self-sufficient nation and making the sector the main engine for rural poverty eradication (Nyerere, 1968). However, as studies indicate, the country has not used more than 10% of the potential in all agriculture sub-sectors including crops, livestock, fisheries and forestry. Some observers opine that the root cause of this situation is the something to do with how policies for the agriculture sector designed. They argue that policies have been basing on false assumptions, following unconsciously footsteps, some of which inherited since colonial era. With those assumptions, sometimes comparison of agricultural systems transformation between developed countries may be flawed. For instance, a comparison between America and Tanzania agriculture on issues like cropping systems and patterns, mechanisation, intensification of input use such as pesticides and fertilizers, and technology sophistication requires relevant background of circumstances in both scenarios. A case in point could be the observation in an article '*The Sun Never Sets on Bad Agricultural Policies: How Colonial Administrators,* *Socialist Bureaucrats and Multinational Corporations Failed Farming in Tanzania'* by a blogger Gnikvar 2.

The article showed that in Tanzania many farmers use the same implements they would have used thousands of years ago and where yields are a fraction of what they are in the United States. It is easy to assume that these poor peasants cannot undertake agricultural development and transforming the Tanzanian economy will require replacing peasant farming with modern agriculture. Development policy under colonial rule, socialist rule and the current capitalist government has all been based on these assumptions.

The above negative evaluation of Tanzania's policies is very serious and can easily be dismissed as a product of neo-colonial arrogance or a misplaced comparison of incomparable economic systems. This is especially true when you consider that the rural development policies of Tanzania have always aimed at raising the smallholder farmers from poverty and ensuring rural and urban prosperity. At the same time, such an evaluation raises the question whether there has been a remarkable departure from inherited colonial policies on agriculture in general and smallholder farmers in particular. As Andrew Coulson (2013) indicates, there have been various strategies used by the colonial government to keep agricultural production low and rural development minimal. They included: selective modernization of agriculture implemented through what was known as the 'focal point approach' under which few progressive farmers were supported to excel and the rest encouraged to work for them or to seek wage employment outside their areas. This created inequality within and between regions. Though used to create the so-called *yeoman class* of farmers who were closer to the colonial state and who later in countries like Kenya opposed the nationalist movement. Selective modernization was one of the policies, which suppressed the emergence of a dynamic agricultural sector in Tanzania.

Another colonial strategy was total control of producer organizations including cooperatives and their subordination to crop marketing boards. It was after riots and resistance that cooperatives were allowed limited autonomy (Cliffe, 1972). The controlling of peasant surplus through control of farmers' cooperatives may have changed its form, but it seems to have retained its objective specifically control of surplus produced by farmers, which has not been very beneficial to the smallholder farmers (Hyden, 1980). Seimu has found that the compulsory coffee marketing policies instituted in Kilimanjaro and other coffee growing areas, did not disappear with the end of colonial rule (Seimu, 2016a). The British colonial legacy of agricultural policy planning has been carried over to the present day in Ghana, South Africa and Tanzania (Scholz, 2015). A study, which traced the persistence of colonial policies and peasant responses in Kilombero, indicated that the impacts of such policies at the national and local levels are still observable (Mwase, 1983).

Likewise, rural non-industrialization, which was interrupted only in the post-WW I period seems to have continued until after independence. It is marked by the suppression of the link between industry and agriculture, limited agro-processing, presence of policies and practices that keep the local market for agricultural products low, and minimal support for value addition on cash crops (Isinika, Mbava and Van Sidele, 2016). Rural non-industrialization was supplemented by an overemphasis on cash versus food crops giving higher value to cash crops, which are exported and keeping food production and prices for food crops low thereby keeping smallholder farmers poor. Initially, the policy aimed at forcing peasants to migrate to mines, white owned farms and urban centres in search of jobs to earn money to pay taxes.

The segmentation of agriculture into cash and food crops and the suppression of market development for food crops has also contributed to low prices, low wages, high informality, increased sector's vulnerability and lack of competitiveness. Other factors, which accompanied these strategies include the state promoted imbalance between rural and urban labour markets; over-regulated food export markets; a system of communal property 'ownership' without property rights (Albertus, 2021); lack of protection of indigenous knowledge and relegation of community intellectual property rights; and infrastructure development focused on transit trade enclaves. Other strategies used include poor storage and other logistical support systems for perishable food products; lack of infrastructure for upgrading food quality standards etc. In essence, these strategies strengthened the exploitation of farmers rather than their development (Koponen, 2010). The assessment of colonial agricultural policies by several researchers is that although Tanganyika was not a settler colony, the influence of its small settler community in shaping colonial agricultural marketing and cooperative development policy has been very significant (Seimu and Zoppi, 2021; Mruma, 2014; Suda, 1990).

1.3. Reversing the colonial legacy in agricultural policy

Colonial agricultural policies were the backbone of colonial extractive strategies predicated upon maintaining Tanzania as a primary commodity exporter and the creation of a class society in which the privileged few Africans felt part of the system and were used to suppress anti-colonial feelings and endeavours. The system of land ownership was initially based on communal land tenure. It was a feudal system administered by pre-colonial states but had a very strong social welfare function. , A similar system notionally retained, but stripped of its welfare aspects as actual ownership belonged to the colonial state under the Land Ordinance of 1923.

Efforts to reverse colonial land policies have involved five key phases. The first phase started in 1963 immediately after independence involved the abolition of freehold land tenure by then dominated by the white farmers and very few farmers of Asian origin. All freeholds were converted into leases of 99 years with the aim to prevent land remaining in the hands of foreigners most of whom were likely to remain absentee owners. In addition to freehold, was a system of leaseholds under which rights of occupancy and deemed rights of occupancy were granted. In 1969, all these were converted into rights of occupancy under the Government Leaseholds (Conversion to Rights of Occupancy) Act, No.44 of 1969. Rights of occupancy were therefore those granted by the state and revocable under specified conditions subject to an appellate process. The residual category were the deemed rights of occupancy under which no title was granted but their existence was recognized as governed by customary tenure.

The most far-reaching reforms started during the second phase in 1967 when the ruling party, the Tanganyika African National Union (TANU) passed the Arusha Declaration making Tanzania a socialist country based on principles of equality and improvement of the living conditions of workers and peasants. The objectives were to improve the quality of life through proper and equitable exploitation of national resources for national development. Also promoting cooperatives and the collective system of power, production and resources distribution known as 'Ujamaa'; abolition of the exploitation of one person by another; and establishing an inclusive system of democratic participation in economic, social and political decision making by those affected by those decisions (TANU, 1967).

To ensure the successful implementation of the new systems of land ownership, the system of chieftainships was also abolished in 1968 under the Customary Leasehold (Enfranchisement) Act, No.47 of 1968. Chiefs and landlords were the main custodians and beneficiaries of the traditional land tenure. To ensure they did not obstruct the reforms, their official status was abolished and most of them were absorbed within the local government system. The Land Tenure (Village Settlements) Act, No.1 of 1965, the Rural Land Planning and Utilization Act, No.14 of 1973 and the Village and Ujamaa Villages (Registration, Designation and Administration) Act, No. 21 of 1975 were all aimed anchoring rural production and administration in the framework established by the Arusha Declaration.

This opened the third phase of reforms – a national drive to organize smallholder farmers into collective ujamaa villages and cooperatives. These villages and cooperatives intended to be multi-purpose entities for provision of all essential services by the state while farmers organize themselves in a participatory manner to produce, market their produce and decide on how to share or invest the surplus. With the promulgation of the Arusha Declaration in 1967, cooperatives became the main engine of socialist policies. Cooperative production also introduced, taking cooperatives beyond marketing of members' crops and other produce into collective farming in Ujamaa villages.

Under the Presidential Circular No.1 of 1969, elaborate procedures were established to be followed in the formation of these villages and cooperatives. Their formation involved moving farmers from traditional villages to new ujamaa villages. The circular emphasized prior education of staff involved in the process of relocating people to the ujamaa villages and there should be no use of force. However, some overenthusiastic public officials seeking recognition through quick results, used force making some of the farmers unsupportive of the whole process.

The fourth phase of land reforms focused on land acquisition and formation of state-owned agricultural organizations in a concerted effort to reduce private land ownership and advance the socialist agenda. This has seen big coffee estates and sisal farms nationalized without compensation under the Coffee Estates (Acquisition and Re-grant) Act of 1973 and the Sisal Estates (Acquisition and Re-grant) Act of 1973. The nationalized properties were re-granted to cooperative unions and crop boards leading to a big number of state agricultural corporations such as the Tanzania Coffee Board (TCB), the Tanzania Sisal Corporation (TSC), the National Agriculture and Food Corporation (NAFCO), National Ranching Corporation (NARCO), Sugar Development Corporation (SUDECO) and the Tanzania Wood Industry Corporation (TWICO) only to mention a few.

The performance of these enterprises as well as the ujamaa villages was not as impressive as had been hoped. This led to the latest phase of reforms characterized by efforts to strengthen individual tenure and introduce market mechanisms in land ownership and development.

The current fifth phase of the land reforms includes on-going efforts to change the land tenure system through facilitation of land acquisition by local and foreign investors. Some land law experts consider this as the only phase which, in a limited way, has attempted to change the tenure system arguing that the previous phases changed arrangements for utilizing land but did not depart from the dual colonial system of state ownership of all land (Fimbo, 2010; Chachage, 2010). This book assesses policy and technological innovations introduced across the five phases to improve agricultural production and productivity and their impact of poverty reduction.

1.4. About this book

This is a multiple-author book comprises of fourteen chapters. As the agriculture sector is broad involving general and sub-sector specific policy reforms and innovations, the multiple-author project benefits from a diversity of background, specialization, expertize and style of authors. This first chapter introduces the book shading key highlights on agricultural policy reforms in Tanzania.

Chapter 2 on the *Interlink Between Tanzanian Policies and Strategies Towards Agricultural Productivity Between 1983 and 2022* by Justin K. Urassa, Suzana S. Nyanda, and Emanuel T. Malisa provides an in-depth analysis of four decades of agricultural policy evolution and its effects on crop productivity. It reveals that the economic reforms of the 1980s and the liberalization policies of the 1990s produced mixed outcomes for smallholder farmers, with some gains overshadowed by persistent structural challenges. Despite decades of interventions, the study finds that a significant productivity gap persists, particularly among smallholder farmers. Findings underscore that while Tanzania has made progress in agricultural policy development, persistent gaps in implementation, financing, and coordination continue to limit productivity gains. Addressing these challenges through integrated, well-resourced, and collaborative strategies is key to improving food security, household incomes, and overall agricultural performance.

Chapter 3 titled *Agro-processing as a Driver for Productivity Enhancement in Agriculture* by Ahmed Ndyeshobola and Donald Mmari argues that agro-processing is a strategic catalyst for Tanzania's agricultural transformation, focusing on cotton, coffee, and tea value chains. While agriculture remains central to GDP and employment, productivity is hampered by climate risks, poor agronomic practices, and low adoption of technologies. Agro-processing can boost yields, expand exports, and add value, with the textile sector showing promise through global integration and modest export growth. However, structural challenges—such as high taxes, limited inputs, and weak infrastructure—persist. The authors stress improving production practices in coffee, leveraging global tea demand by empowering smallholders, and incentivizing private investment in processing facilities. They recommend stronger farmer–processor integration, timely input provision, knowledge sharing on efficient techniques, gender equity, and collaborative stakeholder engagement to unlock sector-wide growth and financial returns.

Chapter 4 offers an in-depth *Comparison of Top-Down and Farmer-Led Adoption and Innovation in Agriculture in Tanzania* by Paschal B. Mihyo and Jamal B. Msami explores contrasting approaches to technology adoption and innovation in Tanzanian agriculture. The authors argue that top-down, state-driven initiatives often fail due to administrative bottlenecks, inadequate funding, and disregard for farmers' knowledge and cultural contexts, resulting in poor adoption and sustainability. In contrast, farmer-led innovations—such as irrigation systems and new banana varieties—achieve higher adoption rates because they build on local knowledge, participatory systems, and farmer-to-farmer learning. The chapter concludes that successful technology transfer requires blending external knowledge with local expertise, empowering farmers, and shifting from prescriptive top-down models to collaborative approaches that support and scale farmer-led innovations rather than replacing them.

Chapter 5 on *Challenges to the Transfer of Knowledge from Researchers to Farmers in Tanzania* by Paschal B. Mihyo, Lucas A. Katera, and Cornel Jahari examines systemic barriers to effective knowledge transfer from research institutions to farmers. Despite strong institutional readiness, persistent underfunding since the 1970s has weakened the National Agricultural Research System (NARS), limiting outreach and technology dissemination. Case studies of TARI, LITA, and other agencies reveal gaps in infrastructure, human resources, and participatory engagement. Farmer Field Schools—the main transfer mechanism—often fail to reach poor smallholders due to non-technical constraints such as insecure land tenure, limited credit access, and input shortages. The authors call for increased government investment in research and extension, improved infrastructure, and public–private partnerships to localize production of inputs like fertilizers and vaccines. They also recommend capacity building for extension officers and farmers, and participatory approaches that integrate local knowledge to ensure interventions meet farmers' real needs. Effective knowledge transfer, they conclude, must be collaborative, adequately funded, and responsive to local contexts.

Chapter 6 on *Upgrading and Integrating Farmer-Focused Innovations in Tanzania (SAGCOT Experience)* by Antony Muchoki examines the transformative role of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) in driving farmer-centered innovations and its evolution toward the AGCOT framework. Rooted in Kilimo Kwanza, SAGCOT has leveraged public–private partnerships, cluster-based development, and strategic infrastructure investments to modernize agriculture and attract private capital. Key interventions include rural road connectivity through TARURA, soil testing and sustainable management practices, and climate-smart initiatives under the Green Growth Partnership. Its inclusive green growth tools promote gender equality, environmental stewardship, and social inclusiveness. The chapter concludes that SAGCOT has laid a strong foundation for national-scale transformation, recommending greater emphasis on value chain revitalization, commodity-specific associations, and farmer-to-farmer knowledge-sharing platforms to sustain momentum and scale impact.

Chapter 7 by Jane Mpapalika explores the role of Indigenous Knowledge (IK) in enhancing agricultural productivity and climate resilience among smallholder farmers in Kagera. Based on a 2022 survey of women-led farming groups, the study finds that farmers rely heavily on IK for predicting rainfall, selecting crops, and implementing practices such as mixed cropping and crop rotation to preserve soil fertility. IK also supports climate change adaptation and ecological preservation, though challenges persist, including low productivity, limited crop diversification, unreliable weather forecasts, and minimal use of hybrid seeds. The author recommends formalizing and protecting IK, integrating it into education curricula, raising awareness among researchers and extension officers, and promoting climate-smart agriculture to complement traditional practices. These measures, combined with capacity building and ecological conservation, can unlock IK's potential for sustainable agricultural development in Kagera and beyond.

Chapter 8 on the *Potential Implications of Public Agricultural Investment on Economic Outcomes in Tanzania* by Asiya Maskaeva and Mgeni Msafiri employs a dynamic Computable General Equilibrium (CGE) model to assess how public investment in agricultural infrastructure impacts productivity, growth, and poverty reduction. The study finds that increased investment—especially in the crop sub-sector—can accelerate agricultural growth beyond the 6% target to over 8% by 2030, boost exports, and create jobs, thereby driving national economic growth and poverty reduction. However, financing through borrowing and indirect taxes has adverse effects on households and the economy, underscoring the need for strategic funding mechanisms. Investments in irrigation and export-oriented strategies yield the highest returns, while improved productivity in agriculture also enhances labor productivity in non-agricultural sectors. The authors conclude that well-targeted, adequately financed public agricultural investment is critical for achieving Tanzania's development goals and unlocking wealth creation.

Derick Msafiri, Cornel Joseph, and Thadeus Mboghoina analyse time-series data (1990–2022) using Auto-Regressive Distributed Lag (ARDL) and Granger causality techniques to assess the *Impact of Agricultural Credit on Productivity in Tanzania* in Chapter 9. They establish significant positive long-run impact of credit, rainfall, and capital formation on productivity, while lending rates, inflation, and low-skilled labor exert negative effects. A bidirectional causality between credit and productivity suggests that improved access to credit enables farmers to invest in modern technologies, boosting yields and stimulating further credit uptake. However, short-term impacts are negative, possibly due to misuse of loans for non-productive purposes. The authors recommend strengthening rural loan markets, lowering interest rates, extending repayment periods, and complementing financial support with investments in infrastructure, technology, and research to create an enabling environment for sustainable agricultural growth.

David Gongwe Mhando's Chapter 10 on *Warehouse Receipt Systems and Agricultural Transformation in Tanzania: Unlocking Smallholder Prosperity through Policy Innovation* explores how Warehouse Receipt Systems (WRS) address key challenges for smallholder farmers, including limited market access, financial exclusion, and post-harvest losses. By enabling farmers to store produce in certified warehouses, use receipts as collateral, and access better prices, WRS promotes financial inclusion, market stability, and gender equity. Drawing lessons from Kenya and Uganda, the chapter recommends digitizing WRS through electronic systems, strengthening farmer education and financial literacy, implementing crop insurance and price stabilization funds, and fostering public–private partnerships to expand infrastructure and technology adoption. These measures can enhance WRS effectiveness, reduce risks, and unlock smallholder prosperity as a driver of agricultural transformation in Tanzania.

Chapter 11 on *Trends in Budget Allocation and Credit Facilities in Support of Agricultural Development in Tanzania* by Donald E. Mmari and Ahmed Ndyeshobola analyzes government and development partner financing for agriculture, a theme echoed throughout the report. The chapter reviews funding trends across key sub-sectors and highlights persistent challenges in supporting a sector dominated by smallholder farmers with limited education, weak financial capacity, and constrained access to credit. Structural barriers include an underdeveloped banking system, reliance on small-scale cooperatives, and an evolving land tenure regime that restricts collateral availability. While efforts by government and partners are acknowledged, the authors stress that funding remains inadequate to meet sectoral needs, calling for more robust investment strategies to overcome systemic constraints and accelerate agricultural transformation.

Chapter 12 on *Smallholder Farmers' Access and Use of Knowledge and Information to Enhance Agricultural Productivity in Rural Tanzania* by Constatine George and Amani Sanga evaluates policies and interventions aimed at improving farmers' access to modern farming knowledge. The study finds that smallholders primarily rely on media, extension officers, and social networks for information, with oral communication being the most common and cost-effective method. However, significant barriers persist, including poor infrastructure, limited literacy, bureaucratic hurdles, language constraints, and scheduling conflicts between broadcasts and farming activities. Issues of trust and low English proficiency further hinder knowledge absorption. The authors recommend strengthening local communication channels, improving farmer education, and tailoring information delivery to rural realities to enhance adoption of modern agricultural practices.

Chapter 13 by Donald E. Mmari and Paschal B. Mihyo examines China's strategies—such as industrial clusters, Township and Village Enterprises

(TVEs), integrated human development, and combined market/non-market mechanisms—and their relevance for Tanzania's poverty eradication efforts; to glean *Lessons from China's Policies on Rural Poverty Reduction*. The study underscores the role of strong state involvement, partnerships with social movements, and resource mobilization in driving rural transformation. It highlights Africa–China cooperation opportunities in investment and technology transfer, noting Tanzania's slower progress compared to countries like Ethiopia due to limited strategic preparedness. Drawing lessons from China, the authors recommend holistic policies that integrate economic growth with social equity, strong leadership commitment, incentives for rural professionals, and a shift from technology transfer to technology acquisition. They conclude that Tanzania must adopt comprehensive, inclusive strategies to achieve sustainable rural poverty reduction.

The concluding chapter by Jamal B. Msami, Donald E. Mmari, and Lucas A. Katera synthesizes the book's findings using a Political, Economic, Social, Technological, Legal, and Environmental (PESTEL) framework. Politically, land reforms have dominated agricultural policy since 1961, yet land tenure remains largely customary, limiting investment incentives. Economically, productivity gains have been modest, driven more by land expansion than efficiency, with persistent challenges of low investment, input constraints, and inadequate financing. Socially, knowledge transfer mechanisms like Farmer Field Schools struggle to reach poor smallholders due to cultural and structural barriers, while technical factors reveal reliance on undocumented indigenous knowledge and limited integration of local expertise. The chapter highlights SAGCOT's success in fostering public–private partnerships and rural connectivity as a model for innovation. Legally, regulatory hurdles around credit, input production, and research governance continue to impede progress. The authors conclude with recommendations for stronger financing, participatory knowledge systems, improved infrastructure, and policy reforms to create an enabling environment for agricultural transformation.

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Chapter 2 The interlink Between Policies and Strategies towards Agricultural Productivity in Tanzania from 1983 to 2022

Justin K. Urassa, Suzana S. Nyanda and Emmanuel T. Malisa

2.1. Introduction

Tanzania has since independence aimed at transforming the smallholder subsistence farming to increase its productivity, reduce food deficit and for rural poverty reduction. Earlier initiatives included use of the 'transformation approach' which aimed at enabling smallholder farmers to gain economies of scale by settling farmers on new land and use of tractors; however, by 1966 the approach failed in most areas (Coulson, 2013). Tanzania also tried the 'improvement approach,' which involved persuading small-scale farmers to adopt improved technologies. The government also came up with slogans/policies such as "*Kilimo cha Kufa Na Kupona*") ("Agriculture a Matter of Life and Death"), "*Siasa ni Kilimo*" ("Politics is Agriculture"), "*Kilimo cha Umwagiliaji*" (Irrigated Farming), "*Ujamaa na Kujitegemea*" (African Socialism and Self-reliance). However, the policies did not achieve their intended goals due to systemic challenges, including infrastructure deficits, lack of funding or overreliance on donor support, communities' resistance, and limited effectiveness of institutions.

Furthermore, Tanzania faced economic hardships of the 1980s, where between 1980 and 1985 the economy experienced low or negative growth in real GDP as production and exports declined and capacity utilization in manufacturing fell. In addition, there was a large deficit in the balance of payments and a severe shortage of foreign exchange reserves leading to an accumulation of external payment arrears (Agrawal et al., 1993). Therefore, in the mid-1980s Tanzania embarked on economic reforms in response to internal and external imbalances caused by inappropriate exchange rates and pricing policies, expansionary financial policies, and structural problems (Agrawal et al., 1993). As regards agriculture, the reforms included allowing the private sector alongside primary cooperative societies and the National Milling Corporation (NMC) to participate and negotiate purchase prices, the latter were the sole buyers before. In addition, price controls lifted on most domestic retail products. For instance, in 1990, indicative pricing system replaced the fixed official producer prices, allowing market forces greater influence over pricing. Moreover, the monopoly of the NMC in grain marketing sharply curtailed in 1991 and its operations were limited to commercial milling (Agrawal et al., 1993:15).

Tanzania's agricultural sector is a major source of livelihood providing employment to about 62% of the country's population (NBS & OCSG-Zanzibar, 2024). In the early 1990s, the sector was a source of employment to 84.8% of the population; the observed decline is due to a rise in contribution of the industry and service sectors from 2.6% to 6.8% and 12.6% to 29% respectively (AEO, 2024), as a result of structural transformation of the economy. Similarly, statistics also show a declining trend in the contribution of the sector in the country's economy. For example, in 2022 the sector's share of the GDP was 26% compared to the 42% record in the early 1990s (AEO, 2024). However, the sector will continue to be an important driver of growth, job creation, and rural poverty reduction because the increase in the growth of modern sectors has a small noticeable contribution in reducing the level of the population involved in agriculture (World Bank, 2022).

Tanzania's agricultural sector is currently growing in line with the Government's targets as set out in its Five-Year Development Plan III (2021 -2026) (URT, 2021a). For example, agriculture grew at 3.5% between 2006 and 2016 and increased to 4.8% from 2018-2020 (World Bank, 2022), aligning with Sub-Saharan Africa's average growth of 4.4%. This rate outperforms regions like East Asia (3.2%), South Asia (3.1%), and Latin America (2.5%). However, it falls short of the 6% growth target set by African leaders in the 2003 Maputo and 2016 Malabo Declarations (AU/NEPAD, 2016). Moreover, to fulfil Tanzania's 2025 Vision, the country's agricultural growth rate needed to be 6 percent or above.

Despite the sector's growth, smallholder farmers' productivity remains low.

Therefore, the chapter examines how the country's agricultural sector has responded to the government's policies and strategies. The chapter mainly used secondary data from Tanzania's Ministry of Agriculture, the FAOSTAT database, and a systematic review of government policies and strategies, and peer-reviewed journal articles and other relevant publications. Specifically, the chapter is organized in seven sub-sections as follows: i) policy considerations and the implementation of ASDP I and ASDP II; ii) productivity trends of selected food and traditional cash crops; iii) Production, importation and use of industrial/inorganic fertilizers; and iv) Production and use of improved seeds by smallholder farmers. Also, v) Budgetary allocation to the agricultural sector; vi) Smallholder farmers' access to agricultural financing; and vii) Conclusions.

2.2. Policy considerations and the implementation of ASDP I and II

Tanzania's economic reforms in the mid-1980s included initiatives to transform subsistence farming and boost smallholder productivity and incomes. Key policies, strategies and programmes implemented include the 1997 Agriculture and Livestock Development Policy, the 2001 Agricultural Sector Development Strategy (ASDS) (URT, 2001a), the 2009 "*Kilimo Kwanza* (Agriculture First)" initiative (TNBC, 2009), the 2013 National Agriculture Policy (URT, 2013a), and the Agriculture Sector Development Programmes I and II (URT, 2003; 2016). The Five-Year Development Plans (FYDP I-III) (URT, 2011; 2016b; 2021a) also emphasized productivity.

Qualitative content analysis of these documents performed using NVivo software, highlights varying focus levels on productivity, financing, and extension services, revealing limited emphasis on increasing yields and funding as shown in Figure 1. Therefore, following this initial observations from the NVivo analysis, a more detailed explanation of the implementation and shortfalls of the ASDP I and II is presented in subsequent sections.

Figure 2.1 : Word cloud showing various issues emerging from the reviewed Agricultural Policies and Strategies/Programmes

Source: *Authors'*

2.3. Agricultural Sector Development Programme (ASDP)

Tanzania's Development Vision (TDV) 2025 has been the central policy guiding Tanzania's transformation into a middle-income economy by 2025 (URT, ndb). Under this framework, the Agricultural Sector Development Strategy (ASDS) of 2001 was implemented through the Agricultural Sector Development Programme in two phases (ASDP I and II) that focused on farmer empowerment, agricultural services, and district-level investment through District Agricultural Development Plans (DADPs). Specifically, the objectives of ASDP I (2006/2007 – 2011/2012) were to: i) enable farmers to have better access to and use of agricultural knowledge, technologies, marketing systems and infrastructure, all of which contribute to higher productivity, profitability, and farm incomes; and ii) promote private investment based on an improved regulatory and policy environment. As for the ASDP II (2017/2018–2027/2028), the objective was to transform the agricultural sector (crops, livestock & fisheries) towards higher productivity, commercialization level and smallholder farmer income for improved livelihood, food security, and nutrition (URT, 2017). Thus, the ASDPs intended to transform the agricultural sector to enhance farmers' livelihoods and improve food security and nutrition.

Further, ASDP I supported agricultural interventions such as mechanization (tractors, power tillers), infrastructure for transportation and irrigation (rural roads, small-scale irrigation), and market infrastructure for crops and livestock. It also enhanced livestock facilities, food storage, and agro-processing (e.g., milling and oil extraction) while improving service delivery through training and transport support for local government authority (LGA) staff (URT, 2014). On the other hand, ASDP II (2017/18–2027/28) prioritizes water management, irrigation, mechanization, improved seeds, fertilizers, vaccines, and rangeland management. It also targets yield-enhancing technologies, value addition, and market infrastructure, focuses on water/land management, productivity, commercialization, and sector enablers (2016b).

2.4. ASDPs implementation actors

The implementation actors of ASDP I and II include the agriculture sector lead ministries, these include the Ministry of Agriculture, Livestock and Fisheries, Industry and Trade, and the President's Office - Regional Administration and Local Governments (PO-RALG). Other actors include farmer groups, NGOs, private sector, development partners, and local government authorities (LGAs) such as District Councils and Ward Development Committees. During the implementation, the actors actively engaged with one another, sharing information and resources to achieve the programmes objectives. Implementation actors shared technical information related to irrigation, crop and livestock production, market information, project funds-related information, project implementation progress, monitoring missions, farmer group information, and pest and disease emergence information.

Furthermore, involving multiple actors such as the Ministries, LGAs, NGOs, and private sectors can lead to more effective agricultural policies and practices (Maryono et al., 2024). Malisa et al. (2023) argue that while the implementation of ASDP involved complex, multi-level interactions and active stakeholder engagement, these efforts did not necessarily translate into more effective programme execution. This is because there were actor-specific issues that constrained execution of their roles to the network. For example, farmer groups were too weak to deliver the expected project results. Moreover, Giuffre (2013) argues that in a situation where multiple actors are involved, roles played by individual actors are not as important as those based on their relationships with other actors in the network.

2.5. Achievements

Overall, remarkable success was realized in the implementation of ASDP I whereby it successfully created an enabling environment for increased agricultural productivity, though some villages did not receive interventions due to differing community priorities, which often focused on infrastructure over agriculture (Urassa et al., 2023). Generally, under the ASDPs farmers prioritize interventions through the obstacles and opportunities to development (O & D) with guidance from the technical staff. However, at the village level, agricultural projects have often been secondary, with communities placing greater emphasis on the construction of schools, health facilities, and roads.

ASDP II aims to enhance productivity, commercialization, and incomes for food security, but grassroots implementation has been limited, partly due to a lack of separate funding, unlike ASDP I's basket funding (URT, 2017). ASDP II is primarily funded through Other Charges (OC) from the central government—a mechanism that may partly explain its sub-optimal performance due to limited and unpredictable resource flows. Therefore, funding limitations and low prioritization of agriculture at the local level have so far hindered ASDP II’s success (Urassa et al., 2023). Therefore, despite the relevance of the objectives of the ASDPs a systematic review shows success is sub-optimal so far. Thus, the success of ASDPs and potentially similar interventions in Tanzania depends on rigorous participatory prioritization of community needs, effective collaboration among stakeholders, and sufficient funding for the prioritized interventions.

2.6. Production trends of selected food and traditional cash crops

2.6.1. Production of main staples

The most important staples in Tanzania include maize, rice and common beans which form the bulk of what is consumed daily by the majority; rice is the second most important food crop after maize. On the other hand, the common bean is Tanzania's leading legume crop, and it plays a key role in the livelihoods of smallholder farmers. The subsections below present the above-mentioned crops production trends (1983/84 and 2019/20).

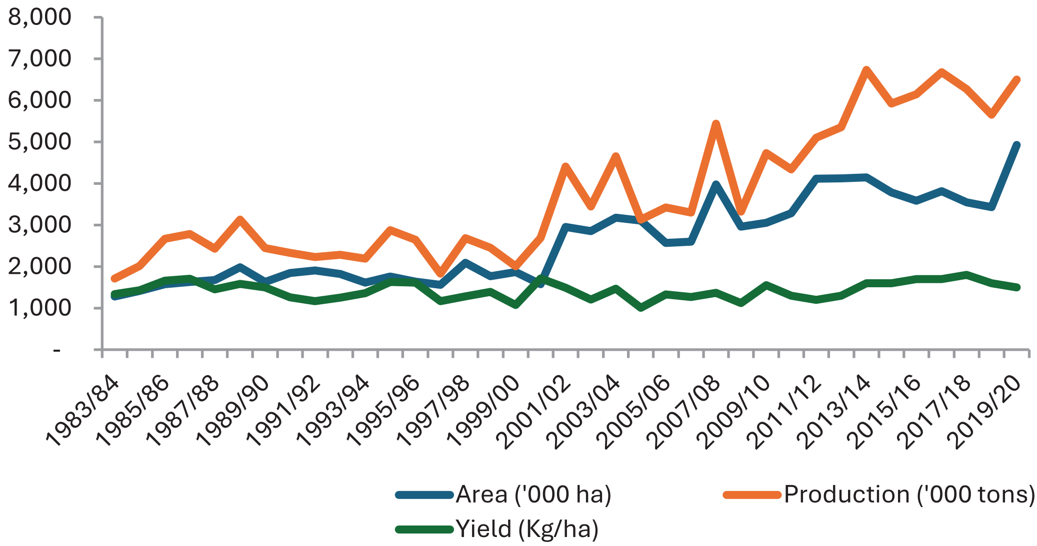
2.6.2. Maize production

Maize *(Zea mays)* is an important food cash crop (Urassa, 2015; Wilson and Lewis, 2015; URT, 2021c) grown both for subsistence and as a cash crop. In addition, maize makes up 75% of the country's cereal consumption (Msuya et al., 2008 as cited by Gahanga and Urassa, 2019). According to Wilson and Lewis most (65 - 80 %) of the maize produced by smallholder farmers is for own consumption and 20 – 35 % enters commercial channels. Additionally, maize comprises an average of 16 percent of national household food expenditures, though there are big regional variations (Wilson and Lewis, 2015). According to the National Sample Census of Agriculture of 2019/20 maize occupied the largest planted area of 4,931,111 ha (66.6 percent), followed by paddy (1,688,241 ha; 22.8 percent) and sorghum (512,888 ha; 6.9 percent) (URT, 2021c).

Despite an increase both in area under maize production and the crops total production (Figure 2), maize yield in Tanzania has remained almost stagnant. The correlation between maize production area (ha) and yield (kg/ha) is weak (0.089), while that between area and total production (tons) is strong (0.930), indicating production growth is driven by expanded land use rather than improved productivity. From 1983/84 to 2019/20, maize production fluctuated, between 1,711,710 tons (1983/84) and 6,734,440 tons (2013/14). In addition, yield ranged from 1,007 kg/ha (2004/05) and 1,800 kg/ha (2017/18), with land use varying between 1,279,620 ha (1983/84) and 4,927,748 ha (2019/20).

Furthermore, Figure 2 shows that Tanzania's maize productivity remains low (i.e., below 2,000 kg/ha) (Urassa, 2015; Wilson and Lewis, 2015); the observation aligns with the 1,500 kg/ha reported in the latest National Sample Census of Agriculture of 2019/20. Despite this being higher than the 1,200 kg/ha reported in 1983/84 agricultural season it nonetheless remains low compared to the 4,500 – 5,100 Kg/ha reported from the "Kilimo/SG 2000" project implemented in the northern and southern highlands of Tanzania between 1989 and 2004 (Urassa, 2010). Furthermore, it is significantly lower than the global average of 5,800 kg/ha and Ethiopia's 4,000 kg/ha (Erenstein et al., 2022). Therefore, more efforts are required to raise the crops productivity if Tanzania is to meet its ever-growing food and feed demand for humans and livestock production.

Figure 2.2 : Production of maize in Tanzania (1983/84 - 2019/2020)



Source: *URT (1984, 1988, 1994, 2000, 2006, 2010, 2020, 2021c[1])*

[1] All the production trend figures are based on data extracted from the Basic Data Agriculture and Livestock Sector 1983/84 -1987/88; FAOSTAT –Database (2024) (for years with no Basic Agriculture Sector Data); Basic

2.6.3. Rice production

Rice (*Oryza sativa*) is Tanzania's second most important cereal (URT, 2019), the crop is produced in 64 districts and provides a livelihood to over two million people (Wilson and Lewis, 2015 as cited by URT, 2019). In addition, producing households consume about 30% of the rice they produce. Most rice farms are small ranging from 0.5 – 3 ha (URT, 2019). Moreover, rice production has increased from 328,280 to 3,174,770 tons in the 1983/84 and 2018/19 cropping seasons respectively and area planted with the crop increased from 271,200 to 1,052,550 ha (URT, 2021c) and yield ranged between 1,210 and 3,000 Kg/ha. According to URT (2021c) in the 2018/19 cropping season smallholder farmers planted 1,688,241 ha (99.3% of total area) and produced 3,330,293 tons (98.2% of total production).

Figure 2.3 further shows that area under production (ha), total production (tons) and yield (Kg/ha) ranged between 237,540 (1884/85) and 1,655,087 ha (2019/20), 306, 850 (2000/01) and 3,429, 340 tons (2015/16) and 1,000 (2000/01) and 3,300 Kg/ha (2017/18) respectively. In addition, there were high positive correlations of 0.934 and 0.884 between area and production, yield, and production respectively, suggesting that the country's increased rice production was a function of both expansion of land and increased productivity. Furthermore, the correlation between area and yield was positive but, moderate (i.e., 0.690).

Nonetheless, Tanzania's rice productivity remains low despite an increase in productivity between 1983/84 and 2019/20 (Figure 2.3). For example, the 3,300 kg/ha reported in the 2017/18 cropping season falls short of the global average of 5,600 kg/ha for irrigated land but is higher than the 600-2,300 kg/ha reported for rain-fed paddy production (Arouna et al., 2021). Furthermore, it is lower than those reported that reported for Senegal (4,100 kg/ha), Asia (4,400 kg/ha), Vietnam (5,300 kg/ha) and Egypt (9,400 kg/ha). Factors contributing to this low yield include

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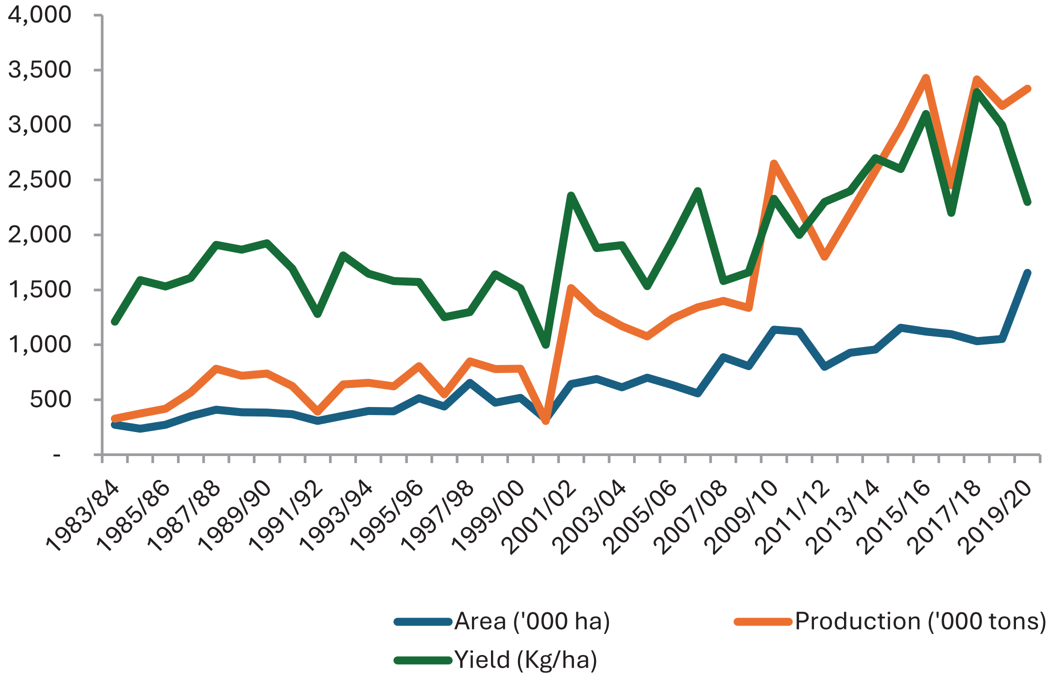
Data Agriculture Sector 1993/94 – 1999/2000; Basic Data Agriculture Sector 1995/96 – 2002/2003, Basic Data Agriculture and Cooperative Sector 1998/99 – 2004/05; Agriculture Basic Data 2005/2006 - 2009/2010 and Basic Data Crop Sector (Tanzania Main land 2018/19 (URT, 2020) and the National Sample Census of Agriculture of 2019/20 (URT, 2021c) overreliance on rain-fed production, use of low-yielding cultivars, improper fertilizer application, low irrigation use, poor water management, broadcasting seeds instead of planting in regular rows, poor weed, pest, and disease control, and poor harvesting and post-harvesting practices (Wilson and Lewis, 2015). Therefore, Tanzania needs to relook at its agricultural policy and the National Rice Development Strategy Phase II if the country is to achieve the goal of Tanzania being self-sufficient in rice production, contribute to the East African region's self-sufficiency, and become a market leader in the region (URT, 2019).

Figure 2.3 : Production of paddy/rice in Tanzania (1983/84 - 2019/2020)



***Source**: FAOSTAT (2024)*

2.6.4. Common beans production

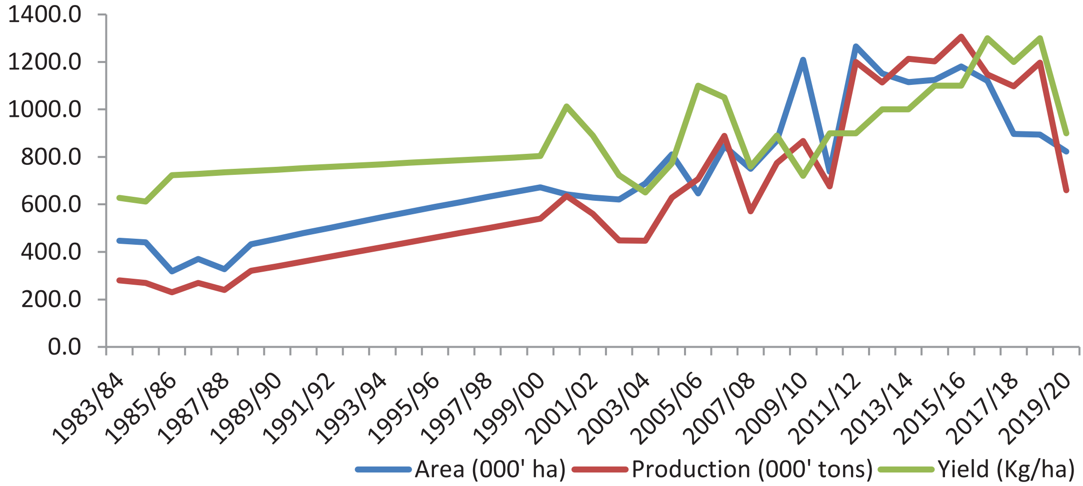
Common bean (*Phaseolus vulgaris*) is a crucial food security crop and income source for smallholder farmers in Tanzania (Mishili et al., 2015; Mutungi et al., 2020 as cited by Mkuna, 2022; Ndimbo et al., 2022). According to Ndimbo et al. (2022) the crop accounts for 78% of land under legumes. Common beans are predominantly produced in the

Northern Zone (Arusha, Kilimanjaro, Manyara, and Tanga) and Southern Zone (Mbeya, Iringa, Ruvuma, and Rukwa) and Lake Zone (Kagera) (BTC 2012; and Larochelle et al., 2017 as cited by Musimu, 2018). Tanzania's per capita consumption of common beans stands at 19.3 kg which contributes 16.9% of the protein and 7.3% of the calories in human nutrition (FAO, 2013; Messina, 2016) as cited by Ndimbo et al. (2022).

However, its productivity remains low, with an average of 900 kg/ha reported for the 2019/20 cropping season, far below Tanzania's potential of 1,500 - 3,000 kg/ha recommended by Tanzania research institutions (Rubyogo et al., 2007; Ronner and Giller, 2013, Bucheyeki and Mmbaga, 2013) as cited by Musimu (2018).

Tanzania's bean production area (ha) has nearly doubled from 446,700 ha (1983/84) to 823,000.00 ha (2019/20), with a range of 126, 540 - 318, 000 ha (Figure 2.4). Additionally, production and productivity have also doubled from 339,510 to 661,699 tons and 627.3 to 1,300 kg/ha; the highest yield recorded being 1,300 kg/ha (2016/17 & 2019/20). Despite the reported fluctuations there has been an upward trend for all the above. Between 1983/84 and 2019/20 Tanzania’s bean production was highly correlated (0.937) with area expansion compared increased yields; the correlation between yield and production was 0.830 and it moderate (0.629) between bean area and yield.

Figure 2.4 : Production of common beans in Tanzania (1983/84 - 2019/2020)



***Source**: FAOSTAT (2024)*

However, Tanzania's economic reforms and agricultural sector transformation strategies ought to have led to higher bean yields for smallholder farmers due to free movement of crops and market price determination. Moreover, with increased urbanization and population growth, farmers were expected to invest in improved production technologies to increase productivity and income. Furthermore, low bean yields are often caused by low adoption of improved bean varieties, insufficient use of agricultural technologies, low soil fertility, poor crop management, and susceptibility to insect pests and diseases (Mkonda and He, 2016; Musimu, 2018; Kiriba et al, 2019).

2.7. Production of selected cash crops

Traditional cash crops grown in Tanzania include coffee, cashew nut, tea, cotton, tobacco, and sisal. However, of the above-mentioned crops cotton, tobacco and coffee have been for a long time the leading earners of the country's foreign exchange. The subsections below present the above-mentioned crops production trends (1983/84 to 2019/20).

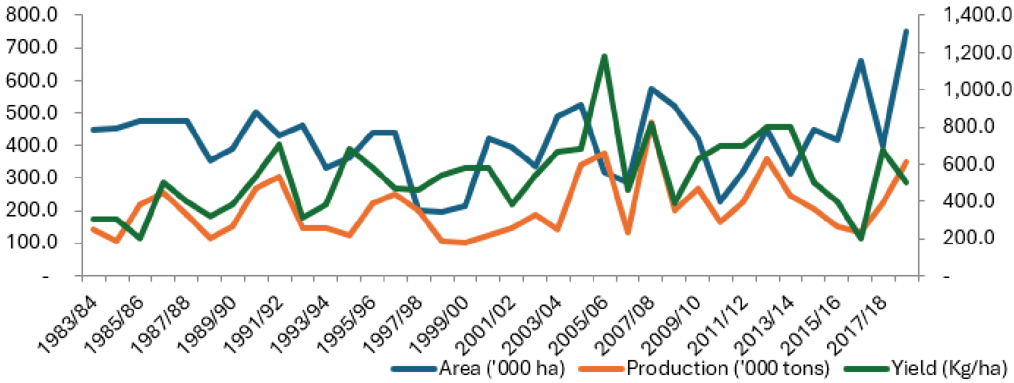
2.7.1. Cotton production

Tanzania's cotton sector is dominated by smallholder farmers farming between 0.5 and 15 ha, the average acreage being 1.5 acres (The Citizen, 2013). Cotton is mainly grown in Mwanza, Shinyanga, Singida, Mara, Kagera, and Tabora, which produce 95% of the cotton. Other regions include Morogoro, Manyara, Tanga, and Kilimanjaro. Tanzania's structural adjustment program (SAP) in the 1980s and the liberalization of the economy in the 1990s led to mixed outcomes, including increased vulnerability of primary commodity producers to global market fluctuations. The liberalization of the cotton sector involved removing input subsidies and credit, and transferring marketing and export to private companies, removing the monopoly of the Tanzania Cotton Marketing Board (TCMB) (Bargawi, 2008).

In the 1980s, the Tanzanian government managed the cotton sector through the Tanzania Cotton Authority (TCA). However, due to poor performance, regional cooperative unions were reinstated in 1986, taking charge of cotton production, providing seasonal credit, and handling ginning in their regions (Poulton and Maro, 2009). Nonetheless, this led to reduced market access, rising fuel and transport costs for agro-commodity producers, causing soaring energy prices and a significant reduction in their real incomes. In addition, the removal of state support for fertilizers and pesticides also led to a dramatic rise in production costs, undercutting increased cotton production in the 1990s. Moreover, exchange rates also affected some agro-commodity producers and their input supply (Bargawi, 2009).

The decline in cotton production prompted the government's intervention in the late 1990s; cotton production fell to around 100,000 tons between 1998 and 1999 (Poulton and Maro, 2009). In addition, the Tanzania Cotton Board (TCB) held a meeting in 1999 to improve the sector and collaborated with leading ginners to implement new institutional arrangements for seed multiplication and input supply. Additionally, the TCB's passbook system was introduced to enhance producers' access to crop protection chemicals through forced saving and this proved crucial for the resurgence of Tanzania's cotton sector in 2004 and 2005 (Poulton and Maro, 2009). Other factors included attractive seed cotton prices in 2003 and good rainfall.

Figure 2.5 : Cotton production trend in Tanzania (1983/84 - 2018/19)



***Source**: FAOSTAT (2024)*

Tanzania's cotton production fluctuated significantly between 1983/84 and 2019/20 cropping seasons, with the lowest and highest production levels being 140 300 tons (1983/84) and 472 100 tons in (2007/08) respectively (Figure 2.5), however, the lowest production (i.e., 100,000 tons) was recorded in the 1998/99 season. The Figure also shows that both area under production and total production increased: nonetheless, the increase production was slightly higher. Additionally, a positive correlation (0.397) exists between area under production and total production. Cotton yield also fluctuated between 1984/84 and 2019/20 with the average being 555.1 kg/ha which is far below Tanzania's 2015 target of 1,500 kg/ha (The Citizen, 2013) and China's 4,500 kg/ha (Masaki and Marwa, 2019). Despite Tanzania's economic reforms and liberalization of the cotton sector yield has ranged between 200 kg/ha (1985/86) and 1,300 kg/ha (2019/20). Moreover, the negative correlation between area under cotton cultivation and yield (-0.188) suggests that expanding land for cotton production has been associated with declining productivity. Thus, suggesting expansion of cotton production area may not necessarily lead to higher productivity.

Tanzania's low cotton yield is attributed to various factors, including improper regulation, climate change (Baffes, 2005), poor crop protection, decline in pesticide availability and introduction of new pesticides that farmers are unfamiliar with (Poulton and Maro, 2005), low investment, and lack of value addition (The Citizen, 2013), overreliance on rainfall, low investment, inadequate extension services (The Citizen, 2013). Moreover, exogenous factors like El Niño and La Niña have exacerbated the situation. In addition, the liberalization of the cotton sector reduced production quality and quantity due to decreased input use, variety mixing, and abandonment of zoning (Baffes, 2005).

2.7.2. Tobacco production

Tobacco (*Nicotiana tobaccum*) was first introduced in Tanzania (Songea) from the then Nyasaland (Malawi) in 1930, it has since then become a household crop in 13 regions across the country. The introduction of tobacco in Urambo district after World War II marked a significant development in the country (TTB, 2024). Currently, tobacco is grown in the regions of Tabora, Katavi, Shinyanga, Geita, Kagera, Kigoma, Iringa, Singida, Mbeya, Ruvuma, Songwe, Mara, and Morogoro. In addition, Ruvuma region cultivates 'Dark Fire Cured tobacco', while all other regions cultivate 'Virginia Flue Cured tobacco'. Tobacco is one of Tanzania’s designated strategic export crops currently being cultivated under contract farming arrangements (Makoye et al., 2022). In 2012, Tanzania ranked third producing 14.4% of Africa’s tobacco leaf after Zimbabwe (25.9%) and Zambia (16.4%) (WHO, 2021). In the past two decades, Tanzania, along with Mozambique and Zambia, has significantly increased its tobacco leaf production (WHO, 2021:3). From 2000 to 2020, the area under tobacco cultivation increased by 38.14%, with 0.15% of the country's agricultural land dedicated to tobacco growing. In 2020, tobacco leaf export accounted for 2.45% of Tanzania's total exports earnings (WHO, 2023).

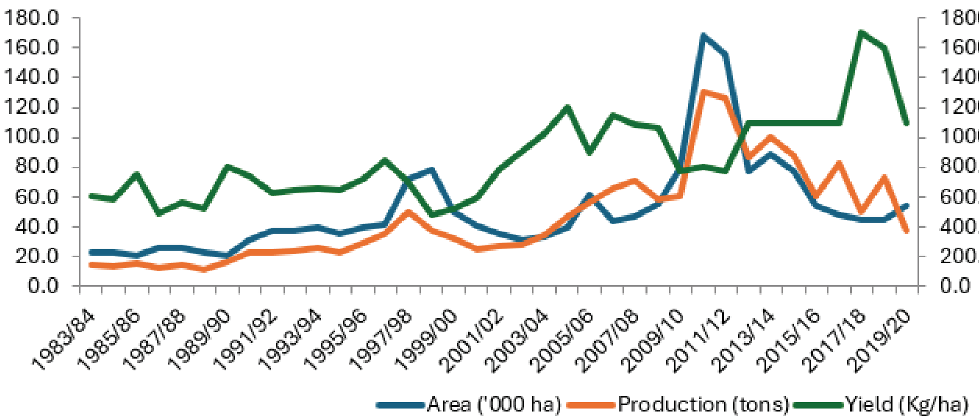
Before liberalization of Tanzania’s tobacco sector in the 1990s the sector was heavily regulated by the government following the Arusha Declaration of 1967. The government established the Tanganyika Tobacco Board in the 1960s and the Tobacco Authority of Tanzania (TAT) in 1970. In 1984, TAT was transformed into Tanzania Tobacco Processing and Marketing Board (TTPMB) (TTB, 2024). The Tobacco Industry Act, 24 of 2001, tasked TTB with overseeing the entire tobacco value chain and encouraging private sector participation. However, in 2011, the government enacted the Tobacco Act of 2011 (URT, 2001b), which introduced greater regulation of contracts between farmers and companies. The Act aimed to address concerns about power imbalance in contract farming, which had previously disadvantaged smallholder farmers (Rugimbana, 2008; Makoye et al., 2022). The sector's liberalization in 1993 allowed private tobacco buying companies to venture into contract farming with farmers while also allowing multinational companies to engage directly with farmers (Simon, 1998 as cited by Rugimbana, 2008). Moreover, the transformation of the tobacco industry has led to increased productivity and higher-quality tobacco, making Tanzania a key supplier of Virginia flue-cured tobacco globally (WHO, 2021; Prowse & Pérez Niño, 2022).

However, the transformation of the tobacco sector also brought challenges these include corruption at certain levels of government and lack of proper governance in some of the unions and primary societies dealing with tobacco buying (Tuinstra, 2015). On the other hand, there are issues of price fluctuation for both inputs and tobacco leaf prices due to farmers' weak bargaining power and the dominance of a few large buyers (Ntibiyoboka, 2014). Furthermore, tobacco productivity (kg/ha) remains low (Rweyemammu and Kimaro, 2006; Mbujilo, 2020) due to untimely or improper use of fertilizers (Zungo and Mbwana, 2021), limited access to credit, and a poor connection to the markets (Mbujilo, 2020).

Figure 2.6 shows Tanzania's tobacco production has experienced an upward growth, with a high positive correlation (0.867) between area (ha) under cultivation and production (tons); between 1983/84 and 2019/20 the minimum and maximum production were 11,800 tons (1988/89) and 130,000 tons (2010/11), respectively. The average for the whole period was 46,200 tons. The crop's productivity has also increased between 1983/84 and 2019/20 cropping seasons; the minimum and maximum yields being 482 kg/ha (1998/99) and 1,700 kg/ha (2017/18), with the average for the whole period being 860 kg/ha. However, the observed yields are lower than the 3,000 kg/ha reported for Brazil (Tuinstra, 2015). Nonetheless, there was a weak positive correlation (0.109) between area under tobacco cultivation and yield.

Despite challenges faced by smallholder farmers, the liberalization of Tanzania economy and the tobacco sectors in the 1980s and 1990s has positively impacted the crops production. The above has ensured farmers timely access to inputs and markets through contact farming (Mwimo et al., 2016). Furthermore, the Tobacco Council, comprising tobacco growers, buyers, and the Ministry of Agriculture, negotiates tobacco buying prices based on set grades. Prior to price negotiations, the council agrees on the farmer cost of production (COP), with agreed grade prices being minimum indicative. In addition, liberalization of the sector ensured secure markets for tobacco producers.

Figure 2.6 : Trend of tobacco production in Tanzania (1983/84 - 2019/20)



***Source**: FAOSTAT (2024)*

2.7.3. Coffee production

Coffee is a particularly important export crop for Tanzania ranking second after tobacco, the crop accounts for 24% of the country's total foreign exchange earnings (NBS, 2019 as cited by TCB, 2021). The coffee industry directly employs about 450,000 families and indirectly an additional 2.4 million people (TCB, 2017 as cited by TCB, 2021). Tanzania produces two types of coffee: Arabica and Robusta. Arabica coffee production is concentrated in Kilimanjaro, Arusha, Mbeya, Songwe, and Ruvuma; of the 450,000 families 120,000 engage in production of Robusta coffee mainly in Kagera Region.

Overall smallholder farmers produce 90% of Tanzania’s coffee; 10% is grown on over 110 estates. Tanzania has a great opportunity to boost its coffee production due to steady annual growth in world coffee consumption, production limitations in larger coffee producing countries, development of "Specialty Coffee" niche markets, and its potential competitive advantage over Central American producers of mild Arabica (TCB, 2021:4). Furthermore, Tanzania is also in a unique position to market its Kilimanjaro-grown coffee to Japan, where the word "Kilimanjaro" has strong marketing power. However, Tanzania's average annual production has stagnated at about 50,000 metric tons over the past 35 years, with yields fluctuating significantly and quality potential not fully exploited (TCB, 2021).

Tanzania's coffee sector has undergone regulatory measures before and after the country's liberalization of the economy. For example, following the Arusha Declaration of 1967 that led to adoption of African Socialism and Self-reliance ideology, a state-controlled economy and villagization, the government’s coffee sector policy centred on increasing coffee production by nationalizing private estates, controlling producer prices, and expanding its macro-economic policy (Brooks & Kessy, 2017). Therefore, coffee marketing, export, and extension services were directly administered by the Crop Authorities and Tanzania Coffee Marketing Board, and financed by government banks (Lofchie, 2014 and von Freyhold, 1979 as cited by Brooks and Kessy, 2017). In addition, Brooks and Kessy citing McHenry Jr. (1994) and Ibhawoh and Dibua (2003) point out that political control over coffee production was maintained through government control of the primary societies, regional cooperatives, and rural development banks.

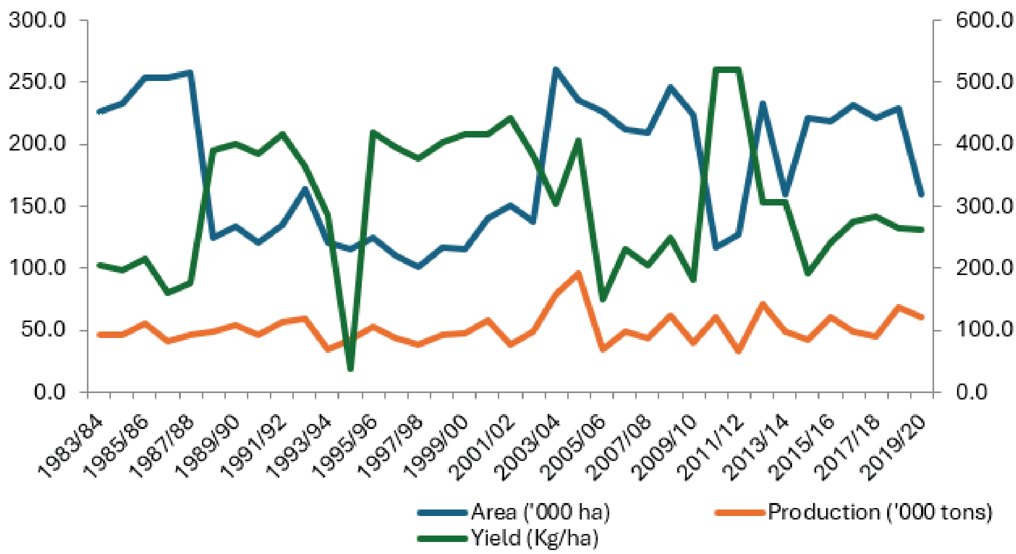
Coffee production in Tanzania experienced steady declines in the mid-1970s after having performed well through the late 1960s and early 1970s

(Chachage, 2003; Msuya 1979 as cited by Brooks & Kessy, 2017). Therefore, in 1977 'The Coffee Industry Act of 1977 was enacted. The ACT enabled the establishment of the Tanzania Coffee Authority (TCA) whose mandate was to control, regulate, develop and improve Tanzania's coffee industry. Furthermore, TCA was among other things entrusted with the role of marketing and exportation of coffee and setting the price for coffee and coffee products within Tanzania (URT, 1977). Generally, The Tanzania Coffee Industry Act of 1977 and Coffee Marketing Board Act (1984) restricted coffee exportation by private traders (URT, 1977; 1984). However, due to the 1980s and early 1990s economic hardships the government working closely with the World Bank and the IMF accelerated the coffee sector's transformation with a set of core policy adjustments that reshaped it for a more active private participation (Brooks & Kessy, 2017).

The Coffee Industry Act of 2001 was enacted in 2001 to support the liberalization of Tanzania's coffee sector and modernize its regulatory framework (URT, 2001c). The Act established the Tanzania Coffee Board (TCB) to regulate, promote, and advice on increasing coffee production and productivity whereby TCB was required to issue licenses for various coffee activities, register land, and maintain quality standards. In addition, in 2013, the Tanzania Coffee Industry Regulations, 2013 were put in place; these established guidelines for coffee production, processing, marketing, and export, promoting transparency and accountability. Therefore, all coffee growers, traders, processors, and exporters must acquire the necessary licenses from TCB to legally operate. Furthermore, producers and processors must adhere to established quality standards, including proper grading, processing, and packaging so as to ensure high-quality coffee for domestic and export markets. Additionally, all coffee must be sold through designated channels such as auctions or licensed buyers to promote fair competition and transparency (URT, 2013b).

Despite Tanzania's efforts to increase coffee productivity after the country's 1980s economic reforms and liberalization of the coffee sector in the 1990s, the crop's production has been fluctuating (Figure 2.7). The fluctuation was higher in relation to land under coffee cultivation compared with production, with land under production and total coffee produced in the period 1983/84 – 2018/19 ranging between 100,600 – 260,100 ha and 33,200 - 95, 400 tons respectively; the averages for both are 180,100 ha and 51,100 tons respectively. Despite the expansion of land under coffee production, yields have not increased in the same direction, with a negative correlation (-0.776) between area under production (ha) and yield (Kg/ha). Nonetheless, there was a positive correlation (0.309) between area and production.

Figure 2.7 : Coffee area and production trend (1983/84 – 2018/19)



Source: *FAOSTAT (2024)*

Unfortunately, Tanzania's liberalization of the coffee industry has not corresponded with increased yields (Figure 2.7). For example, between 1983/84 and 2018/19 the lowest and highest yields were 519.9 kg/ha (2010/11) and 150 kg/ha (2005/06) respectively, average yield is 307.4 kg/ha. Generally, Tanzanian yields are far below the 748.2 kg/ha, 923.4 kg/ha and 1,014.6 kg/ha[2] for the years 1900, 2000 and 2014 reported for the world's top ten coffee producers (Brazil, Vietnam, Colombia, Indonesia, Ethiopia, India, Honduras, Guatemala, Peru and Uganda

[2] The calculations are based on data retrieved from the FAO Coffee Pocketbook 2015

(FAOSTAT, 2024). In addition, they are also lower than the averages for the other East African countries' of Burundi, Kenya, Rwanda and Uganda i.e., 640 kg/ha, 764.2 kg/ha and 604.2 kg/ha reported for the years 1990, 2000 and 2014: Tanzania's average for the same years was 401.0 kg/ha, 415.7 kg/ha and 305.7 kg/ha respectively. Currently, smallholder farmers' yield per coffee tree ranges between 0.25 kg and 3.0 kg, while that of large farmers is about 2 kg/coffee tree (TCB, 2021). According to TCB, increasing smallholder productivity to 2 kg per tree will allow Tanzania to reach the goal of producing 300,000 MT (Marwa, nd). In addition, a production of 200,000 MT, five times of the current coffee production level, would put Tanzania among the top 10 coffee producing countries in the world from the current ranking of 18.

Tanzania's coffee production and productivity have been constrained by various factors, including unpredictable weather, old/aged coffee trees, low yielding coffee varieties, low usage of inputs due to high prices, high cost of production, and volatile and falling coffee prices (TCB, 2021). In addition, Tanzania has been unable to achieve its coffee production potential due to a fragmented marketing system, poor infrastructure, and lack of access to finance (Marwa, nd).

2.8. Use of Inorganic Fertilizers in Tanzania

Easy access and use of modern inputs such as inorganic fertilizers, improved seeds and pesticides by farming households is critical for higher output and productivity per unit of labour and or land (kg/ha) (Urassa, 2010; Keizire et al., 2020). For example, use of inorganic fertilizers in areas with depleted soil fertility can immensely improve crop productivity.

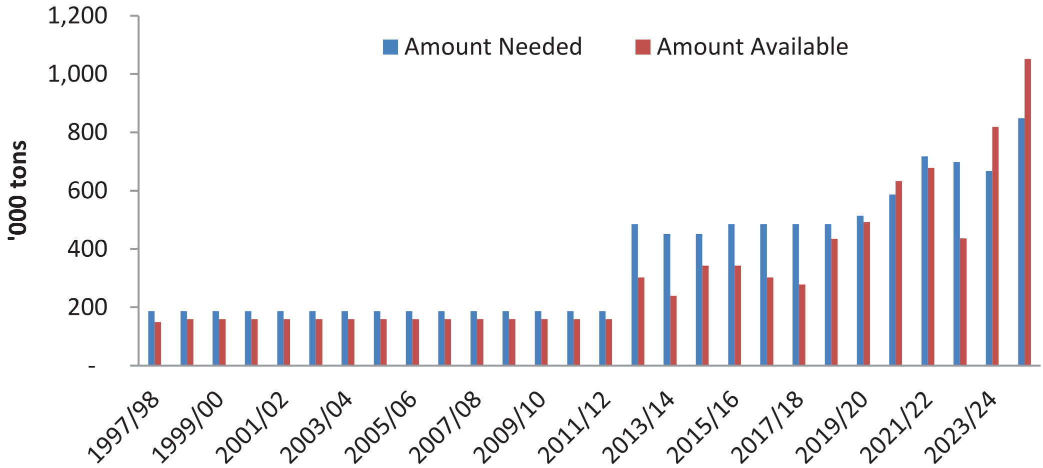
From the late 1960s to 1994, Tanzania's fertilizer importation and marketing system was dominated by state agencies, responsible for demand assessment, international orders, distribution, and incentive programs (Benson et al., 2012). In the early 1970s, the government in partnership with an international firm built a fertilizer factory in Tanga, Tanzania Fertilizer Company (TFC) which used phosphate inputs from the Minjingu deposit to produce fertilizer for smallholder farmers and large-scale commercial producers. However, the government-run system was characterized by inefficiencies, delays, and high fiscal costs (Benson et al., 2012). Therefore, in 1994, the government liberalized Tanzania's fertilizer market, allowing the private sector to enter the market, in line with the country's SAPs of the 1980s.

Through economic reforms and liberalization of the economy Tanzania has implemented various policies and regulations to encourage smallholder farmers to use inorganic fertilizers. These include the 2001 Agriculture Sector Development Strategy (ASDS) (URT, 2001a), The Fertilizer Act of 2009 (URT, 2009), the 2013 Tanzania Agriculture Policy (URT, 2013a), and the National Agricultural Input Voucher Scheme (NAIVS). The Fertilizer Act resulted into establishment of the Tanzania Fertilizer Regulatory Authority (TFRA); TFRA is responsible for regulating fertilizer quality, registering, and licensing dealers, issuing permits, and maintaining their register (URT, 2009). The NAIVS aims to increase maize and rice production, promote food security, and encourage smallholder farmers to try new seed and chemical fertilizers (URT, 2014). The ASDS of 2001 among other things aimed to reduce transaction costs and develop competitive agricultural marketing systems for inputs and crop and livestock outputs hence, increased farm profitability and farmers' adoption of modern technologies (URT, 2001a:6). The NAIVS programme has contributed to an increase in fertilizer use and improved yields in targeted regions during its implementation phase (URT, 2014). However, it faced several challenges, including delays in voucher distribution, fraud, and issues with the targeting of beneficiaries. Some reports show that wealthier farmers benefited disproportionately, while poorer farmers were left out. Nonetheless, the program's long-term sustainability is questionable due to its overreliance on donor funding.

Therefore, Tanzania's liberalization of the fertilizer sector in line with the macro-economic reforms and SAPs has had both positive and negative effects on the agricultural sector. For example, the private sector's participation in the supply of inputs, including fertilizers, did not keep up with the pace of the government and its parastatals withdrawal (Ponte, 2001; Skastein, 2005). On the other hand, cooperative unions were adversely affected by the economic reforms, leading to financial constraints and a lack of credit facilities which hindered their ability to supply smallholder farmers with affordable fertilizers. In addition, smallholder farmers' access to fertilizers and other inputs was affected by poverty and a lack of credit facilities. Furthermore, the closure of the Tanga-based factory in the early 1990s led to total reliance on imports, which were relatively expensive for ordinary small-scale farmers due to the lack of government subsidies offered before the 1980s SAPs. The liberalization of fertilizer importation in 1991 and the gradual removal of government subsidies led to a decline in chemical fertilizer use due to higher fertilizer prices that denied access to the same by poorly resourced farmers (Majule, 2004 as cited by Urassa, 2010).

Figure 2.8 shows an upward increase in both the use and availability of inorganic (industrial) fertilizers. Fertilizer use in Tanzania has fluctuated between cropping seasons, with average amounts of fertilizer used, available, and deficit being 363,148.7, 312,380.8, and 50,769.9 tons, respectively (Figure 2.8). The National Agriculture Sample Census of 2019 shows that only 20.2% of Tanzania's planted area was applied with fertilizers in the 2019/20 cropping season, with 39.6% using organic fertilizers and 60.4% using inorganic fertilizers. Despite liberalization of the economy and the agro-inputs sector, Tanzania's use of inorganic fertilizers remains low; the country has one of the lowest application rates whereby farmers use on average 19 kilograms (kg) per hectare (Ha) compared to the world average of 100 kg/Ha (World Bank, 2024). Furthermore, Tanzania’s average fertilizer use is lower than Sub-Saharan Africa's average of 37 kg/Ha and the Abuja declaration target of 50 kg/ha by 2025. Additionally, it is also lower than the global average of 129 kg/Ha and that of other regions, i.e., Europe and Oceania (82–83 kg/Ha), Americas (151 kg/Ha), and Asia (187 kg/Ha) (FAO, 2022).

Figure 2.8 : Use of inorganic fertilizers in Tanzania (1997/98 – 2023/24)



Source: *URT/MoA (Ministry of Agriculture Budget Speeches (1998 – 2024)*

Tanzania smallholder farmers' low fertilizer usage can be attributed to several factors. First, many farmers lack awareness of the benefits of inorganic fertilizers, which are not traditionally used in many farming communities (Urassa, 2010; Keizire et al., 2022). Second, fertilizers are often inaccessible or too expensive for smallholder farmers (Majule, 2004 as cited by Urassa, 2010; Keizire et al., 2022; The World Bank, 2024). Third, policy-related issues, such as lack of unified reporting and overlapping regulatory mandates between agencies[3], further limit access. In addition, restrictive fertilizer regulations, high registration costs for modern technologies, counterfeiting, inefficient clearance systems, and high inland transport costs also contribute to low fertilizer use (Keizire et al., 2022).

2.9. Production, distribution, and use of improved seeds by smallholder farmers in Tanzania

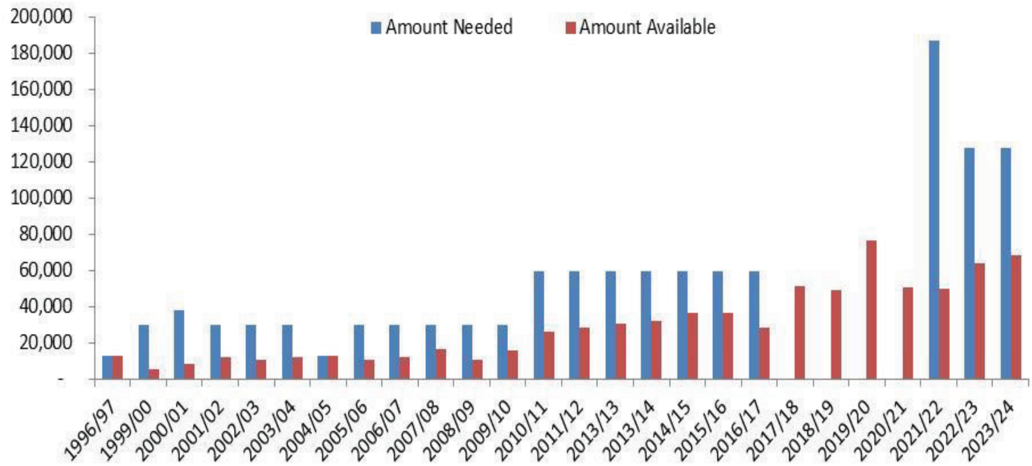
Use of improved seeds and other inputs, such as fertilizers and pesticides, is crucial for Tanzania's smallholder farming and crop productivity. However, only 40% of Tanzanian farmers use these seeds, leading to

[3] For example, Tanzania Fertilizer Regulatory Authority (TFRA), the Weights and Measures Agency (WMA), and others.

lower crop productivity (TNBC, 2009). Factors preventing farmers from using improved seeds include lack of awareness, cost, and shortages at the right time and place (World Bank, 2014). According to the World Bank Tanzania has experienced a general increase in farmers' use of improved seeds following Tanzania's enactment of the 2003 seed act, which repealed the Seeds Regulation of Standards Act of 1973. Furthermore, the liberalization of Tanzania's seed sector has led to an increase in the availability of improved seeds for farmers (Figures 9 and 10). However, the use of improved seeds by smallholder farmers remains low; with only 22.1% of Tanzania's total planted area using improved seeds in 2018/19 a marginal increase from the 18 percent in 2002/03 and is lower than the 24 % reported in 2007/08 National Agriculture Sample Survey (National Bureau of Statistics et al., 2010; URT, 2021c). Therefore, the low adoption of improved seeds threatens households' food and income security.

Demand and supply of improved seeds in Tanzania have been increasing steadily between 1996/97 and 2023/24 (Figure 2.9). However, a deficit persists, leading many farmers use of traditional seeds or recycled hybrid seeds from previous seasons thus, affecting smallholder farmers' productivity (Urassa, 2010). Farmers' use of improved seeds is constrained by cultural, institutional, economic, and technological factors (Mugabi, 2014). Cultural barriers, poor dissemination of research findings, and high prices negatively impacts farmers' use of improved seeds, leading to their continued use of traditional seeds (Urassa, 2015, Mugabi, 2014; AGRA, 2016). Moreover, the low yielding traditional seeds or recycled hybrid seeds are less expensive compared to the high-yielding ones. According to AGRA recycling seeds for example beans can lead to severe yield loss due to impurities and contamination by diseases, particularly bacterial and fungal diseases common in bean growing ecosystems. To enhance smallholder farmers' productivity, Tanzania needs to invest in developing a robust domestic improved seed industry. This would reduce seed costs and associated taxes, making them more affordable for farmers (Mugabi, 2014). Equally important is fostering effective synergy between the country's agricultural extension and research services to ensure the successful adoption and utilization of improved seed varieties (Mattee, 1994).

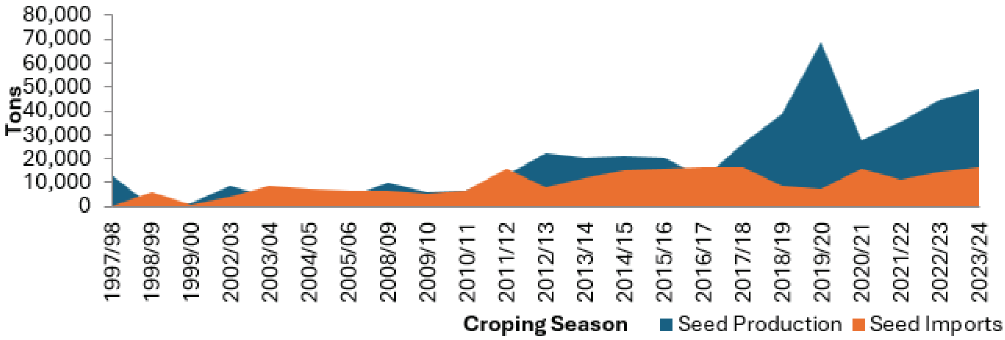
Figure 2.9 : Availability and use of improved seeds in Tanzania (1996/97 – 2023/24)



Source: *URT/MoA (Ministry of Agriculture Budget Speeches (1997 – 2024)*

Liberalization of Tanzania's seed sector allowed both public institutions and private firms to participate in seed production and supply; plant breeders in Agriculture Research Institutes (ARIs) continue to produce pre-basic seeds, which are then provided to the Agricultural Seed Agency (ASA) for foundation seeds. Private firms are now allowed to produce foundation seeds of public varieties, allowing them to develop and multiply their own improved seeds (World Bank, 2012). In addition, farmers participate in the production of 'Quality Declared Seeds' (QDS), produced locally based on FAO standards and Tanzania's contexts. The production of QDS is typically undertaken by farmers while random checks and field inspections is done by government agencies (World Bank, 2012).

Figure 2.10 : Production and importation of improved seeds in Tanzania



Source: *URT/MoA (Ministry of Agriculture Budget Speeches (1998 – 2024)*

The liberalization of Tanzania's seed sector has contributed to the country's availability of improved seeds. Tanzania's seed sector has experienced significant growth since 1997, with the highest production recorded in the 2019/2020 cropping season (Figure 2.10). However, the country struggles in relation to self-sufficiency in its seed needs due to several challenges. The challenges include a weak regulatory framework, inadequate infrastructure, bureaucracy, low participation of local and foreign bodies in seed production and breeding, limited capacity of breeders to maintain seed varieties, limited demand due to ignorance and lack of awareness, poverty, and a shortage of agro-dealers and distributors (World Bank, 2012; AGRA, 2016; NAO/URT, 2019). AGRA (2016) argues that breeders' limited capacity to maintain seed varieties is one of the major challenges facing Tanzania seed marketing system. According to the World Bank (2012) certification and release of new seed varieties can take up to three years which constrains for companies interested in introducing new varieties (World Bank, 2012). In addition, the limited involvement of the private sector in seed breeding also hinders the supply of improved seeds. On the other hand, AGRA (2016) argues that a shortage of storage, processing, and seed distribution infrastructure affects seed quality and availability across Tanzania.

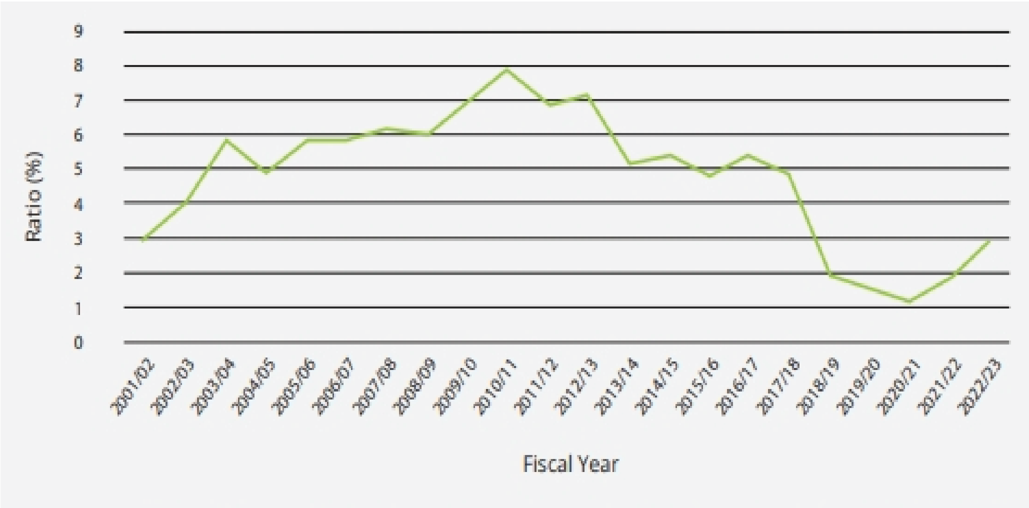
Furthermore, the Limited demand for improved seeds due to ignorance and lack of awareness significantly affects their adoptions by smallholder farmers who are generally unaware of the potential return on investment associated with their use (Mattee, 1994; Urassa, 2010; 2015; AGRA, 2016;

Makingi and Urassa, 2017). Another factor is poverty, many smallholder farmers in Tanzania lack access to affordable credit options hence, their inability to afford the price of improved seeds despite their inherent high yielding capacity (AGRA, 2016; NAO/URT, 2019). Moreover, many continue to use old and obsolete OPV maize varieties due to a lack of sufficient promotion for new varieties (AGRA, 2016). Lastly, the shortage of agro-dealers and distributors in the country impacts farmers by making them search for quality seeds and fertilizers far away, which may discourage some (NAO/URT, 2019). Addressing these challenges is crucial for the Tanzanian seed industry to ensure the availability and sustainability of improved seed varieties.

2.10. Agricultural budgetary allocation

Adequate agricultural budgeting is crucial for enhanced productivity, food security, economic growth, and poverty reduction. The Maputo Declaration (2003) set a bold commitment for African nations: allocate at least 10% of national public expenditure to agriculture as a catalyst for achieving 6% annual sector growth and driving rural poverty reduction. This pledge, under the Comprehensive Africa Agriculture Development Programme (CAADP), underscores agriculture's central role in economic transformation and food security across the continent. The declaration aims to increase agricultural productivity, reduce hunger through improved planning, policies, infrastructure, and adoption of agricultural technologies.

Figure 2.11 : Trends in share of agriculture sector budget (2001/02-2022/23)



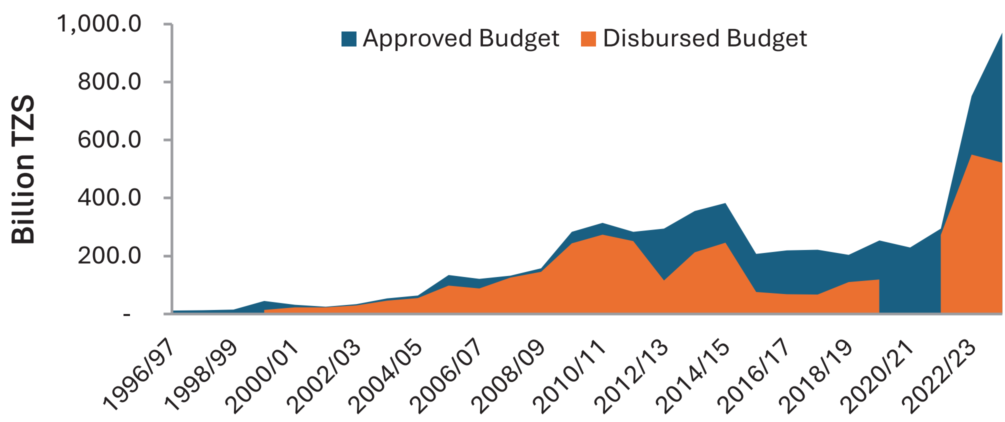
Source: *ANSAF, 2023/24 Pre-Budget Speech*

Tanzania's agricultural sector faced significant challenges in the 1980s due to the economic challenges the country was facing that led to the implementation of SAPs. The SAPs were expected to lead to increased food and export crops productivity through better producer prices, improved product and input marketing, and an increased government budget for agriculture (Meertens, 2000). However, the increase in budgetary allocation to the sector has fluctuated over time, with the highest and lowest proportions in 2010/11 and 2020/21 fiscal years, respectively. Between 2000/01 and 2022/23, the sector's allocation was 6% or above for five years only (ANSAF 2023: 4). According to ANSAF (2023), Tanzania falls far too short of the African Union agreed 10% budgetary allocation to the agricultural sector, with low public investments potentially leading to food and nutrition insecurity and poverty.

The agricultural sector needs 10% of the total budget to stimulate 6% growth of the economy for poverty reduction and improved rural livelihoods (AU/NEPAD, 2003). Between 2003 and 2023, Tanzania has only allocated 5% or more of its total budget to the agricultural sector twelve times (63.2%) and only in one-year 2010/11 it was 8% the closest it has come to the Maputo Declaration on Agriculture and Food security (Figure 2.11).

Between 1996/97 and 2023/24, the amount of money approved/allocated to the Ministry of Agriculture increased from TZS 11.6 billion to TZS 970.8 billion. The increase has been gradual from 1996/97 to 2005/06, but fluctuated between 2006/07 to 2021/22, with the highest increase in 2022/23 (Figure 2.11). However, not all approved money was received by the ministry, with some years receiving less than 50% of the approved amount, affecting or delaying the implementation of development projects (Figure 2.12). Additionally, a sizeable portion of the money approved and received was for general expenditure, not development. To achieve the desired growth in the agriculture sector it is important to understand where and how money is spent, doing so allows optimization and proper expenditure targeting (World Bank, 2022).

Figure 2.12 : Budgetary allocation to the Ministry of Agriculture (1996/97 to 2023/24)



Source: *URT/MoA (Ministry of Agriculture Budget Speeches (1997 – 2024)*

2.11. Smallholder farmers access to agricultural finance

Since Tanzania Mainland's independence in 1961, the government has made numerous efforts to ensure the agricultural sector has access to reliable financing. Between 1961 and 1984, several institutions were established, including the Agriculture Credit Agency (ACA), National Development and Cooperative Bank (NDCA), Tanzania Rural Development Bank (TRDB), and Cooperative and Rural Development Bank (CRDB) (BOT, 2011). These institutions aimed to provide financial services to smallholder farmers and rural dwellers to transform subsistence production. Following the Arusha Declaration, Tanzania nationalized all private commercial banks, merging their assets and liabilities to establish the National Bank of Commerce (NBC) (BOT, 2011). However, this did not improve financial inclusiveness, leading to the establishment of non-financial institutions to serve rural and periphery areas. Despite the formation of the Tanzania Rural Development Bank (TRDB), most rural populations, particularly smallholder farmers, lacked access to formal financial services (Kanyabwoya, 2021). The above occurred due to the state's control over the financial institutions, non-promotion of farmers' savings, incorrect interest rates, political interference, and non-enabling economic environment (Temu, 1999).

The 1980s economic hardships and underperformance of the banking industry led to the 1991 reforms of Tanzania's financial sector. The reforms focused on legal reforms, payment system modernization, privatization of state-owned banks, and financial market development. These reforms significantly impacted the banking sector's growth, thus, creating the possibility of smallholder farmers' access to financial resources through new entries by local and foreign-owned banks (BOT, 2011).

In addition, the National Bank of Tanzania (NBC) was restructured in 1997, forming three separate entities: NBC Limited, the National Microfinance Bank Limited, and Consolidated Holdings Corporation. The Cooperative and Rural Development Bank was also restructured into a private bank in 1996. Early foreign banks in the market included Meridian Biao Bank Tanzania Limited, Stanbic Bank Tanzania Limited, Standard Chartered Bank Tanzania Limited, Eurafrican Bank Tanzania Limited, and Citibank Tanzania Limited. However, Kanyabwoya (2021) argues that the entry of foreign and local private banks did little to integrate those left out.

Access to affordable loans allows farmers to invest in quality seeds, fertilizers, pesticides, and infrastructure for better yields and value-added processing (Lupila, 2024). Moreover, credit enhances market access by enabling farmers to hire transport to reach lucrative markets, thus improving incomes and the agricultural sector's economic impact (Girabi and Mwakaje, 2013). Despite agriculture's importance, the sector suffers from limited financing, receiving only 9% of formal credit, compared to 26% for industry and 14% for services (URT, 2017; IFAD, 2022). Currently, rural financing is particularly constrained, with only 6.5% of rural households accessing credit, and agricultural loans comprising just 15.4% of commercial bank lending in 2011 (TADB, 2022).

Further, high interest rates and short-term loan structures deter borrowing by smallholder farmers, and lack of land titles limits collateral options (Girabi and Mwakaje, 2013; WB, 2014). In addition, women, and youth face additional challenges in obtaining funding due to insufficient guarantees and strict repayment terms, which restricts economic empowerment (Girabi and Mwakaje, 2013; FSDT, 2024). Findings by FinScope Tanzania (2017) on women and youth’s limited access to credits indicated issues such as youth and women farmers’ low productivity due to their cultivation of very small and fragmented land plots normally not owned or the smaller parcels they own relative to men, as well as their low use of improved technologies and poorly functioning value chains, and high delivery costs of bank finance to women and youth in rural areas compared to urban areas.

Regulations impeding lenders from charging interest rates that cover the actual cost and risk and, low Agricultural Marketing Cooperative Societies (AMCOS) membership. Nonetheless, women play a significant role in agricultural production and households could benefit immensely if they had access to credit (Mohamed and Temu, 2009). Overtime, informal credit sources, such as SACCOs and community microfinance, remain an alternative source of credit to smallholder farmers, women, and the youth due to formal system limitations like credit rationing and geographical challenges (Kashuliza, 1993).

Nonetheless, interventions by various financial inclusion stakeholders have improved the uptake of formal financial services by smallholder farmers from 55 percent in 2017 to 70 percent in 2023. The notable increase was attributed to high adoption of digital financial services, increased awareness of financial products and services and strong collaboration amongst public and private financial inclusion stakeholders (NCIF, 2023). Moreover, mobile platforms such as Vodacom's M-Pesa, Airtel Money, and Mixx by Yas (formerly Tigo Pesa) have expanded rural financial access, facilitating savings, transfers, and funding. In addition, Innovative digital solutions such as M-Kopa and AgriFin have introduced credit based on mobile transaction history, reducing the reliance on traditional collateral and lowering transaction costs. These advancements help farmers overcome bureaucratic barriers, enhancing their ability to finance agricultural activities.

However, while there have been improvements in financial access for Tanzanian smallholder farmers, significant challenges persist. Specifically, financial service providers often fail to meet farmers' needs due to issues like unpredictable farming income, weak property rights hindering use of land as collateral, inconsistent cash flows, and cultural practices that reduce demand for formal financial services (NCFI, 2023). Consequently, small and medium scale enterprises (SMEs) engaging in value addition lack access to the much-needed credit (URT, 2017). Therefore, many farmers rely on sources such as contract farming, warehouse receipts, and microfinance institutions (MFIs) as their commercial bank access remains limited. For example, tobacco contract farming began in Tanzania in 1997/98, replacing the previous system where farmers sold produce to cooperative unions (Mwimo, et al., 2016).

The new framework involves buyers, cooperative societies, and banks entering into agreements, with buyers purchasing the crop, banks financing input supplies, and farmers being responsible for production. Therefore, there is need for this challenge to be addressed to ensure that the financially excluded population (smallholder farmers, younger people, and women) gets access to credit (FinScope Tanzania, 2017).

Further, a study by the Tanzania Agricultural Development Bank (TADB) on agribusiness financing for women and youth has shown that, financial institutions in Tanzania lend to various value chains, including tea, coffee, tobacco, cotton, sugar cane, and paddy, as well as horticulture, poultry, sunflower, dairy, fishing, animal rearing, and farm input. However, there is limited data on financing specifically targeting women and youth, who are often underserved due to cultural norms, lack of collateral, and perception of higher risk. The study covered seven financial institutions: Tanzania Commercial Bank, National Bank of Commence, CRDB, Uchumi Commercial Bank, Victoria Finance, Yetu Microfinance Bank, and FINCA Microfinance Bank (TADB, 2022). In addition, while CRDB offered a specific product for women, i.e., Malkia Agribusiness, the other surveyed institutions do not specifically cater to women and youth.

According to the NCFI (2023), challenges hindering access to credit in Tanzania include: high-interest rates; absence of Secured Transactions Law to allow movable collaterals by FSPs; the limited scope of the credit referencing system to include alternative information, including utility bills; and inadequate availability and interoperability on business, property and residential address information. Other challenges include lack of data interoperability between MNO and banks affects borrowers' credit rating scores, increased cyber security risks, thus threatening consumer trust and confidence in utilization of digital financial services; limited access to unique identification by microfinance clients; and unqualified staff managing microfinance institutions; low financial literacy levels. Also, inadequate proportionate regulatory requirements for SACCOS; inadequate information systems to support data collection and supervision of microfinance activities; and limited availability of disaggregated data on credit.

2.12. Conclusions and recommendations

2.12.1. Conclusions

The chapter examined the impact of Tanzania's agricultural policies and strategies on the productivity of selected crops. The chapter has shown that Tanzania's economic reforms in the 1980s and liberalization of the agricultural sector in the 1990s have both positively and negatively impacted smallholder farmers' productivity. And despite well-intentioned policies, the country has yet to achieve the desired outcomes. Nonetheless, it can be concluded that implementation of ASDP I successfully created an environment for increased agricultural productivity, despite challenges such as differing community priorities and lack of synergy among multiple actors.

However, ASDP II's achievements are not encouraging due to funding limitations and low prioritization of agriculture at the local level, ASDP II lacks the basket funding enjoyed by ASDP I and is therefore funded through other charges (OC) from the central government. It can also be concluded that productivity/yield of six examined crops remains low compared to other developing countries and the global average. However, the tobacco industry has responded positively, leading to increased productivity and higher-quality tobacco, making Tanzania a key global supplier of Virginia flue-cured tobacco. Nonetheless, the other crops' increased production is due to land expansion rather than increased productivity per unit of land used, falling short of the country's policy goal of increasing crop productivity for increased food security and household incomes.

2.12.2. Recommendations

To increase Tanzania smallholder farmers' productivity as per the aims of the various policies and strategies covered in the chapter and the conclusions the following actions/measures are recommended:

i. The agriculture sector lead ministries (ASLMs) and other actors, such as farmer groups, NGOs, private sector, development partners, and LGAs, need to work together to address issues that constrain their roles in the network. Doing this will ensure that the multiple actors align with the overall goal of transforming smallholder agriculture, and that the network's relationships are more important than individual actions.

ii. LGAs should collaborate with Agricultural Research Institutes to promote improved agricultural technologies like seeds and inorganic fertilizers, thereby enhancing smallholder farmers' productivity, thereby boosting food security and incomes.

iii. There is need for capacity building for the Ward and Village Development Committees on how to carefully plan and prioritize their developments needs through O & D.

iv. The government needs to create a conducive environment for smallholder farmers especially women and youth to access affordable agricultural financing, which can enhance their adoption of advanced technologies and boost productivity.

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Chapter 3 Agro-processing as a Driver for Productivity Enhancement in Agriculture

Ahmed A. Ndyeshobola and Donald E. Mmari

3.1. Introduction

Tanzania is blessed with significant growth potential from its human resource and abundant natural resources, the latter including arable land, forests, fisheries, minerals, rich biodiversity, and wildlife resources. There are over 44 million hectares of arable land available in Tanzania, with 29.4 million hectares suitable for irrigation. The country is well known for its agricultural products and exports. Agriculture is undoubtedly the largest single sector and one of the most important sectors of the Tanzanian economy, with the country benefitting from a diverse production base that includes staple food crops, a variety of cash crops, and livestock.

Hence, the agricultural sector is not only one of the drivers of Tanzania's economy but also the means of livelihood for most of the Tanzanian growing population. The sector comprises of crop production for both industrial use agro-processing and direct consumption as food; horticulture and floriculture; livestock; fisheries and aquaculture; and agroforestry production.

The most common agro-export crops in Tanzania, also known as traditional export crops, include coffee, cotton, cashew nuts, tobacco, tea, and sisal. Several factors influence the geographical location of these crops and the respective farmer’s choice as highlighted below.

Figure 3.1 : Factors influencing a choice of export crops

Multiple factors influence the farmer's choice of export crops, including:

- Physical factors, such as soil quality and water availability;
- Economic factors such as marketability and input prices;
- Personal preferences of the households;
- Crop profiles, including crop yield and pest resistance;
- Resource availability such as seeds, fertilizer, and machinery.

***Source**: Authors'*

Agriculture account for 29 percent of the country's GDP and 66% of the workforce. In addition, it accounted for 17.6% of total (goods and services) exports. Also, it remains central to Tanzania's industrialization as it provides markets for industrial products and has the potential to provide raw materials for industries, particularly agro-processing.

Tanzania's agro-processing industry is a dominant segment of the manufacturing sector and holds tremendous potential for future expansion. The country benefits from abundant agricultural resources, leaving it well positioned to expand production of cotton, coffee, tea, cashew nut, tobacco, and forestry for the export markets in the regional and global value chains.

Smallholder farmers, who are dependent on rainfall for crops production, dominate the agro-export sub-sectors. Farmers and other sub-sector stakeholders face considerable challenges in enhancing production and modernizing the industry to increase yields, value-addition and exports. Declining commodity prices and volatility, land acquisition hurdles, and smallholder farmers struggling to access economically viable technologies, adequate storage facilities, markets, and credit have affected the main agro-export sub-sector.[4]

Although the agro-processing industry still remains in its early stages, the government's mid-term development agenda, the Five-Year Development Plan II 2016/17-2020/21 (FYDP II), and the subsequent one, 2021/22-2025/26 (FYDP III), targeted a significant increase in agro-processing output, with new policy interventions and rising global demand for Tanzanian products expected to support future increase in investment inflows.

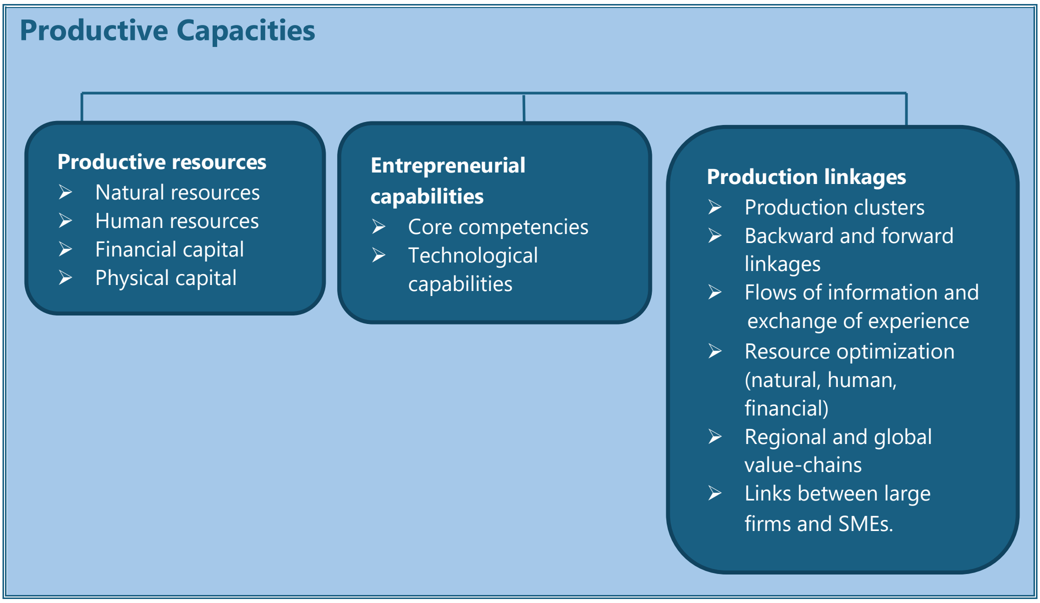
3.2. Importance of developing productive capacities in Agriculture

Like in all economies, the development of productive capacities in agriculture is important in enhancing Tanzania's sustained economic growth and effective integration into the regional and global economies, thereby increasing its share of the benefits of international trade.

Similarly, Tanzania like other developing countries is confronted with the daunting task of developing productive capacities and transforming the structure of its economy in the face of a rapid population growth and a rapidly changing global economic and trade environment. It also encounters constraints on the use of trade policy instruments to foster industrialization, trade expansion, and other national development goals.

The importance of developing productive capacities for economic growth, industrial and trade expansion, and for poverty reduction is evident in the development experience of other countries, such as South Korea, Indonesia, Thailand, Brazil, etc., which have achieved sustained industrial and trade expansion, leading to substantial poverty reduction over the last three decades. The hallmark of their achievements is that they have consciously sought to promote economic growth and trade expansion, through deliberate policies aimed at developing and enabling the expansion of domestic productive capacities, in particular agro-processing. Efforts also involved effective promotion of investment, innovation and structural transformation.

Figure 3.2 : Key components of productive capacities



Source*: UNCTAD—Developing Productive Capacities; LDCs Report 2006*

Figure 3.2 above provides a snapshot of the key components of productive capacities as developed by UNCTAD. In that regard, increased agricultural productivity, accelerated industrialization and building up of international competitiveness in tradable sectors constitutes the basic objectives, which must be pursued in a systematic way, focusing on the real economy targets revolving around the following six pillars[5]:

[5] These pillars are adapted from UNCTAD

The six pillars are the following:

- Setting clear and realistic goals and targets;
- Lifting core binding constraints to the development of productive capacities;
- Addressing issues of policy incoherence;
- Harnessing gender potential for productive transformation;
- Developing, promoting and diversifying exports;
- Making regionalism work for productive transformation.

In line with the six pillars, the potential output of an economy is the maximum aggregate supply of goods and services that can be achieved if all productive resources and entrepreneurial capabilities are utilized efficiently and to the fullest degree. Enhancing productivity is the ultimate engine of growth in the global economy. Raising productivity in the key sectors is, therefore, a fundamental challenge and a key target for all countries going forward.

The growth of productivity, that is, the efficiency with which societies combine their people, resources, and tools in the production is the main driver of the development process for industrialisation and trade expansion, and poverty reduction. Long-term incremental improvements in earnings in industry and/or agriculture, which forms the source of employment and livelihoods for many of the population in the developing countries can be achieved mainly by increasing industrial worker and farmer productivity.

Long-term productivity growth is driven by innovation, investment in physical capital, and enhanced human capital. This requires a growth-friendly environment, with supportive institutions and macroeconomic stability. Innovation, cross-border technology transfer, and expertise in producing complex and sophisticated agro-processed exports have increased in importance, along with demographic factors.

As per Tables 3.1, 3.2, and 3.3 below, productivity gains within each sector of economic activity are primarily the outcome of increased dynamism within production units. Resource reallocation from less- to more-productive firms and activities contributes to agro-industry-level productivity growth. Such is a case for Tanzania, which is a low-middle income market economy with greater market distortions.[i]

Internal drivers: The internal drivers of productivity growth in agriculture include productivity-enhancing organizational features and practices that shape producers' capabilities as summarized in Table 3.1, below.

Table 3.1 : Internal Drivers of Productivity Growth in Agriculture

Technological progress	Technological innovation, driven partly by R&D and complemented by physical capital and producers' skills, will boost labour productivity and output;
	New production techniques allow producers and agro-processing firms to improve product quality and expand the range of marketed products;
Input quality	Higher-quality labour and capital can raise agro-processing's labour productivity measured as output per worker or per worker hour;
	Better-educated, well-trained, and experienced farmers and agro-processing workers tend to be more productive;
	New capital goods enable faster productivity growth, through embodied technical progress.
Management	Good management can improve the efficiency of production. The best managerial practices include setting clear targets, monitoring progress, and rewarding performance.
	Incentives for team production, cross training, work experience, and frequent employee-manager communication can also raise agro-processing productivity.

Source*: Adapted from WB—Global Productivity, Trends, Drivers, and Policies –Edited by Alistair Dieppe --2021*

Key long-run drivers of productivity growth: Historically, sustained labour productivity growth has been driven by innovation, better education, and investment in physical capital. This depends on long-term drivers as outlined in Table 3.2 below.

Table 3.2 : Long-run Drivers of Productivity Growth in Agriculture

Long-run drivers	Innovation and investment by the private sector in agriculture require a growth-friendly environment, with supportive institutions and policies, including policies that promote agro-processing, macroeconomic stability and the rule of law;
	Productivity growth also benefits from expertise in producing relatively complex and sophisticated agro-processed exports, which is associated with international technology diffusion.

***Source**: Adapted from WB—Global Productivity, Trends, Drivers, and Policies –Edited by Alistair Dieppe --2021*

External drivers: These are outside forces that influence productivity within the agriculture sector. These external factors allow producers to improve their efficiency (the "within" effect) and stimulate more efficient producers to improve their efficiency faster than others (the "between" effect). Table 3.3 below summarizes the external drivers of productivity growth.

Table 3.3 : External Drivers of Productivity Growth

Regulatory and operating environments	Institutions and regulations influence agro-processing productivity partly through incentives to invest in human and physical capital, and to acquire technology;
	Agro-processing productivity tends to be lower in poorly regulated markets: weaker enforcement of competition laws can allow a large inefficient firm to drive productive competitors out of the market by abusing its market power; higher barriers of entry can prevent creative destruction;

	Agro-processing firms may be reluctant to undertake costly R&D when competitors, especially those in the informal sector, can infringe intellectual property rights;
	The enforcement of property rights, and public-private partnerships to create technology extension centres in agriculture and agro-processing clusters, can increase firm participation in global value chains and raise productivity;
	Improvements in the business environment and conducive regulatory practices, including fair competition and increased business freedom supports the growth of total factor productivity (TFP) and labour productivity.
Spill-overs and input markets	The presence of highly productive agro-processing firms can have spill-over effects and raise the productivity of other firms and producers in the agriculture sector;
	These spill-overs occur as knowledge and innovation are transferred through trade, financing, and agglomeration channels;
	Flexible and integrated capital and labour markets can promote the reallocation of inputs toward the most productive sub-sectors in agriculture and the respective agro-processing firms.

Source*: Adapted from WB—Global Productivity, Trends, Drivers, and Policies –Edited by Alistair Dieppe --2021*

The effects of different drivers on productivity growth have changed over time. Innovation and experience with economic complexity, related to participation in global value chains and cross-border technology transfer, seem to have increased in importance. So have demographic factors, notably changes in population age structures. In contrast, the importance of urbanization related to the sectoral shift from agriculture to manufacturing and subsequently to services has weakened.

On a more positive note, modern technologies could yet reinvigorate productivity growth, and some of the improvements in drivers already achieved should continue to support growth over the next few decades.

3.3. Significance of a focus on enhancing productivity in agriculture to policy makers

Governments seeking to raise productivity growth in the agriculture sector should, *inter alia*:

- Increase public investment and stimulate private investment in the sector;
- Improve human capital of farmers and agro-processors;
- Foster agro-processing firm productivity, partly through on-the-job training and upgraded management capabilities;
- Increase the exposure of agro-processing firms to international trade and foreign investment;
- Enable the reallocation of resources in the agriculture sector toward more productive sub-sectors;
- Seek to diversify production in the agriculture sector.

The benefits of many productivity-friendly policies could be enhanced by improving the macroeconomic and institutional environment.

Importance of agro-processing & productive capacities for policy makers

- A better understanding of how to promote agriculture-based economic growth: how to start it, to sustain it, and how to accelerate it;
- A better understanding on why some form of economic growth are poverty-reducing than others;
- A better understanding on how to ensure that economic growth supports the objective of poverty reduction.

Productivity-friendly policies for the agriculture sector entails, *inter alia*, improving the following key elements of the macroeconomic and institutional environment.[ii]

(1) Improving the proximate sources of growth

- Meet infrastructure investment needs;
- Remove private sector investment constraints including financial deepening, as credit constraints can hold back private investment;
- Invest in human capital by closing the educational gaps and providing better health care with the view to increase human capital in all agriculture sub-sector and the respective agro-processing firms.

(2) Creating a growth-friendly environment

- Strengthen institutions and government effectiveness--mindful that institutional quality plays a crucial role in growth;
- Mindful that the sector specific productivity gains can stem from policies that limit market power and promote fair competition, more even-handed contract enforcement, simplified and transparent legal systems, and governance reforms that lower political risk;
- Lower transaction costs and increasing trust in institutions;
- Promote gender equality--Improvements in gender equality could raise productivity and income per capita.

(3) Boosting productivity at the firm level

- Foster capabilities of farmers and agro-processing firms;
- Promote domestic and international knowledge diffusion, and enhance the absorptive capacities of firms to support domestic innovation;
- Effective participation in global value chains can improve management, partly through the diffusion of good practices;
- The use of public-private partnerships to create technology extension centers in sub-sectoral clusters can increase firm participation in global value chains and raise overall productivity.

(4) Address informality

- Informal sectors account for about 70 percent of employment in EMDEs, with especially high concentrations in SSA;
- Informal enterprises are often small, inefficient, and relatively unproductive;
- Reallocating capital and workers from relatively unproductive informal enterprises to formal firms could boost aggregate productivity in agriculture.

(5) Innovation and technology transfer

- In the long run, growth relies on innovation;
- Firms innovate by introducing new products and better ways to produce existing goods and services;
- EMDEs and, hence, Tanzania can benefit from the diffusion of technologies across national borders.

(6) Demographic dividends

- One demographic factor affecting labour productivity is the age composition of the labour force;
- Evidence suggests that economies with higher young or working-age population shares adapt more readily to new technologies, skills, and organizational structures.

(7) Institutions

- Economists often regard the rule of law as an especially important determinant of productivity. The rule of law can mitigate violence, secure property rights, preserve institutional checks and constraints on government, and limit state capture and corruption;
- Productivity growth is positively associated with institutional quality, proxied by a rule of law index;
- Productivity growth in economies with relatively good institutions also tends to be more stable than where institutions are weaker.

(8) Macroeconomic stability

- Macroeconomic instability can form a binding constraint, which limits the benefits of other drivers of productivity enhancement;
- In stable macroeconomic environments, the effect of investment on output is stronger, conditional convergence is faster, and measures of institutional quality have more explanatory power as determinants of productivity growth;
- Even for countries with ample buffers, financial instability can be contagious.

(9) Trade

- Most of the evidence on trade indicates that relatively open economies are more productive;
- In addition to gains through exploiting comparative advantage, participation in regional and global markets can enable knowledge diffusion and technology transfer;
- Imports of sophisticated/advanced machinery can directly improve labour productivity at the firm, sector, and country level;
- Exporting firms are often relatively productive, but evidence on the role of exports is complicated by self-selection: other things equal, productive firms are more likely to be competitive and choose to export.

(10) Finance

- Financial depth is often linked with higher labour productivity and faster productivity growth;
- Well-developed financial markets can improve the efficiency of capital allocation and enable firms to make productivity-enhancing investments;
- They may also allow firms to diversify investment risk and increase liquidity, and to stimulate entrepreneurship;
- But financial sector reform is not without risks, because mismanaged deregulation can lead to unsustainable lending booms and banking crises.

Source: *Adapted from World Bank (2021): Boosting productivity in Sub-Saharan Africa: Policies and institutions to Promote Efficiency.*

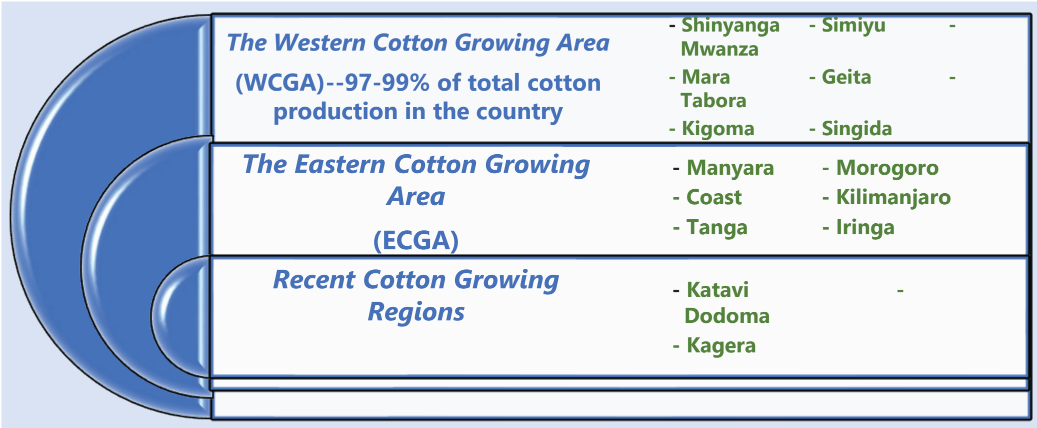
Raising of productive capacities in Tanzania's agricultural sector is imperative as both a growth strategy and a response to the opportunities provided by the changing market configuration. The market for agro-processed products or value-added agricultural commodities is expected to grow significantly over the next three decades and beyond due to population growth and projected GDP growth following the recovery from the disturbances of Covid-19 pandemic and the Russian- Ukraine conflict. Estimates of population growth in the EAC, SADC, and Africa provide the largest opportunity, as is the expected GDP growth in America, Asia, and the BRICS.

The various bilateral trade and investment agreements between Tanzania and other countries and regional trading blocs provides the entry point into securing market access and tapping into the investment potentials emanating with the expected industrial (agro-processing) and trade expansion. However, significant efforts and strategic industrial policy will be needed to enable Tanzania to harness the opportunities and the potentials availed by these trends in these major regional, continental, and global markets.

3.4. Opportunities and Constraints in the Cotton, Textile and Garment Sub-Sector

The cotton, textile and garment sub-sector is a critical source of employment in Tanzania. The sub-sector is composed of a majority of micro, small and medium-sized enterprises, generating large-scale employment – both for skilled and unskilled workers – especially for youth and women. Tanzania has substantial untapped resources for growing cotton—in the three main zones as per Figure 3.3—and for developing a vibrant export-oriented textile and clothing sector.

Figure 3.3 : Main Cotton Growing Zones in Tanzania



Source: *Authors'*

One of the sub-sectors that given priority to contribute to industrial strategy in Tanzania is the textile and garment sub-sector. The sub-sector achieved this status due to deliberate government policies to promote textile industries since the 1960s. Hence, the Tanzanian textile industry well integrated with a mix of processes and products, which includes ginning, spinning, weaving, bed sheets, garments, knitting, woven blankets and related clothing items.

Although many of Africa's textile sectors have struggled in the wake of the end of the multi-fibre agreements, Tanzania's textiles and garment production still holds a significant growth potential, with cotton crops providing a livelihood for up to 40% of the population. Under the FYDP III targets, the sub-sector will expand to create up to 10,000 new jobs and USD1billion of annual exports in FY 2025/26 (URT, 2020).

3.4.1. The Cotton-Textile-Garment Value Chain

Tanzania's textile and clothing value chain has integrated into global production networks, with limited regional linkages. It also benefits from targeted preferential access to global markets that further contributes to attracting investments. While producers in the country benefit from duty-free market access to the European Union through the Everything but Arms (EBA) initiative and to the United States under the African Growth and Opportunity Act, they still need to enhance their productivity and competitiveness to sustainably and effectively take advantage of such opportunities. In the home market, local producers, and manufacturers face difficulties in competing with imported second-hand clothing and cheap imports from East and South Asia.

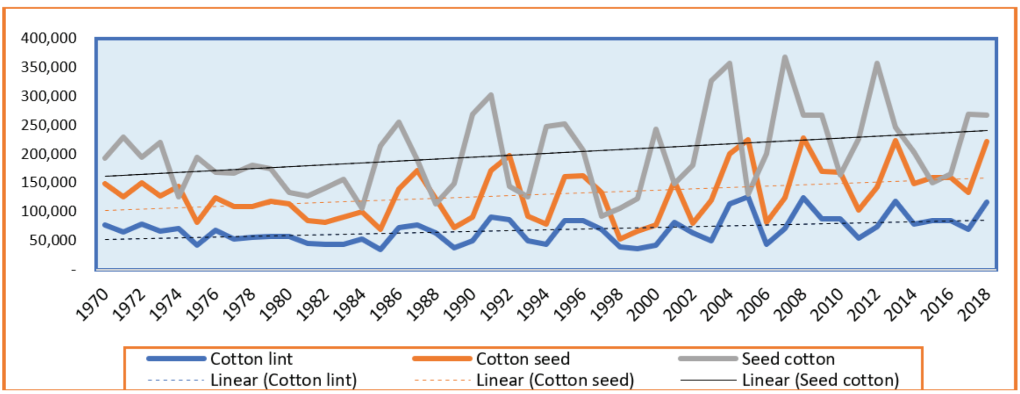
Positive aspects of the textile sub-sector...

- Abundant availability of raw materials--cotton;
- Presence of a complete value chain system;
- Opportunities for competitive cost of manufacturing;
- Availability of large pool of young labourforce;
- Large and growing internal, regional and global markets.

This is despite of the fact that producers continue to grapple with challenges including power shortages, illegal textile imports, and a shortage of semi-processed goods like yarn and fabric, along with broader hurdles such as limited availability of skilled personnel.

Overall, there is high volatility in the production trend of cotton as shown in Figure 3.4. Recently, the highest volume of seed cotton harvest was 356,262 MT in 2012 and 348,775 MT in 2019, but thereafter it sharply decreased to 122,000 MT in 2020. According to the recent data from the Tanzania Cotton Board, the production of cotton for the year 2021 was 145,000 MT.

Figure 3.4 : Cotton Production in Tanzania, in Metric Tonnes



Source: *Ministry of Industry and Trade (MIT)*

The cotton processing capacity is spread across the western and eastern main cotton growing zones as per Table 3.4 below. Hence of the country's ten (10) textile mills two (02) are in the western cotton growing zone

(Mwanza and Shinyanga), four (04) in the Eastern cotton growing zones (Morogoro and Arusha), and four (04) in the coastal zone of Dar es Salaam.

Table 3.4 : Status of the textile and garment industry by market orientation

Textile Industry	**Products***	**CGA Location**
Western cotton growing area		
Mwanza Textiles Mills LTD (MWATEX)	Spinning, weaving, local fabrics for **domestic use**	WCGA - Mwanza
Dahong Textiles Tanzania LTD	Cotton yarn for **export to China**	WCGA - Shinyanga
Eastern cotton growing area		
21st Century LTD/Metal Afritex LTD/MUTEX	Yarn and woven fabric for **local and export sales**	ECGA - Morogoro
Mazava Garments/Fabrics LTD	Producing sportswear for **AGOA (export)**	ECGA - Morogoro
Sunflag Tanzania	Yarn, fabrics, and garments for **local and export sales**	ECGA - Arusha
A to Z Textile Mills	Mosquito nets; Other (mainly packaging), Knitting of cotton fabrics, Tees, and polos for **export (AGOA) and local sales**	ECGA - Arusha
Dar es Salaam		
Namera LTD/ Nida Textiles LTD	Production of fabrics for **local and export sales**, K-K-K, Bed linen	Dar es Salaam
Open Sanit Enterprise	Trading in security products and workwear with some sewing and boot-making--**for local sales**	Dar es Salaam
Tanzania TOOKU Garments LTD	Men's jeans, T-shirts, and polo shirts for USA market, under **AGOA (export)**	Dar es Salaam
Urafiki Textile (suspended production)	Local fabrics for **domestic use**	Dar es Salaam

**Most textile mills have a good export capacity—seven out of ten*

***Source:** Ministry of Industries and Trade*

3.4.2. Growth Opportunities for the Enhancement of Productivity in the Cotton, Textiles, and Garment sub-sector

The sub-sector is engaged in manufacturing and exporting of cotton products ranging from lint and yarn to textile and clothing. To strengthen its competitiveness, it is expected that players will, *inter alia*:

1. Maintain and upkeep all requirements of SA 8000 standards;
2. Comply with national and other applicable laws and other requirements to which the sub-sector subscribes to;
3. Comply with collective bargaining agreements;
4. Respect the international and local interested parties in the business.

The potential of the actors in the sub-sector to ensure high quality and competitive products depends on how the opportunities can be realistically realized, and the extent to which the key challenges are addressed. Table 3.5 provide a summary of the opportunities for this sub-sector.

Table 3.5 : Growth Opportunities for the Productive Capacities in the Cotton &Textiles sub-sector

Area	**Opportunities**
Production of raw cotton	Enhance the production of raw cotton for industrial processing, industrial raw materials and for export.
Production of main textile products	Enhance production of main textile products by local companies; main products include:
	i. Garments • Manufactures all type of Men's, Ladies, Kids and Baby wear including tops, bottoms, jackets, and knitwear products. • 100% certified organic cotton products available and exported to USA, Europe, India, and other export markets.
	ii. Yarns with some selected companies producing: • Ring spun yarns – both combed and carded. • Single and double yarns from Ne 16/1 to Ne 40/1. • All yarns are electronically cleared, auto coned and spliced by Schlafhorst 338 autoconer.
	iii. Knitted Fabric

	• Greigh, PFD (prepared for dyeing) as well as dyed in combed and carded. • 100% cotton single jersey, interlock, pique, fleece, rib, drop needles, etc. • Fabric with spandex / elastane. • Polyester cotton blended fabric. • Yarn dyed feeder stripe and auto striper in single jersey and pique.
	iv. Mosquito Nets • 100% polyester warp knitted mosquito nets. • ITNs (insecticide treated nets) and untreated nets. • Treatment kit or re-treatment tablets as per requirement.
	v. Woven Fabric • 100% cotton fabrics, 100% polyester fabric as well as various blends of polyester, viscose and cotton in 36″ to 72″ finished width. • Household linens like bed sheets, tablecloths, curtains. • Traditional East African wear like Kikoi, Masai Shuka, Kanga and Kitenges, and Grey Fabric and Bedsheets.
Modernization of technology	Enhance modernization of technology in the key factories and farms;
	Technology – investing in new machines to replace the bulk of the old machinery at the factory—in the process of renewal;
Strengthen the workforce	Build and strengthen internal capacity to train newly recruited workers for 4-6 months for basic training and through international training facilities;
	Incorporate university internships.

3.4.3. Underlying Challenges against the Enhancement of Productivity in the Cotton, Textiles and Garment Sub-sector

Table 3.6 provides a summary of key productivity challenges and constraints that limits the potential of the textile's subsector.

Table 3.6 : Key Productivity Challenges and Constraints facing the Textiles sub-sector

Challenge/Constraint	Description
Declining production of raw cotton	Declining production of raw cotton because of bad projection by farmers and the Tanzania Cotton Board, varying weather conditions, and resource demands for production of other cash crops and food products;
Low supply of cotton raw materials	Low and poor quality of supply of cotton raw materials from farmers and spinning plants;
	Declining production of raw cotton by farmers;
	Continued exportation of raw cotton by cotton exporters, sometimes breaching their domestic contractual commitments;
	Local yarn not suited for textile products for the export markets;
Low-capacity utilization	Low-capacity utilization in most textile mills; necessitating borrowing to sustain operations due to lack of sufficient cotton;
Logistical constraints	Chemicals are mostly imported from India and China, subject to stringent, costly and sometimes complex import processing procedures;
	Power shedding by TANESCO, which is quite often and without advance notification;
	Electricity quite expensive at approximately USD 0.10/unit;
Manpower	Lack of readily available skilled manpower;
	Lack of skilled workforce paralleled by high costs of training;
	Industrial skills of the workforce remain a major challenge;

Inadequate government and policy support	High turnover of Senior Officials at the key government ministries that creates policy instability and unpredictability;
	Low trust between government officials and the private sector undermines the credibility and effectiveness of public-private dialogue;
	While the 2020 import tariff hike on some textile products encouraged domestic production, undervaluation of imports in subsequent years reduced the impact of tariffs;
	Lack of incentive packages for the local agro-processing industries to effectively enable them compete in the international markets;
	Lack of transparency between government institutions and agriculture & agro-processing industry leading to limited benefits of dialogue among the parties.

3.4.4. Some Policy Recommendations

Overcoming these productivity and related constraints will help enhance growth of Tanzania's cotton production, agro-processing facilities, consumption, exports, and earnings to levels envisaged in the FYDP III targets (for 2025/26) and other policy documents. Some of the changes that need to be introduced and enhanced include:

- Farmers and processing firms must share their best experiences and constraints with one another;
- Necessary production inputs and equipments must be availed to farmers and processing firms in need at the appropriate time;
- Newly learned techniques or information about farming and processing must be shared with farmers and processing firms;
- Women farmers must be given equal opportunities in this male-dominated cotton farming system.

Therefore, farmers, buyers and processing firms are under pressure and must face complex issues to ensure the sustainable development of the cotton and textile sub-sector: higher productivity, better quality, better exports, better local sales, and better incomes - at national and international level.

3.5 Opportunities and Constraints in the Coffee Sub-Sector

Coffee is one of Tanzania's primary agricultural export commodities, accounting for about 5% of total exports value, and generating export earnings averaging USD 100 million per annum over the last 30 years. The industry provides direct income to more than 400,000 farming households thus supporting the livelihoods of an estimated 2.4 million individuals. It is estimated that over 320,000 smallholder farming households are responsible for between 90% and 95% of the coffee production in the country. These families farm an average area of 0.5 to 1.0 hectares each, with the remaining 5-10% of all coffee produced by some 110 estates. An estimated two million additional people employed either directly or indirectly in the Tanzania's coffee industry.

3.5.1. The Coffee Value Chain

Tanzania has a long tradition of coffee growing being the Africa's fourth biggest producer of coffee, behind Ethiopia, Uganda, and Cote D'Ivoire. The country has abundant land with appropriate altitude, temperature, rainfall, and suitable soil for high quality arabica and robusta production. Since the 19th century, coffee has been one of the most important exports in the country. Although it accounts for only 0.7% of the global coffee trade, it remains one of the largest export crops in Tanzania. In recent years, however, traditional export crops, including coffee has been overtaken in their export contribution by non-traditional exports, including tourism, minerals, and transport.

That notwithstanding, the global market for coffee has undergone radical changes that have shaped the competitiveness of the coffee sub-sector in Tanzania.

The three main factors affecting coffee production include:

- The collapse of the International Coffee Agreement's quota system since 1989;
- Liberalisation of coffee marketing in Tanzania in the 2000;
- Technological advances in roasting and blending of coffee.

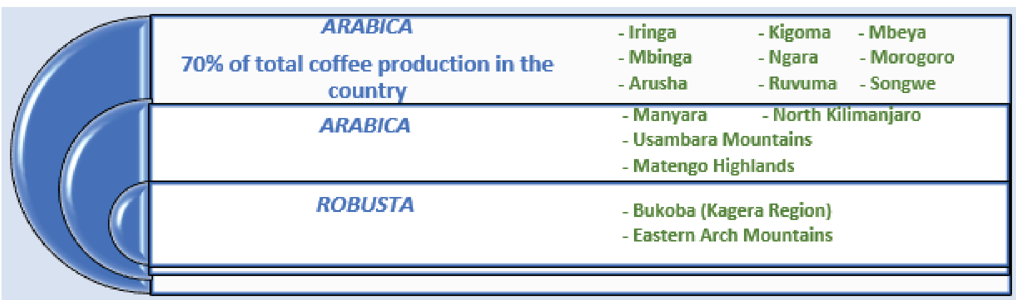
Technological advancements have enabled the global coffee roasters to adjust their blending so that more of lower-cost coffee is used, undercutting competitiveness of Tanzania's natural premium quality coffee. There have also been large increases in production by both traditional and new suppliers such as Brazil and Vietnam, respectively. The outcome of these changes has seen segmentation of the coffee market between mainstream markets on the one hand and emergence of differentiated niche markets (specialty coffee markets) in developed countries. As a result, despite Tanzania's unique potential to compete due to its favourable geographical advantage to produce mild Arabica other than the Tanzania Peaberry Coffee of Kilimanjaro, it has been trapped into supplying low-quality mild Arabica, and growers are easily squeezed out of the global market by the availability of high-quality Robusta.

Hence, the average yearly production over the past thirty years had stagnated at a level of about 50,000 MT, and yields had continuously decreased. The high-quality potential has not been fully exploited, thus contributing to low farm gate prices, and the slow reduction in rural poverty in the key coffee growing areas. Despite the significance of the coffee sub-sector in Tanzania, the local coffee industry has faced challenges in recent years, with yields falling since a peak in the late 1990s. However, as the subsequent sections of this chapter indicate, there are signs that recent efforts by the Government to improve coffee promotion and exports are beginning to reverse these trends.

The main coffee growing regions are as per Figures 3.5 and 3.6 below. Around 90% of the farmers are organised in cooperatives - such as the Kilimanjaro Natives Cooperative Union (the first in Africa), the Arusha Cooperative Union, Bukoba and Karagwe Cooperative Unions, etc. These agricultural and marketing cooperatives are dealing with the production, processing, transport, and marketing of the coffee.

The private estates producing coffee have a bigger land surface and a larger capacity of production. These farmers have a full control of the process and thus of the quality of their product. They can also offer a full commodity traceability, which makes a critical difference in the specialty market.

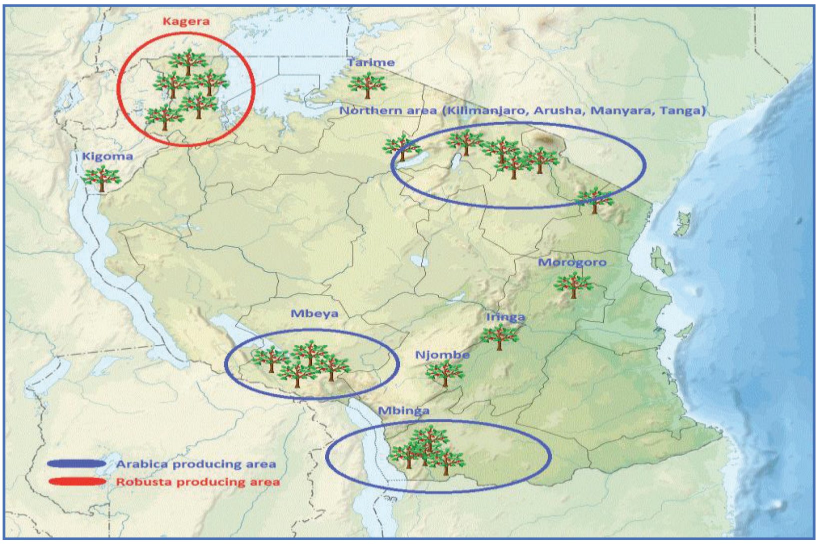
Figure 3.5 : The Main Coffee Growing Regions of Arabica and Robusta coffee



Tanzanian arabica coffees are grown on the slopes of Mount Kilimanjaro and Mount Meru in the Northern areas, under the shade of banana trees. In Southern Highlands of Mbeya and Ruvuma regions coffee is intercropped with bananas and some areas are pure stand. The slopes of

Mt. Kilimanjaro and Mt. Meru, which rise to altitudes of 1,000-2,500 meters above sea level, produce the largest share of the arabica coffee. An estimated 90% of Tanzania's mild arabica comes from smallholder farmers, while the remaining 10% comes from large coffee estates. Arabica coffee makes up to 70% of total country production. Robusta coffee grown in the western areas along Lake Victoria in Kagera region constitutes 30% of the total coffee production in Tanzania.

Figure 3.6 : Coffee producing areas in Tanzania



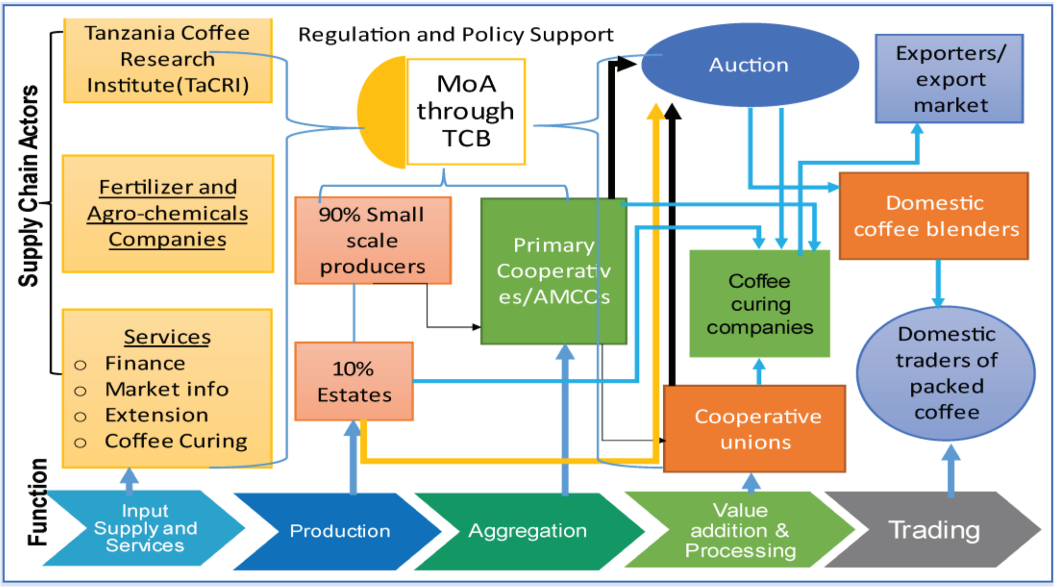
Source: *Tanzania Coffee Industry Development Strategy 2011/2021.*

Tanzanian arabica is classically associated with the washed coffee profile: clean, bright, and floral. Northern coffees tend to have a pleasant aroma, a rich acidity and mouthfeel, and a sweet, balanced taste. These characteristics are derived from the mineral nutrients found in the region's mountainous volcanic soils. Southern coffees, meanwhile, are characteristically medium-bodied with fine acidity. They have good fruity and floral aromas and flavours.

The regions around Lake Victoria, at moderate elevations of 800–900 meters above sea level, particularly in the Kagera region, are synonymous with Tanzania's robusta coffee. Two new species were found recently in Tanzania's Eastern Arc Mountains, *Coffea bridsoniae* and *C. kihansiensis*. Harvest time is traditionally October to February.

Germany was once the major customer of Tanzanian coffee, but with enhanced marketing and quality control, Japan and the United States have begun to purchase the lion's share of exports. The latest (for the period 2017-2021) and very expansive coffee value chain is indicated in Figure 3.7 below.

Figure 3.7 : Tanzania's Coffee Value Chain Structure and Actors



Source: *The Role of Coffee Production and Trade on Gender Equity and Livelihood Improvement in Tanzania, Sustainability 2021*

The direction of the arrows shows the movement of services and/or coffee product from one supply chain actor to another. Actors under the same node of the supply chain are shown using the same colour.

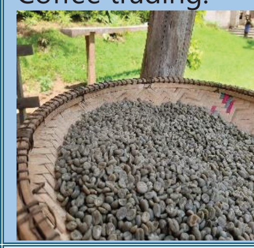
Overall, the sub-sector faces a gamut of interrelated challenges across the entire value chain.

The major constraints to	• Erratic weather due to climate change;
	• Poor agronomical practices exacerbated by weak extension services;
	• Low productivity due to aged trees;
	• Low use of inputs;
	• Low multiplication of improved seedling varieties;
	• Institutional and regulatory bottlenecks;
	• A long value chain with several intermediaries;

competitiveness and export growth are:	• An inefficient marketing system encumbered by middlemen that depress farm gate prices on one hand, and an oligopoly of related firms that dominate trade, thus affecting prices at the coffee auction
	• Long transit times due to port delays.[6]

Coffee farmers also lack the tools, training, and bargaining power to create a profitable business, and women suffer the most. Women contribute to the bulk of coffee-related labour force but are restricted in access to land, coffee trees, or financial resources.

Table 3.7 : Coffee processing factories in Tanzania

Region	Coffee Processing Factory	Processed Coffee
Kagera ***Robusta Coffee***	Tanganyika Instant Coffee Public Limited Company (TANICA PLC)	Pure Instant Coffee—the Kilimanjaro Blend—and Roasted Beans. 
	Buhaya Coffee	Processing and selling of roasted ground coffee, and roasted coffee beans.
Kilimanjaro ***Arabica Coffee***	Choice Coffee Co. Ltd	Specialty Green Coffee and Roasted Coffee trading.  
Arusha		Coffee roasting, grinding, and packing.

[6] REPOA-- Competitiveness and diversification of traditional agricultural exports along the Southern, Western, Central and Northern Corridors—Value Chain Analysis for Coffee and Sisal; 2019.

Arabica Coffee	Tanzanite Coffee Limited	
	Arusha Coffee Mill /Coffee Exporters Ltd	Milling of P1, P2, P3 and Cherry Mbuni. Warranting and promoting for sale at auction.
Mbeya *Arabica Coffee*	Mlowo Coffee Industry	Processing / curing of parchment coffee.
Songwe *Arabica Coffee*	Mbozi Coffee Curing Company	Processing / curing of parchment coffee.
Morogoro Arabica Coffee	Mambo Coffee Company Limited	Coffee sourcing from small farmers / cooperatives and Coffee Auction (Moshi).
Dar es Salaam Arabica & Robusta Coffee	AFRITEA & COFFEE BLENDERS 1963 LTD	Tanzania's largest coffee packing company; packing instant coffee powder; and roasting, grinding, and packing pure coffee 
Songea *Arabica Coffee*	Magic Bean Coffee Factory—Café Business Consult Ltd.	Roasted and Ground Coffee 

The ten coffee processing factories as shown on Table 3.7 ensure that the coffee they export meets consumer requirements by ensuring traceability and good hygiene, good farming and proper post-harvesting handling as per the International Standards Certification and that all the coffees are inspected, analysed and certified prior to export. Therefore, they care about coffee farming, handling, logistics, and final delivery.

About 90% of the Arabica produced in the country undergo wet processing (washed). After processing and drying, coffee is then graded. Tanzania has its own grading system with a dozen individual grades: AAA, AA, A, B, PB, C, E, F, AF, TT, UG, and TEX. Tanzania opted for the British nomenclature of grading according to shape, size and density. Robusta, however, is typically naturally (dry) processed and graded according to size after drying.

3.5.2. Growth Opportunities for the Enhancement of Productivity in the Coffee Sub-Sector

Tanzania, one of Africa's top four coffee producers in Africa, has growth opportunities to step up its coffee output, and the latest statistics proves so. Coffee production in Tanzania was 1.25 million bags[7] in 2019/2020 and forecasted to increase by 3.7% in the 2021/2022 season to reach 1.4 million bags during the 2021/2022 season (TCB/USAD, 2024). Table 3.8 provides a snapshot of opportunities for enhancing the coffee-processing led productivity in the subsector.

Table 3.8 : Growth Opportunities for the Productive Capacities

Productivity enhancement is on the move	Analysis indicate that productivity enhancement is on the move and, as a result, production is growing thanks to two main factors:
	➢ increased use of fertilizers, as more growers gain access to credit from financial institutions, and
	➢ better operations among coffee marketing co-operatives;
Factors supporting enhancement	Other factors supporting enhancement are improved support from the government's agricultural extension services;
	The timely entry of new coffee trees into the most productive period of their two-to-three-year yield cycle;
	The upward trend in production on Tanzania's total coffee farming land area of 265,000 hectares

[7] The standard bag of coffee is 60 kilograms.

Domestic reforms and international demand	gained momentum from domestic reforms and international demand;
	➢ Farmers are now motivated to grow quality coffee thanks to new regulations that allow them to directly enter contracts with foreign buyers to eliminate middlemen, thereby increasing profitability for growers;[iii]
	➢ Foreign buyers often require growers to adopt practices such as stumping, pruning, weeding, mulching, and fertilizing to help ensure quality production, and as these practices proliferate in Tanzania, yields will rise;
	➢ Additionally, many coffee-growing regions are expected to enter the most productive period of their crop-bearing cycle, increasing yields every two to three years;
The 2021–2025 strategic plan of the Tanzania Coffee Board	The following four thrusts were identified under this strategy: i. Increased productivity, ii) enhanced internal marketing process and business environment, iii) improved quality, and iv) development of new markets including sustainable coffee;
	If the strategy is fully implemented, Tanzania's coffee output will increase further, which targets production of 5 million bags during the next four years.
	This is estimated to bring in additional revenues of at least US$150 million per year to the coffee industry through export earnings; with 75% distributed to coffee farmers, almost doubling the coffee incomes of about 400,000 households—hence contributing to the reduction of poverty and enhancing the sustainable capacity for self-improvement of the coffee industry;
	The strategy calls for distributing at least 20 million seedlings every year and lifting the share of

	specialty coffee from 37% of production now to 70% by the end of the 2024/2025 coffee year;
Activities of various non-governmental organizations	The plan's objectives are partly supported by the activities of various non-governmental organizations such as Vi-Agroforestry, Hanns R. Neumann Stiftung, Solidaridad, Mark Up, and Agricultural Non-State Actors Forum (ANSAF) that are implementing a number of small-holder support projects financed, *inter alia*, by the European Union and Sweden;
	The project will equip at least 24,000 new coffee farmers with skills on coffee production, postharvest, and marketing;
	The initiative will also "strengthen 60 coffee primary cooperatives actively working in the targeted areas and transform them into centres for providing and disseminating agricultural inputs, technology, and information;
TCB's intensified campaigns to promote higher domestic coffee consumption	Tanzania Coffee Board (TCB) also intensified campaigns to promote higher domestic coffee consumption currently estimated at a modest 50,000 bags;
	TCB targets to increasing local consumption to reach 15% of the nation's coffee output within the next 10 years;
	Local consumption is partly constrained by consumer preference in Tanzania for drinking tea rather than coffee due to the history, tradition, and the relatively lower cost of tea;
	On a per-capita basis, Tanzania's annual consumption of coffee is a mere 0.6kg, compared, to 3.4kgs in the country's leading coffee export destination, Japan.

Sources: *Mtaki, B., M. Snyder, and J. Wrobel, (2022). USDA Annual Report on Tanzania Coffee Industry.*

3.5.3. Underlying Challenges against the Enhancement of Productivity in the Coffee Sub-Sector

Although Tanzania's coffee industry is on a growth trajectory for the last few years, both the government, through TCB, and private-sector coffee stakeholders need to combine efforts to address persistent challenges facing the coffee industry highlighted in Table 3.9 below. Yields have in general decreased, and quality and productivity potential are not fully exploited, thus contributing to low farm gate prices, and the slow reduction of rural poverty. Since the late 1990s, production figures have stagnated, and sometimes fallen, in various parts of the country, settling somewhere around 50,000 metric tonnes. They reached a brief peak in the mid-2000s, but broadly speaking, the industry has struggled to enhance its productivity and increase its production volumes, save for the ongoing public investments and efforts to stimulate production expansion.

Table 3.9 : Key Productivity Challenges and Constraints facing the Coffee sub-sector

Low usage of fertilizers	Low usage of fertilizers and inadequate agricultural inputs (fertilizers, pesticides, fungicides), though increasing slowly, fertiliser and pesticide use are low, leading to rampant pests and diseases;
Underutilization of research findings	Underutilization of research findings, leading to poor farm maintenance practices such as insufficient pruning and stumping of trees;
Coffee wilt disease	The arrival of coffee wilt disease in 1997 and poor management of pests and diseases; this disease (which affects both arabica and robusta plants) is caused by the *tracheomycosis fungus*, and results in the irreversible death of the coffee plant;
	Since the late 1990s, coffee wilt disease and several other environmental challenges including low moisture content have meant that individual plant yields have decreased;

Low farmgate prices	Farmgate prices in Tanzania remain low. Highly volatile coffee prices and other factors cause dramatic fluctuations in Tanzania's coffee production;[iv]
Aged coffee plants	Coffee plants are broadly very old with low yields, many older coffee trees in Tanzania cannot realise their full potential of yields;
Infrastructure	Infrastructure is also an issue. Lack of access to mechanised irrigation systems is one of the biggest challenges facing smallholder farmers, who often struggle to source water at critical periods during the growing season;
	Further, some areas are quite isolated, and transport is difficult (roads, railways);
Poor agricultural practices	Tanzania also suffers from poor agricultural practices in many cases because of insufficient extension services and technical support; shortage of skills among extension workers for better agricultural practices;
Lack of a prominent local coffee culture	Most Tanzanian coffee is exported, and very little remains for the underdeveloped internal market
The complex and high tax structure	Taxes are relatively high at 10-20% which decreases further investment in the sub-sector and continues to erode a significant portion of the gains made by the industry. The tax structure includes input-related taxes, other indirect taxes (local levies?), and sector- and economy-wide distortions that affect the profitability of the sector;
Intrusive licensing procedures	Licensing procedures are too intrusive and heavy administrative fees (licenses) does undermine trading capacities;
Government has become too	Government has become too involved in the coffee market, contributing to its inefficiency (negative impact of overregulation);

involved in the coffee market (overregulation rather than growth support)	Lack of strong support from government and development partners in terms of GAP training to raise productivity and quality, and in improving marketing systems to stabilise prices and strengthen farmer intermediary organizations;
	The coffee sub-sector lacks a political champion, who can raise the profile of coffee and attract resources to develop the sector at levels that are comparable to what has been achieved by other high-growth sub-sectors like horticulture or the multi-donor-supported Southern Agriculture Growth Corridor of Tanzania (SAGCOT) initiative.

3.5.4. Some Policy Recommendations

Overcoming these productivity constraints will help ensure that the growth of Tanzania's coffee production, consumption, exports, and earnings remain on track. Some of the changes that needs to be brought into stream include:

- Enabling farmers to share their experience with one another;
- Necessary inputs and equipment must be availed to farmers and firms in need at the appropriate time;
- Newly learned techniques or information about their farming must be shared with other farmers;
- Women farmers must be given equal opportunities in this male-dominated coffee farming;
- Increasing farmers and processors financial returns as an incentive to use legal marketing channels and reducing the regulatory burden

Through a combination of efforts by co-operatives and the government, Tanzania's national average yield is expected to increase from the current 250kg/ha to 600kg/ha (TYPICA 2025) as productivity enhancing initiatives take shape. Therefore, farmers, buyers and institutions are currently all under pressure and must face complex issues to ensure the rapid and robust development of the coffee industry. Under the current political context, dialogue and collaboration between the different stakeholders seems necessary to find the best suitable solution to enhance productivity in this sub-sector sustainably.

3.6. Opportunities and Constraints in the Tea Sub-Sector

Tea is among Tanzania's main agricultural products along with coffee, cotton, cashews, cloves, tobacco, rice, sugar, pyrethrum, and maize. Tea is a generator of wealth and employment to rural areas and supports the wellbeing of over 50,000 families in Tanzania. In Tanzanian, tea is grown under two systems: smallholder production on plots averaging less than a hectare, and large estates production, which often exceed 1,000 hectares per farm. It is also grown in the three main regions as indicated in Figure 3.8 below.

Tea is one of Tanzania's major traditional export crops, contributing about $30 million to the country's export earnings annually. Despite the sector's early success, nationalisation of the estates along with neglect of the smallholder sector made it clear that only broad-based policy reforms would revive the sub-sector. Much of Tanzania is too dry for tea and only 22,000 hectares of the total land area is under tea cultivation, equivalent to around one tenth of the area under tea cultivation in the neighbouring producing country, Kenya.

Figure 3.8 : The Three Main Tea Planting Areas in Tanzania

3.6.1. The Tea Value Chain

The Tea Authority promoted smallholder tea production, typically on plots of about a third of a hectare. Smallholder tea production in Tanzania was supported by the donor community especially two World Bank operations. The first is a USD 1.4 million loan in 1966 – part of an agricultural credit project – and the second a USD 7.1 million loan in 1972. Smallholder production increased considerably, accounting for about a quarter of Tanzania's tea production during the early 1980s and as much as 29 per cent in the 1985/86 season.

Most of the smallholder tea leaf is processed by eight factories owned by the Tea Authority. The rest is processed by factories owned by the estates. Table 3.10 lists the seventeen (17) existing tea-processing plants by location.

Table 3.10 : Tea Processing Plants in Tanzania

Region		Tea Processing Plant
Mbeya	1	Wakulima Tea Company
	2	Mwakaleli Tea Company –Lugomba
Njombe	3	Unilever Tea Tanzania
	4	Lupembe Tea Factory – Mfrika
	5	Luponde Tea Factory – Luponde
	6	Mlangali Tea Estates—Ikondo
Iringa	7	Unilever Tea Tanzania Ltd, Lugoda Factory, Mufindi
	8	Kibwele, Unilever Tea Tanzania Ltd.—Lufuna
	9	Kilima, Unilever Tea Tanzania Ltd—Lufuna
	10	Dabaga Factory –Ilula
Kagera	11	Maruku Tea Factory—Bukoba
	12	Kagera Tea Company Ltd. – Bukoba
Tanga	13	Dindira Tea Factory – Hakaro, Usambara
Dar es Salaam	14	Tanzania Tea Blenders in Dar es Salaam
	15	Chai Bora –Dar es Salaam
	16	Afritea & Coffee Blenders 1963 Ltd – Dar es Salaam
	17	TATEPA – Dar es Salaam

Despite its apparent success, as early as the mid-1980s there were signs of trouble in the smallholder tea sector which materialized in the early 1990s when smallholder tea production fell rapidly. By the mid-1990s, the share of smallholder tea had dropped below 10 per cent and by 1998 it had fallen to 5 per cent, the lowest level since tea was introduced as a smallholder crop in Tanzania.

Contributing to the decline were:

- Low prices and late payments by the Tea Authority,
- Ineffiecient processing factories,
- Inadequate use of inputs,
- Rundown transport equipment and roads connecting farms to tea factories (feeder roads),
- Declining yields because of a failure to switch to high-yielding varieties.

In addition, the Tanzanian Government gave no incentives to factory or plantation workers to become more productive. Government tea research programmes were underfunded which hampered any progress in tea cultivation techniques, soil maintenance and clonal plant development. The tea industry was close to collapse when the government decided to privatise the tea estates and factories it had previously nationalised. Investments have been made in these factories to ensure their future success.

Reforms in the tea sub-sector started much earlier than reforms in other export crop sub-sectors, undertaken and owned by both the government and the industry and have been successful. There has been considerable supply response, tea quality has improved, and the research system has been highly successful in developing and disseminating useful research findings to both estates and smallholders. As a result, tea production increased from 9,182 tonnes in 1971 to 46,058 tonnes in 2020, growing at an average annual rate of 4.12%. However, some issues remain to be addressed, namely excessive taxation, over-regulation, and the trade policy environment.

A number of factors can be attributed to the success of the reforms. Foremost, both the nationalised estates and the smallholder sector reached a state of collapse. Therefore, reforms appeared not only to be the only feasible alternative but there was also no opposition to reforms since there were no potential losers. Further, the fact that the estates, which were under private management and ownership, were highly successful indicated that the poor performance of the nationalised estates and smallholders reflected bad management and poor policy choices rather than external factors.

Despite the successful outcomes, the reform agenda is by no means complete. Reducing taxation and streamlining the tax code will certainly induce further supply response, as more resources will remain within the sector. Reforming trade policy is also essential. In addition to the benefits to be realised by poor rural households, reducing the tea industry's trade barriers will increase regional cooperation. Finally, the power of the Tea Board and the relevant ministries should be limited to activities such as collecting and disseminating market information and statistics and enforcing regulations that contribute to a friendly investment climate.

3.6.2 Opportunities for productivity growth in the tea sub-sector

The growing global population is indicative of the growing demand for tea globally. Tanzania will need to take advantages of the opportunities for increasing its share of tea exports by raising productivity and making the tea industry competitive. Table 3.11 provides a summary of the opportunities for enhancing productive capacities and competitiveness of the Tanzanian tea sub-sector.

Table 3.11 : Enhancement Opportunities for Productivity in the Tea sub-sector

a. Productivity enhancement for processing and export	The authorities are targeting to raise production and productivity of tea and tea products over the next five years;
	Improvement of extension services, supply of quality seeds, distribution of pesticides and insecticides are among the Government's measures;
	To that end, the Tea Board of Tanzania (TBT) is targeting to enhance productivity in the five regions: Iringa, Njombe, Mbeya, Tanga and Kagera with the view to increase the current cultivated land from 22,721 hectares to 25,000 hectares;

	Tea processing is carried out by 19 factories owned by large scale farmers and 4 factories jointly owned by smallholding farmers in the key tea production regions;
	In support of that process Unilever Tea Tanzania Ltd (UTT) has set up an USD 8 million processing factory in Njombe (Southern Tanzania) and is supporting farmers with best production practices, seedlings, fertilizers and extension services;
b. Expansion Through the Block-farming model	Unilever, The Wood Foundation Africa (TWFA) and Gatsby Africa (GA) established a farmer services company – the Njombe Out-growers Services Company (NOSC) – to provide farmers with patient capital as well as ongoing agronomy support, access to inputs and logistics support.
	The TWFA and GA have been in partnership since 2009 through the Chai initiative, a joint venture aimed at transforming the Tanzanian tea sector;
	The Njombe Model and Vision provides an example of how a greenfield development may be de-risked to allow an international tea company such as Unilever to partner with smallholder farmers in a long-term venture; it involves three pillars: a) Farmers providing a supply of green leaf to Unilever at requisite quantities and quality; b) Unilever in turn providing a guaranteed market and committing to pay farmers based on quality; and c) The Chai initiative supporting the relationship through the provision of professional services to farmers;
	It also demonstrates how credit, alongside professionally delivered farmer services may overcome traditional barriers for entering tea production, such as the logistics associated with

	fragmented supply, capital, and affordable access to inputs and services;
	The block farming model employed by NOSC provides a potential blueprint for structuring smallholder farmer production that allows for improvement in terms of productivity, quality and efficiency;
	The block farming model's aim is to demonstrate how a partnership approach between farmers, a private sector investor (in this case Unilever), government, donors (in this case the UK Department for International Development (DFID) – currently known as FCDO, and philanthropic investors can overcome the challenges of a tea greenfield development, developing a sustainable industry that puts the interests of local farmers and communities at the heart of its model.
	The Njombe project has the potential to deliver truly sustainable change in the livelihoods of smallholder farmers and provide a replicable model in other regions and sectors. TWFA and partners have already used this model at two other greenfield investments in Rwanda, with a further two in the planning stages.
c. Other initiatives	The Chai initiative is also supporting a pilot block irrigation scheme to explore a feasible solution for smallholder tea irrigation which can be scaled up and replicated to further improve productivity;
	Chai partners and NOSC trialled mechanised harvesting, as well as providing workforce incentives and training programmes to overcome the labour challenge.

3.6.3 Underlying Challenges against Productivity Enhancement in the Tea Sub-sector

The government attempts to revive the sector by privatizing and rehabilitating two tea estates; restructuring the Tea Board; privatizing the 6 public tea factories; and revamping public research on tea have had some successes, but much remains to be done to fully revitalize the tea sector.

Underlying challenges to address as per Table 3.12 include: improving productivity of all farmers and processing plants; improving the economics of tea production for farmers relative to other crops; stimulating investment in a sub-sector that requires significant upfront costs and long payback periods; issues regarding labour conditions; and service efficiency issues related to coordinating and managing smallholder supply.

Table 3.12 : Key Productivity Enhancement Challenges and Constraints facing the Tea sub-sector

a. Inputs and price levels are main challenges for farmers	The main challenges tea farmers face in relation to the supply of agricultural inputs such as fertiliser and herbicides: they are (too) expensive, not available or not supplied in time;
	Processors are not receiving the necessary and sufficient green tea raw materials to operate efficiently, minimise costs and sustain productivity levels;
	The ability of the processors to offer premium prices to farmers is limited;
	A low yield does not provide farmers with the capital to sufficiently invest in the productivity of their crops through measures such as applying fertiliser, insecticides, etc.
	In some parts of Tanzania, the systems required to support higher smallholder tea production have simply broken down; such that farmers lack the inputs and the information to support the

	improvement of farming practices and to improve yields and productivity;
b. Competing land use demands	In the key tea growing areas there are competing land use demands for forestry, tourism, tea, avocado, mining and subsistence agriculture. This signify that land use planning will be vital in securing land for future tea cultivation;
c. Infrastructure is still inadequate	Poor infrastructure or high transportation costs is an overriding constraint in this sub-sector;
	Infrastructure—especially the lack of access to mechanised irrigation systems is one of the biggest challenges facing smallholder farmers in this sub-sector, who often struggle to source water at critical periods during the growing season;
	Further, some areas are quite isolated, and transport is difficult (roads, railways);
d. Poor agricultural practices	Tanzania also suffers from poor agricultural practices in many cases because of a lack of extension services and technical support; shortage of skills among extension workers for better agricultural practices;
e. Practice of side-selling	The practice of side-selling of low-quality green leaf continues to pose a challenge to the system NOSC and Unilever have introduced in Njombe;
	Tea rejected by NOSC is still finding its way to factories in nearby markets despite this practice being illegal under current tea industry regulations;
	A lack of effective oversight has allowed a secondary market to be sustained that undermines the government's goal of achieving high levels of quality across the entire value chain;
	An excessive and complicated tax regime is a continuing growing concern to the tea industry;

f. The complex and high tax structure	The tax structure is too complex, with too many taxes and rates that are too high;
	Taxes on the tea sector include a district produce cess of 5 per cent of the farmers' price, stamp duty of 1.2 per cent 'free-on-board' (fob), withholding tax of 2 per cent fob, 3.5 per cent Tea Board and research fee, corporate tax, property tax, Value Added Tax, and a service levy of 0.3 per cent of VAT net turnover;
	Tanzanian tax legislation requires a company to pay an alternate tax of 0.5% of its annual turnover if it declares zero profits after the third year of operation; given the greenfield nature of the NOSC development, which requires gradual recovery of farmer debt once tea comes into bearing, it will be at least 17 years before NOSC breaks even;
	The imposition of an alternate tax on loss-making businesses, regardless of the business model and mandate, undermines the operation;
	New land rent tax levied on developed and underdeveloped land is too high and discourages tea expansion . . . raising fuel prices caused by excessive tax on the product. . . road toll tax on irrigation fuel is levied even though the fuel is not used for vehicles;
	Taxes such as payroll levy, education levy are eroding the income from the activities of the tea industry by raising tea production costs, thereby affecting the performance of the tea industry;
g. Government has become too involved in the tea market (overregulation	Government has become too involved in the tea market, contributing to its inefficiency (negative impact of overregulation);
	Despite reforms, the Tea Board and the Ministry of Agriculture are still decision makers, sometimes impairing market driven incentives;

with limited direct growth enhancing support)	The administrative challenge of attracting and managing disparate farmers and deal with local dynamics is significant;
	The tea sub-sector lacks a political champion, who can raise the profile of tea and further attract resources to develop the sub-sector beyond the block-farming model.

3.6.4 Some Policy Recommendations

These and several other underlying challenges, if resolved, could bridge this productivity gap and break the cycle of low investment, prices and yields for smallholders and the tea estates. As also indicated under Table 3.12 (above), bridging the productivity gap and breaking this vicious cycle can be addressed by:

i) Improving the economics of tea production for farmers relative to other crops;

ii) Structuring appropriate financing to address the significant risk, upfront costs and long payback periods;

iii) Addressing service efficiencies related to coordinating and managing smallholder supply; and

iv) Trade policy needs to be revised to allow for the effective build-up of conducive business environment for the tea sub-sector.

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Chapter 4 A Comparison of Top-Down and Farmer-Led Adoption and Innovation Approaches in Tanzania Agriculture

Paschal B. Mihyo and Jamal B. Msami

4.1 Introduction

For quite some time, several researchers have conducted innovation studies in agriculture. However, most of these studies have focused on advanced technology such as those involved in precision farming, smart agriculture and advanced systems to support mechanization of agriculture (Agyei-Holmes, n.d), diffusion of biomass technology (Tarimo et. al., 2024; TIRDO and REPOA, 2023) and adoption of farm-based renewable energy (Kileo and Akyoo 2014; Omari et. al., 2020). Those focused on the dynamics of adoption, adaptation, diffusion and assimilation of new technology among smallholder farmers are limited (Kurgat et. al., 2020; Salaam et. al., 2018). Therefore, this study endeavours to compare modalities and impacts of farmer-to-farmer and state-based transfer of knowledge mechanisms with a specific focus on the adoption and diffusion of such knowledge.

Both at farm and firm level, innovative capabilities are crucial determinants of how to acquire and utilize new knowledge to enhance production, productivity, product quality and competitiveness. Adoption of new technology helps producers enhance their capacity and capabilities to become more successful and meet their development and financial goals. However, to acquire, develop and accumulate these capabilities it requires a good strategy as well as concerted efforts. Studies on technological capability accumulation by late comers in Latin America indicate that innovations leading to catching up and stabilization are a result of carefully thought-out strategies. Those strategies based on clear learning plans backed by implementable learning mechanisms (Bell and Pavitt, 1982; Bell, Scott-Kenimis and Satayarakwit 1982; Katz, 1987).

It is not easy to generalize between farm and firm-based capabilities because the types of knowledge and institutional systems involved are diffent, both structurally and content-wise. Firms normally build on already existing capabilities built within or embedded in manuals, blueprints and human capacity developed through systematic learning. Average firms possess a sizeable stock of human resources either trained or trainable and capable of technology learning. Similarly, technology learning and technical change depend on levels of income between rural enterprises and urban industrial areas as well as between predominantly agrarian and industrialized economies (Bell and Pavitt, 1993).

Contrary to firms, smallholder farmers especially in rural settings have sizeable stocks of human resources with a lot of knowledge accumulated trough learning-by-doing and systematically transferred across generations, but lack resources such as manuals, blueprints or systems for recording, storing and sharing knowledge other than through oral communication, demonstration and observation. In addition, they possess enormous capabilities based on their indigenous systems of production, which if harnessed offer a huge potential for creating conditions for the adoption of advanced innovation. In both farm and firm situations, technological capability can be enhanced by increasing the capacity of actors to transform production and productivity and the capability to address and overcome production, productivity and quality challenges.

In both cases, the acquisition, utilization and accumulation of technological capabilities depend on the existence of knowledge about new technologies. Similarly, depends on capability to identify the technology required according to existing needs, acquire the technology, un-package it to select the most effective ingredients relevant to local needs and conditions, modify it to suit local needs and interface conditions and apply it with the aim of raising the level of efficiency, production and productivity. This implies that there must be a link between the potential for acquisition and utilization of technology, if possible, supported by a clear technology acquisition strategy. Without such a strategy, there cannot be capability accumulation, which leads to adoption, adaptation and diffusion of technology (Palm, 2022).

A survey of 275 firms in Tanzania by Goedhuys and others (2008) found that most of them lack innovation due to a missing link between existing technological potential for research and development and the necessary processes that could lead to the accumulation of technological capability. Lack of a technology acquisition and diffusion strategy permeates all sectors in Tanzania and affects their capacity to acquire, learn and accumulate the required technical and technological capabilities necessary for rapid economic and social transformation (Mwabujoko, 2020; Oyetunde-Usman, 2022).

Accumulation of technology capabilities requires effective systems of technology learning. A study by Figueiredo, (2013) revealed that Brazilian firms managed to catch up with advanced countries indicates that at firm level, technological capability is comprised of knowledge resources within human capital, technical systems such as machines and IT resources backed by supportive organizational systems. However, in Africa both at farm and firm level, these resources are limited. The problem is more acute at farm level where farmers lack their own institutions for research and development and essentially depend on project-based technology projects from governments, research institutions and development partners of a private and public nature. Their human capital resources are limited to a few or sole technology leaders and their technical resources are limited to a few tools and inputs located in individual households of local technology leaders.

Systems of learning affects production, productivity and rural development (Bjornlund and van Rooyen, 2020). They are driven either by locally skilled farmers ready to share knowledge through farmer-to-farmer education or through farmer schools which have institutional funding and other systemic challenges. In isolated cases farmer organizations and networks such as Mtandao wa Vikundi vya Wakulima Tanzania (MVIWATA) in Tanzania form basis of knowledge sharing or transfer but in the majority of cases they are dependent on support from development partners (Wennink and Heemskerk, 2006; Kaburire and Ruvuga, 2006; Massay and Mujava, 2021). Extension services are among the effective mechanism of knowledge transfer. However, extension services have been declining over time, become unreliable (Kulyakawe et.

al., 2021) and even where they are available on commercial basis most farmers are unable to pay (Abed et al. 2020).

To create more advanced hybrid systems of knowledge and technology, farmers need systems for identification, selection, adoption and adaptation of new technology. This may require farmers to upgrade their existing knowledge and technologies by acquiring new and blend with indigenous knowledge. To be effective, this new knowledge needs to diffuse across and modified to suit local ecological, environmental and social conditions. In sum, effective acquisition and diffusion of technology requires elaborate systems of technology learning (Lall, 1985). This chapter seeks to examine how new knowledge is introduced by state and non-state actors in rural settings in Tanzania. It also examines its impact on farmers' capacity to adopt, adapt, diffuse and use it sustainably to transform their systems of production, power and livelihoods.

4.2 Factors influencing rural adoption and innovation of technology

The term 'technology' is very wide. Rogers (1995) has defined technology as 'a design for instrumental action that reduces the uncertainty in a cause-effect relationship involved in achieving a desired outcome'. This definition is a very technical, which seeks to accommodate any system of knowledge embodied in electronic sources, physical human knowledge, print materials such as manuals or blueprints and machinery (Bell, 1982). An innovation on the other hand, has been defined as an idea, practice or object, which is perceived as being new by the person or organization adopting it (Rogers, 1995:11). Knowledge, its newness and its attractiveness to the individual ready to adopt it, are key to the definition. In addition, individuals or organizations opting to adopt such knowledge or techniques need to be convinced of its novelty and utility value. This implies explicit knowledge and awareness of the need for such knowledge or technique, which influences choices. In rural areas, such prior knowledge of the content of the technology does not usually exist.

The acquisition of technology is the first step in the search for and utilization of technology. The knowledge search process is very important because it determines the choice and strengthens the demand orientation of the technology chosen. Often, the introduction of technologies in rural areas follows needs, interests or programmes of governments, research institutions, development partners or local and international NGO instead of farmers' needs or choices. Most of these interventions are project based with predetermined inputs, outputs, outcomes and indicators for measuring the achieved impacts, which may not necessarily tally with needs of the host communities. Similarly, approaches that assume that innovation processes are linear and easily replicable even in differing settings are unlikely to achieve their desired outcomes (Leydesdorf et. al., 2013).

Likewise, in the search for inputs or equipment, farmers acquire knowledge or packages embedded in those programme resources, which sometimes they do not need, understand or did not have in mind. At the same time, technology as a commodity can be acquired through contracts where it is intended to form basis of exchange. For instance, under contract farming, it is common that seeds, fertilizers or other inputs carrying new knowledge or techniques are made part of the contract between farmers and their partners and this limits farmer's choices. A whole package of inputs and equipment maybe supplied to farmers while their interest could be one or a few components of the package such as seeds or fertilizers.

Rogers has indicated five factors that influence rates of innovation (Rogers 1995:15-17). First is relative advantage. This refers to the degree to which an idea is seen or perceived by the adopter to be of higher value than the existing idea or system. The perception may be influenced by considerations of cost, convenience, level of satisfaction or even psychological factors such as prestige. Second is compatibility, which refers to the extent to which the new idea or system fits into the prevalent values, past experience and needs of the potential adopters. This is most important to farmers' propensity for adoption of new technology. Third is ease or complexity of application. The easier the ideas are to understand and apply, the higher the possibility of their fast adoption. Fourth is 'triability', which refers to the degree to which the innovation can be experimented given the conditions of the potential adopter.

According to Rogers, technologies that can be unpackaged and tried in phases stand a better chance of adopted faster. Fifth is observability, which refers to the degree to which the results of the innovation are visible. Rogers has argued that visibility simulates peer assessment of the new idea and exchange or evaluation information. He gives an example of solar systems whose results are very easy for many to see while results of the use of home computers are less observable and their adoption and diffusion rates may therefore be lower or slower.

Building on Rogers' thesis, successful innovation which is the end result of adoption, adaptation, assimilation and diffusion of technology requires numerous factors primary of which are: relevance, demand and needs orientation; availability, accessibility and affordability; adaptability and compatibility; applicability, observability, tri-ability and replicability.

Long term sustainability depends various capabilities related to maintenance, modification, troubleshooting and if possible reverse engineering. Often, the processes of technology transfer to farmers by the state and some non-state institutions do not take into consideration all these factors such as demand and needs orientation; compatibility of the technology with the local agronomical, ecological, social and political conditions (Milheiras et. al, 2022); the need to build the new technology on existing systems and use of local experts as well as the establishment of post-adoption catchment conditions for technical and technological capabilities to support adaptation, diffusion, assimilation, maintenance, modification and subsequent frugal or substantive innovations upon the acquired technology. What makes a difference in the acquisition and domestication of technology is the establishment of autonomous institutions dedicated to the systematic development of technological capabilities.

In ''A New Manifesto' for technology development' Martin Bell (2009) outlined two fundamental capabilities which make it possible for acquired technology to be absorbed into existing systems of production and services, domesticated, and subsequently modified. They include production capabilities which enable people or firms *to continue producing goods or services* with the acquired knowledge and technology and innovation capabilities which help in the *design and configuration* of products and *to introduce changes and improvements* to the products, services and the technology used. Technology transfer initiatives of the past and most likely at present in Tanzania, reflect a lack of sustainability based on capabilities for continuing using the technology and even modifying it to suit continuously changing conditions and goals (Goedhuys et. al., 2008). In the next sections we examine efforts by state and non-state bodies to transfer new technology to farmers, and we compare those efforts with those by farmers engaging in the transfer knowledge to their fellow farmers with the help of local research institutions and development agencies.

4.3 Top-down introduction of new technology to farmers

In most African countries, the education systems at community and institutional levels often organized at the top and the inputs, outputs and deliverables determined by the administrative institutions without the responsibility to engage, involve or consult the targeted communities or groups. In the agricultural sector, extension support, research and farmers' education are no exceptions. Extension services are planned from the top and most extension officers go to the farmers as superior knowledge bearers and seek to transfer knowledge to them through a one-way approach assuming that they have no knowledge at all, their systems are antiquated and need to be changed (FAO 1988, Chapter 4). Extension officers tend to act as instructors passing knowledge to farmers without trying to learn from them.

As a result, farmers' education and learning becomes a one-way process. Researchers have a similar approach. In most cases researchers as well as extension officers have become trapped in the so-called formal systems and forgotten the existence and importance of indigenous or informal systems which have sustained the local communities over the ages (ESAFF, 2013:8).

Evidence on the ground points to the fact that in agriculture, higher value is attached to formal or modern knowledge and technology than to the combination of both the modern and the indigenous knowledge. Most of the initiatives on blending the two seem to be coming from outside Africa (ESAFF, ibid). There is a top-down approach, and it is affecting the initiatives launched by state organs and research institutions which seek to transform rural livelihoods through various projects.

The top-down approach is more evident in the state schemes that seek to introduce new systems of production or resource management within targeted communities. These systems are primarily introduced with the aim of modernizing, formalizing or standardising production methods and inputs such as seeds and fertilizers, infrastructure such as irrigation or soil, water and other natural resources management systems. Most of these novel and useful interventions fail to be adequately adopted and are usually characterized by either a slow pace of implementation or resistance to adaptation, especially where they seek to introduce elements of standardization. Many of them are introduced without testing their concepts on the environmental and cultural contexts of the communities in which they are introduced.

Very few policy makers and state planners consider community knowledge and experiences as relevant to projects they introduce in various communities. Moris (1987) has opined that policy makers tend to regard state driven irrigation technology, for example, as superior and farmer led irrigation initiatives as inferior. After examining public policy responses to drought in Sub-Saharan Africa, Moris developed a concept of development as 'a privileged solution'. He argues that when people originating from a privileged community consider a problem as privileged, they tend to view the solution as privileged too and as a result they take their solution for granted and introduce it in targeted communities without testing its applicability in its local host conditions. Referring to irrigation projects, he opined that, 'In Africa, irrigation projects have often enjoyed a privileged status among some policy makers.' These projects are regarded as the obvious solution for modernizing production, minimizing food imports, removing food deficits and ameliorating the impact of drought'.

According to him, this is the reason why governments keep on investing in irrigation projects despite their poor performance. He attributed this failure to the introduction of highly expensive technologies in contexts different from those where they originate, without analysis, testing or modification. Veldwisch and others (2009) concluded from their research on farmer-led innovations, that farming practices initiated by farmers improve farmers' living standards through increased productivity while state driven projects tend to perform poorly in informal settings. This may be a result of innovations introduced into communities by way of incursion without prior testing or building them on the institutional strength of the targeted communities.

4.3.1 Efforts by the Tanzania National Irrigation Commission to support Irrigation Technology Transfer

State initiated irrigation projects provide a very good example of such initiatives. Some of them tend to be slow and characterized by administrative bottlenecks, lack of adequate funding and excessive reliance on partial donor funding. Irrigated farming is crucial for poverty reduction and national economic growth. According to the 2020 JICA Report on the role of irrigation projects in Tanzania, irrigation has an enormous potential for transforming livelihoods, incomes, and employment in rural areas. Between 2008 and 2017, the land under irrigation increased from 274,000 to 475,000 hectares with a lot of success among a variety of farmers especially among rice growers. It also has added impacts through increased access to clean water in areas covered by the irrigation schemes and increase in the number of small businesses created by farmers using incomes from the sale of crops on irrigated farms (JICA, 2020). The National Irrigation Commission could make a vital contribution to poverty reduction if it succeeds in conducting its objectives and mandates.

Between 2019 and 2020, the Commission had set itself several critical objectives to be accomplished by the end of 2020 (this period is used only as an example). The first was to assess 2,947 irrigation schemes by June 2019. The Annual Report of the Commission for the year 2019/2020 indicates that 2,678 schemes assessed and found functioning as of June 2019. The second objective was to undertake a thorough analysis of 3 schemes and by June 2019 about 60 per cent had been assessed. Third, it had planned to construct sixteen new schemes in 2019.By June 2019, six completed and the remaining ten reached up to 54 percent completion. Fourth, it had planned to build two new dams (Itagata-Itigi and Dongobeshi Hanang) by June 2019. By June that year, the Hanang dam had been completed but the Itigi dam had yet to be completed. The Implementation Report of the Commission, released on the 17 September 2019, reports that non-disbursement of funds was the main challenge affecting completion of the planned schemes. It was further reported that in the financial year 2016/2017 only 37% of the allocated funds were disbursed, in 2017/2018 only 27.5% and over the period 2014/2015 to 2018/2019, out of the TZS 36 billion allocated to the Commission, only TZS 3.8 billion were released. During the same period, the Commission expected to receive an equivalent of TZS 24.6 billion, but the actual disbursement was only 18.74%.

The report also underlines that sometimes the funds are transferred at the wrong time, for example during the rainy season, when construction is either difficult or impossible. Governance and human capacity challenges also affected the effectiveness of the Commission. A board for the Commission had not been appointed, and many leadership positions had remained unfilled. The Commission had 439 vacancies in 2019 but by September of that year, only 232 had been filled and even the staff in place needed training and retooling. In terms of infrastructure, office space was still a problem, office equipment and materials were not adequate, and the Commission felt that most of the contractors who were responding to tender invitations were not adequately skilled and most of them had no adequate financial capacity for the necessary equipment to engage in effective construction of irrigation projects.

The negative impact of the activities and performance bottlenecks of the National Irrigation Commission on the production activities of farmers cannot be overemphasized. This period is selected to show that the state agencies mandated to provide services and transfer knowledge to farmers, can only perform if they are supplied with the necessary equipment, resourced very well in terms of human and finances and enabled to perform within their time frames including timely disbursement of funds.

4.3.2 Efforts by the Tanzania Smallholder Tea Development Agency to transform the tea subsector

This part of the study covers the period 2007-2020, during which the agency launched a transformation programme for the tea subsector through transfer of knowledge to farmers. The agency works very closely with the Tanzania Tea Development Authority and in collaboration with smallholder tea growers to revive the tea industry. Its goals included:

- Mobilizing and empowering smallholder tea growers to access financial resources and other productive services.
- Promoting the formation of savings and credit cooperative societies among smallholder tea producers.
- Participating in the rehabilitation of tea fields campaigns in areas where tea fields had been abandoned.
- Consulting with local authorities to ensure adequate extension support for smallholder tea farmers.
- Introducing and promoting the cultivation of tea in new areas especially in Tarime, Kilolo and Ludewa.
- Facilitating linkages between smallholder tea growers and green leaf processing companies.
- Sensitizing smallholder tea farmers to secure land titles for their fields.
- Promoting quality and competitiveness of tea produced by smallholder growers.

Initially the agency aimed at reviving tea development in the whole country covering some 1,800 hectares of tea plantations, which had deteriorated after the policy reforms involving privatization in the 1990s. They set out to revive at least nine hundred hectares of plantations by 2020. Up to August 2019, about 593 hectares in Bumbuli and 107 hectares in Korogwe in Tanga region had been revived and two tea marketing cooperative unions had been formed in both areas. In addition, 3,700,000 new tea seedlings had been distributed in Tarime (200,000), Mufindi (500,000) and Njombe (3,000,000) districts and training was conducted for young potential smallholder tea farmers in areas earmarked for new investments in Korogwe, Kilolo and Mufindi. Extension officers were given further training. The initiative led to an increase in production such that by June 2020 the association recorded an increase in tea production from

12,360 tons in 2015 to 15,000 tons in 2019. The agency also supported the digital registration of 31,000 smallholder farmers and submitted their names to the Tanzania Tea Board for their digital registration.

However, despite these efforts, there were challenges, which slowed down the achievements of the agency's targets. Technology transfer challenges were common with some farmers failing to follow the advice of agricultural extension officers and continuing with their own ways of cultivation. This was exacerbated by the limited number of extension officers; very few of them had enough time to stay with the farmers, learn from them as they sought to impart in them new skills. The learning cycle in our view was too short. The second challenge related to the aforementioned was that the expectation to raise the level of provision of services from 25% to 75% which was not met, leaving the level of services almost the same. This was due to limitations of budget and the lengthy bureaucracy involved in securing permits for inputs.

The third challenge related to purchase of green leaf. The agency targeted 100% of the green leaf to be purchased and processed by 2020 (Tanzania Tea Board Report 2019/2020) There was not much success on this because the factory which was supposed to have been commissioned in Tango region did not take off and until end of 2020 the process to revive it was on-going. The main challenges that could be addressed as a result of the study are, first, how to increase the number of extension staff not only for tea but for all agricultural activities including horticulture, silviculture and apiculture, livestock, small stock, fishing (including aquaculture). The second is how to increase capacity for transfer of knowledge between experts and farmers and farmers and farmers on the one hand and how to institutionalize transfer of technology for rural transformation on the other. There is the need for coordination between the ministry of agriculture projects and projects based in other ministries on which the ministry of agriculture depends for success need to be improved.

4.3.3 Efforts to transfer knowledge to farmers by the Tanzania Pyrethrum Board

Pyrethrum production had gone down following the market reforms of the early 1990s and during the period 2015 to 2020, the Tanzania Pyrethrum Board resolved to revive production. It set a target of promoting training to facilitate the increase in production in Mbeya (100%), Mufindi (30%) and Makete (70%). The second target was to increase the quality of pyrethrum from 1.2% to 1.26% by June 2019 by constructing drying facilities in selected areas. This was achieved by constructing 20 drying facilities in Mbulu district, 12 in Makete, 50 in Mbeya and 40 in Ileje. In addition, by June 2019 the Board had established pyrethrum inspection centres in Mbeya (12), Ileje (3), Ludewa (3), Kilolo (3), Makete (6), Njombe (6), Mbulu (3) and Babati (3). Contract farming had been strengthened in 16 local authorities where pyrethrum is grown and measures for improving support to farmers were taken.

In addition, the Board achieved the registration of 10,000 pyrethrum farmers, research on soil-based pests in six local authorities, training of two experts on the quality of pyrethrum, and prioritizing purchases from registered farmers. However, the board had acute shortage of human resources. Another challenge had been stiff competition from other crops especially those in horticulture. The 2019 report of the Board indicated that the quality of pyrethrum increased from 1.2 percent to 1.26 percent. In addition, despite the increase in quality, production dropped from 2,400 tons in 2017/2018 to 2,014 tons in 2018/2019. The Report attributed the drop in production to three main factors: an acute shortage of experts especially in the area of inspection; the low level of youth participation in pyrethrum farming and price competition from other crops especially in horticulture.

Therefore, despite heavy financial investment, for the knowledge imparted and systems established to work, other factors had to be addressed. They include human resources strategic preparedness, quality control, relevant skills on the part of experts and capacity of the farmers to acquire, internalize and apply the new knowledge. The Board attributes the adoption failure to the non-involvement of the youth in farming, which limited the impact of training on new knowledge and techniques.

This could be a factor but overall, the experience of the initiative points to systemic and institutional bottlenecks to the transfer of knowledge between farming communities and state institutions.

4.3.4 Efforts by the Tanzania Sugar Board to transform the sugar sub-sector

The period covered by the study is 2019-2020. For the year 2019/2020, the Tanzania Sugar Board had set for itself four main objectives: completion of a sugar cane farmers' database; registration and provision of identity cards to sugar cane farmers; increasing farm area from 52,000 hectares to 97, 000 hectares by 2020; and increasing production by small farmers from 50 tons to 70 tons per hectare. The database on sugar cane farmers was completed and integrated in the database of the Ministry of Agriculture. About 1,125 farmers started growing sugar cane in Mkulazi area. Guidelines were developed and 399 farmers provided with training on modern farming methods. In their annual report for that year, the Board noted that there was limited awareness on how to use the database; some farmers were not resident in their farm areas and titling of land was not going at the required pace.

There was a big difference between the expected increase of production within the country from 300,000 tons to 350,000 tons and the actual production of 124,186.92 tons, 35 percent, as of September 2019. The shortfall was attributed to many factors which should have been foreseen when planning. They include poor infrastructure for irrigation; limited research on sugar cane diseases; obsolete equipment; a high rate of pests; and a very high tax rate on industrial sugar which was a disincentive to prospective investors.

These are a few of the many initiatives launched by crop development boards in Tanzania which show the intent to use a holistic approach in poverty reduction which combines improving knowledge and incomes for farmers, organizing them into cooperatives and encouraging the youth to engage in farming and become more integrated in the agricultural value chains. It can be concluded from these four cases which caver a limited period and does not seek to generalize the challenges identified, that state driven initiatives to promote adoption and innovation among smallholders, absorb a lot of funds but lack other factors necessary for making the adoption and diffusion of new technology and knowledge sustainable.

These challenges indicate problems in the project planning processes. In order for programmes to be properly implemented, strategic preparedness is required in six key areas: governance and leadership; finances; infrastructure (space, IT resources and equipment); programme planning, development and management; monitoring, evaluation, learning and adaptation (MELA); and proper networking (for resources mobilization and retention of support). There is no doubt that in these four cases, there was no strategic preparedness in these six key areas, and the top-down approach ignored the need to involve farmers and their organizations in planning and the introduction of change.

4.4 Farmer led innovations

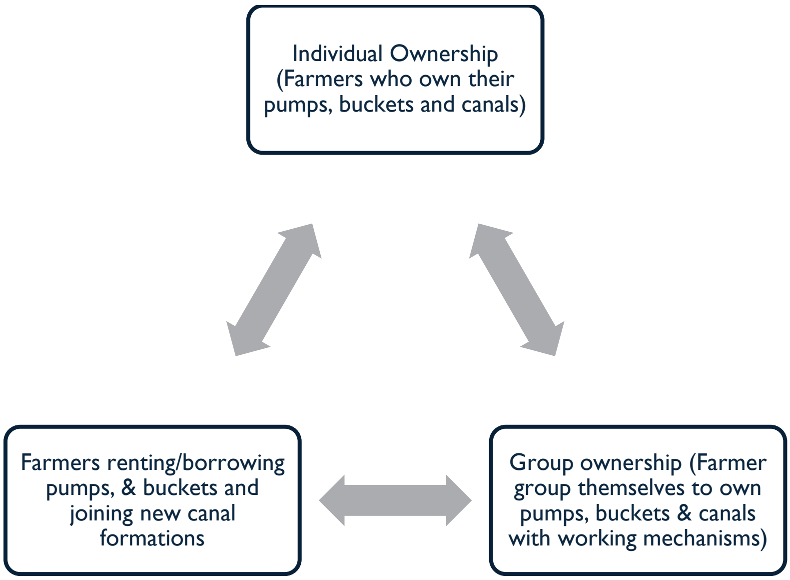
Farmer led innovations take two forms. They can be in partnership with outside agencies such as NGOs, government bodies or research institutions. The second form is when after acquiring technology, some farmers take lead in educating their fellow farmers and transferring this knowledge and technology to them. This section examines the effectiveness of farmer-led initiatives; to start with famer led irrigation schemes.

4.4.1. Farmer-led irrigation systems

Research conducted by Osewe and others (2020) has indicated that while state sponsored irrigation projects in Tanzania have proved unsustainable due to poor maintenance, farmer led irrigation has revolutionised agriculture and transformed farmers' livelihoods. Their study, covering 608 smallholder farmers in Southern Tanzania, the authors found that farmer-led irrigation systems had higher rates of adoption and adaptation than state-based systems. Accordingly, this high rate of adoption was influenced by long-term farmers' experience of drought management techniques, the social dynamics of user groups, their participatory systems and leadership roles based on their gender division of labour. They noted that those who adopted farmer-led irrigation techniques had significant increases in yields and incomes, and farmer-led irrigation was complementary rather subordinated to externally driven initiatives aimed at enhancing food security.

In contrast with state-driven or other top-down approaches, the study emphasized the need to build on farmers' initiatives based on their model as depicted in Figure 4.1.

Figure 4.1 Model of Farmer-Led Irrigation Systems



***Source*:** Osewe, 1M, Liu, A and T. Njagi (2020:3)

In another study on the monitoring absorption of soil water and smallholder irrigation schemes in Tanzania, Mdemu and others noted that many schemes aimed at improving irrigation and soil monitoring technology innovation fail due to several factors which include conscious non-compliance with the requisite standards and limited capacity for adoption of the introduced techniques and technologies (Mdemu et. al., 2020). In the study, the capacity of smallholder farmers is examined within the context of state regulations about land use or directions by experts on modern farming practices such as monoculture which smallholders find very risky due to uncertainties of their rural livelihoods.

In addition, the authors noted that techniques and technologies embedded in the introduced interventions assume that farmers have large pieces of land while majority of targeted smallholders own very small pieces of land over which they grow many crops.

The authors also noted that smallholder farmers do not usually see their farms as commercial or business entities *per se,* a view which reflects the approaches used in the interventions introduced. On the contrary, they see their farms as part of their livelihood ecosystem, which encompasses social, partially commercial and predominantly cultural factors. As a result, they do not see the importance of meticulous planning, review of plans, and in some cases, even innovation.

Furthermore, they examined smallholder behaviour when it comes to state driven innovations and attribute adoption resistance not only to scarcity of resources such as land or lack of capacity for compliance but also to many other factors which influence farmers in deciding on whether to stick or shift from the familiar systems. One of these is the uncertainty of making a successful transition that accompanies the decision to accept new seeds or new animal breeds, which requires certainty of sustaining capacity for compliance with subsequent demands of the new system. This is because once they shift from the indigenous to the modern system, they will need to keep on meeting the standards required to sell crop or animal products in compliance with the rigorous standards on the new markets of those products. There is also the issue of the capability to comply on a sustained basis with rigorous, financially demanding systems of certification of products.

Another factor behind the hesitation for adoption is that in Tanzania and Eastern Africa in general is that, while the international market is growing for 'organically' grown food and animal products, the local market for indigenously grown crops, meats and fish within the region is still very high and even growing. Intuitively, the study by Mdemu and others points to the fact that, export and market access considerations drives most innovations introduced by state and other institutions outside communities of smallholder farmers. These can best be complied with by medium and large-scale farmers while smallholder farmers see the adoption and subsequent diffusion of modern techniques as traps and compliance with standards as potentially erosive of their crop and product sovereignty especially when it comes to seeds.

4.4.2 Farmer to farmer knowledge transfer of banana technology under economic stress

In this section, we examine farmers' adoption of new banana varieties in Kagera region in circumstances of ecological stress, climate volatility and decline in soil fertility leading to desperation for change. In the 1970s, the economy of Kagera region began experiencing shocks. Once dependent on migrant labour from neighbouring countries such as Rwanda and Burundi, when such labour was restricted from 1971, the labour dynamics of the region began to change. Then the banana weevil and other pests began attacking banana plants on a large scale leading to severe threats to income and food security in the region.

The communities in that region began yearning for any change that could restore their economic and food stability. In response, the Kagera Community Development Programme (KCDP) was formed in 1997 by local experts most of who were retired senior civil servants with long experience of management in the public sector. The objective of forming KCDP was to improve food security in the region through increasing productivity of banana production.

The introduction of new varieties of bananas was seen to be the best solution. This study draws a lot from the PhD thesis of Nkuba (2007) on the adoption of new banana varieties in Kagera Region. The KCDP imported 23 varieties, which were introduced in five districts of Kagera Region. The International Transit Centre (ITC) of the International Network for the Improvement of Banana and Plantain (INIBAP) of the Belgian Catholic University of Leuven supplied over 2.45 million banana suckers distributed across the 344 villages out of the 602 villages in the region at that time.

In addition, the project team mobilized extension officers, NGOs, religious groups, primary schools and individual farmers considered to be 'progressive', to be involved and sensitize farmers on the new varieties. Within a short period, farmers were trained on-farm testing was conducted and some of the trained farmers started conducting farmer-to-farmer trainings. There was a lot of enthusiasm on the initiative, where according to Nkuba (2005) out of the sample of 260 farmers, 28.46% had planted new varieties. Out of 195 male-headed households, 30.76% had adopted while out of the 65 female-headed households only 14 (i.e. 21.54%) adopted. The difference in adoption was a result of limited land ownership as well as limited power to make decisions on innovations even when the female is the head of the household. Age and the level of education also found to be significant determinants of the decision to adopt. In terms of age, the study found that older were the earliest adopters because they had more knowledge and experience regarding the performance of existing indigenous varieties.

Land scarcity also influenced rates of adoption as most of the adopters had relatively smaller farms as compared to the non-adopters. However, those who had inherited farms did not adopt quickly because of their attachment to indigenous exotic species. Likewise, those whose farms were most affected by pests and plant diseases had higher rates of adoption. Most of the processes of knowledge transfer were through farmer-to-farmer interaction. It is worth noting that the introduction of these new banana varieties was a collaborative effort between the international and local elites, famers as well as local institutions, which trained the farmers.

Further, the adoption was quick among farmers who chose to give a try the new varieties. These varieties entered the region at time the indigenous varieties were suffering severe attack from the banana weevil and other plant diseases. These diseases were threatening the food and income security of most if not all the farmers. Farmers were desperate for a change because pests (mainly banana weevil, nematodes, Black Sigatoka and Fusarium Wilt) were spreading on an unprecedented scale. Soil fertility was declining very fast aggravated by population pressure; ecological stress caused by land fragmentation due to inheritance systems and land overuse. Adoption of new varieties was quick because the community was ready for change for better or worse.

In addition, in the past farmers in Kagera region had had a very bad experience with innovation. Nkuba (2005:44) explain that during the colonial period, the government had wanted to uproot banana plants as a way of controlling the weevil, but the farmers resisted that policy. Instead, the colonial government introduced a pesticide known as *dieldrin,* which resulted to more destruction of banana plants. Because of that situation, farmers have always resisted pest control through pesticides and therefore they were ready to accept the new varieties instead of going through new innovations they considered potentially destructive. The new varieties were introduced through a participatory process and there was as much disclosure of the necessary information as was possible in the circumstances.

Although the adoption rates were modest, those farmers who adopted believed the new varieties would improve their food security and incomes. The new plants yielded bigger banana bunches with more hands and fingers per bunch. Initially, income from the sales increased and the number of meals increased too. However, these new bananas had different taste from that of the indigenous varieties. After a short time, their local consumption went down and soon the production began to decline partly because the new varieties were producing few suckers and this limited the opportunities for expanding farms. A survey of preferences for indigenous versus new varieties in both Kagera region in Tanzania and in central Uganda, indicated that by 2020, over 95% of the farmers preferred local cultivars to new varieties and hybrid species (Madalla et. al., 2023).

Available evidence suggests that process of introducing these varieties overlooked other crucial factors. According to Lucas (2021), there was the problem of soil nutrients in the form of minerals such as Nitrogen and Potassium whose deficiency had afflicted indigenous species. This had not addressed and continued affecting new varieties the way they had done with local varieties.

Secondly, there were no efforts to increase water availability through irrigation while the new varieties required more water than the local species. Thirdly, extension services were not improved and farmers continued to rely on their own systems of knowledge transfer, which though effective had not tailored to support these varieties. Fourth, farmers continued to use management practices they had always used on indigenous varieties and lack of collateral prevented most of them from accessing financial resources required to develop these varieties profitably. All these problems were caused by lack of risk assessment by those who introduced the new varieties.

Those farmers, who ultimately trained other farmers on the new varieties, could only transfer the knowledge that they had acquired. They therefore continued banana management practices of the past and productivity did not increase to the expected levels. This experience has shown that adoption rates tend to be higher in transfer of knowledge and technology among famers than from state-based experts to farmers. This is because the learning does not involve power dynamics generated by the knowledge and education gaps between trainers and learners.

4.4.3 Farmer to farmer transfer of rice technology - the TANRICE project

The TANRICE project launched in 2012 started with TANRICE 1 as a joint project between the Japan International Cooperation Agency (JICA) and the government of Tanzania. The project was implemented by the Kilimanjaro Agricultural Training Centre (KATC) which has been at the forefront of promoting the adoption of the rice variety known as New Rice for Africa 1 (NERCA1). Using the famous KATC approach, the centre organizes transfer of agricultural technology through a farmer-to-farmer training system. The approach has two components: training activities for extension officers and farmers together and the farmer-to-farmer transfer of knowledge and technology.

The activities start with a baseline survey using participatory rural appraisal (PRA) aimed at gathering information about farmers and their farming practices followed by a Standard Training Course (STC), which exposes District Agricultural Livestock Development Officers (DALDOs), Village Agricultural Extension and Irrigation Officers (VAEIOs) together with a selected number of Key Farmers (KFs) to relevant technology packages. This standard course includes theoretical and practical training after which extension officers offer further training to Key Farmers (KFs). The trained key farmers (KFs) then apply the technical knowledge acquired in what called 'demo fields' through which knowledge is transferred to intermediate farmers (IFs) under the guidance of extension officers and crop tutors or subject matter specialists. During the field days, Key Farmers (KFs) and Intermediate Farmers (IFs) exhibit demo fields to other farmers (OFs).

What distinguishes this farmer-to-farmer KATC approach from conventional approaches is that in the conventional system the knowledge institutions, mainly the Agricultural Research Institutes (ARIs), often in collaboration with District Livestock Development Officers (DALDOS) and Village Agricultural Extension and Irrigation Officers (VAEIOs) get directly in touch with farmers to introduce new technology by organizing training sessions. In the KATC approach, ARIs transfer knowledge to the Ministry of Agriculture and Livestock Training Institutes (MATIs) such as the Kilimanjaro Agricultural Training Institute. The MATIs provide training courses to DALDOS and VAEIOs together with Key Farmers (KFs). After that, the extension officers support the key farmers (KFs) to establish 'demo farms' and use them to transfer knowledge and technology to intermediate farmers (IFs) who in turn are given seeds and inputs to transfer knowledge and technology to other farmers (OFs) (Sekiya et. al, 2025: 400).

In the operationalization of its approach in the transfer of NERICA1 technology, the KATC organized a joint special training course for one DALDO, one VAEIO and 16 KIs. Each KI transferred technology to 3 IFs supporting 64 farmers and each KF received 20 kg of NERICA seeds out of which 3 kg were given to each IF. Each KF and IF were asked to establish a 0.1-hectare demo field. After harvesting, each IF was required to give to 3 other farmers 3 kg of rice seeds thereby completing the transfer of technology cycles. The project started in Kilimanjaro region, but trainees came from other areas including Bagamoyo, Bukombe, Kyela, Ludewa, Makete, Morogoro, Muheza, Nachingwea and Ulanga (Sekiya et.al, 2015:404).

4.5 Conclusion

Despite the elaborate methods used, assessment of the transfer of technology related to NERICA 1 rice variety for the period 2010-2012, indicated that diffusion of this technology from the key farmers to intermediate farmers and ultimately to other farmers did not occur as was anticipated. In 2010-2011, out of the 978 OFs who received training from KF and IFs, only 174, 17.8%, grew NERICA1. In 2011/2012, while 62 KFs trained 146 IFs, only 61 OFs grew NERICA 1 in 2012/2013. The farmers interviewed by Seyika and team who carried out the assessment said the diffusion failed to reach its goals because of lack of guidance and support from extension officers and this was because no district received sufficient funds to enable extension officers to visit villages and provide guidance and support to the farmers (Seyika et.al: 2005-6). The conclusion from this study is that farmer-to-farmer transfer of technology has a higher possibility of adoption in the short term and even in the medium and long term because of the closeness of the trainers and trainees. Similarly, high adoption is likely as this method eliminates big power distance between trainers and trainees and offers flexibility of using terminologies and language with which the farmers are familiar.

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Chapter 5 Challenges to the Transfer of Knowledge from Researchers to Farmers in Tanzania: Some Case Studies

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5.1 Introduction

In Tanzania, agriculture employs 65% of the population and contributes 24% of national exports. It is the backbone of livelihoods for 75% to 80% of rural populations and it sustains the entire population in terms of their food and nutrition requirements (URT 2014). The sector grew at the average annual rate of 3.6% between 2006 and 2016, a rate higher than the East Asian average of 3.2% and 3.1% for the Pacific, 3.1% for South Asia and 2.5% for Latin America. From 2016, agricultural GDP growth has increased and reached an annual growth rate of 4.2% in 2023. In 2023, the contribution of agriculture to the GDP was 27% (URT, 2024). The observed growth has been triggered by the expansion of agricultural area as well as emergence of market oriented small and medium firms with entrepreneurial orientation, which have introduced technology, increased demand for agricultural inputs and services. The sector's growth has boosted employment along the various agricultural value chains (World Bank and FAO, 2022). Other growth triggers include increased use of improved seeds.

Despite of this phenomenal growth, between 2005 and 2020 public services in the agricultural sector declined. Likewise, between 2008 and 2020 irrigated areas cropped by farmers went down from 3% to 2% of all farmed area. In addition, extension services dropped from 67% to 7% during the same period with women and smallholder livestock herders suffering a severe shortage of services. (World Bank 2022). Similarly, funding for agriculture dropped such that it was among the lowest four in Africa, according to the World Bank and FAO (2022). As the result of dwindling sector funding, knowledge systems almost collapsed with livestock research suffered the most. Further, climate sensitive agriculture plans and policies remained unimplemented, areas earmarked for irrigation became smaller and extension services became more inaccessible.

The above challenges slowed down agriculture sector development in Tanzania making poverty the most serious challenge (World Bank and FAO, 2022). The Agriculture Public Expenditure Review of 2022 attributed poor performance and the rise of poverty in some of the best natural resources endowed regions of Tanzania (Kagera, Geita, Lindi, Mara, Mbeya, Mtwara, Mwanza, Shinyanga and Singida) to poor production techniques. This is evident in limited adoption of improved technologies, underdeveloped markets and low farm-level value addition, poor rural infrastructure (roads, telecommunication and electricity), inadequate finance and low public expenditure on rural and agricultural development (World Bank and FAO, 2022:18).

Low public expenditure impacted heavily on research and the ability of research institutions and extension officers to transfer knowledge to farmers. For instance, the funding for agriculture and fisheries declined from 4.6% of the budget in the year 1980/1981 to 2.9% in 1987/1988 (Moshi, et. al., 1997). Following public sector reforms and structural adjustment programmes, which started in the mid-1980s, investment in agricultural research has been experiencing a sharp decline. Institutional reforms of the governance and administrative structures in the sector compounded the problems depriving it of stability in planning and implementation and narrowing space for human resources development for continued research.

Despite of its decline, allocation of agricultural budget was another issue. The bulk of the ministry’s budget was devoted to recurrent expenditure. In the year 2023/2024, 75% of the budget for agriculture went to the central government leaving little for local governments, which are critical vehicles of local development. Table 5.1 summarizes the priorities of the ministry budget. The budget share for research is among the lowest.

Table 5.1 Allocation of the Agriculture Budget, 2024/2025

Activity	Percentage of the Budget
Administration	30%
Forestry management	17%
Extension services	18%
Marketing and storage	14%
Research	5.20%
Irrigation	4.30%
Climate Smart Agriculture	0.05%

Source: Ministry of Agriculture (2025)

Sources of research funds for agriculture, forestry, livestock, and fisheries come predominantly from the government, state owned enterprises and development partners. The reliable flow of resources for research has been the development partners. However, for various reasons, including disillusionment and fatigue on their part, their contribution has been on decline not only for Tanzania but also worldwide. For instance, after peaking at USD 10.8 billion in 2020, agricultural ODA fell to USD 9.9 billion in 2021. Similarly, donor's prioritization of agriculture as a share of total ODA decreased from 6% in 2020 to 5% in 2021 (Donor Tracker 2023).

The agricultural research system began to experience capacity challenges since the mid-1970s, and its growth began taking a sharp decline during the mid-eighties with the onset of the structural adjustment programmes (SAPs). The drastic changes began in 1976 when the Commission for Research and Training changed hands between ministries between 1976 and 1990 and ultimately disbanded in 1990. Between 1990 and 2016, there were many changes in the research centres were reduced by half. At the time the Tanzania Agricultural Research Institute (TARI) was formed in 2016, the research system had only nine research centres and eight sub-centres out of the 54 research centres previously. In 2022, TARI had 376 researchers who were supposed to coordinate these 17 centres and sub-centres. Similarly, the Tanzania Livestock Institute had 60 employees, the Tanzania Fisheries Research Institute 51, the Tanzania Pesticides

Research Centre 31, the Tanzania Forestry Research Institute 22, the Tanzania Coffee Research Institute 20, the Tanzania Tea Research Institute 11.4 full time employment slots (ftes) and the Tanzania Tobacco Research Institute 5.6 (ftes) (World Bank, 2022: 87). The financial and human resources capacity of most the research institutions has greatly affected their ability to effectively support transfer of knowledge and technology to farmers.

5.2 Factors and challenges necessitating technological change

Between 2017 and 2021, food production increased by an average of 2.6% with the highest increase being recorded in maize (4.9%), bananas (6.9%) and legumes (18%). There was a big drop in the production of rice (-11.5%), wheat (-9.1%) and potatoes (-1.3%) during the same period. In addition, while self-sufficiency in food production at national level was high and remained at 126% between 2020 and 2021 (URT, 2024), malnutrition kept on rising. A study by Rosalyne Alphonce (2017) indicated that undernourishment was a big challenge as it affected 39.3% of the rural population while 33.9% of the population was on low dietary energy intake and 26.7% food insecure. The author also noted that although there was food self-sufficiency at the national level, as of 2017, 34% of the population could not meet their daily calorific requirements. Indeed, hunger and malnutrition have preoccupied the Tanzanian government for a long time. While hunger results from low intake of food leading to undernourishment, malnutrition relates to the lack of or deficiency of essential nutrients in the body (Younus and Badpa, 2015; Ersado, 2022).

Despite nutrition being mentioned in key policies such as the National Nutrition Policy of 2016, the National Multi-Sectoral Nutrition Action Plan 2016-2021, the National Food Security and Nutrition Strategy 2015-2025, these policies have focused more on ending hunger with more emphasis on quantities and less attention to supporting systems that can end malnutrition. As a result, malnutrition has been on the rise despite increased food production and it has been highest in the five regions that produce most of the food especially cereals and tubers for local consumption and export (Rukwa, Ruvuma, Njombe, Mbeya and Iringa) (URT 2018).

Furthermore, the National 2018 Nutrition Survey indicates that malnutrition among children and women of reproductive age was higher in regions with the highest density of livestock such as Mwanza (38.4%), Simiyu (37.4%), Geita (36.3%), Mara (35.7%) and Arusha (11.4%). It was also high in regions with very fertile land and abundant fish resources such as Kagera, Njombe, Songwe, Iringa and Singida. Some studies have shown that stunting among children and other forms of malnutrition are higher among pastoralist communities such as the Maasai in Arusha region than in their neighbouring communities despite the abundant supply of milk and meat in communities in Arusha region (Lawson, et. al., 2015).

This paradox of malnutrition in regions with abundant sources of protein and energy rich foods is reflective of the bias in favour of foods that have the potential to end hunger to the neglect of foods essential in the prevention of diseases arising out of malnutrition such as indigenous vegetables, fruits and traditional food security crops (Balderman, et al, 2016). The nexus between food and nutrition security has not been captured both by the national authorities and international development agencies such as the FAO, WHO and UNICEF (Ruxin, 1996).

Another big challenge to smallholder farmers is post-harvest loss. In 2018, the United Republic of Tanzania launched the National Post-Harvest Management Strategy 2019-2029, whose implementation is almost midway. The research by REPOA (2014) whose evidence was used in the situational analysis of this strategy, indicated that the highest risk of post-harvest loss (PHL) was in food security staple crops especially maize, rice and sorghum and the loss affected smallholder farmers most. According to the National Post Harvest Management Strategy 2019-2029, post-harvest losses affect 20% to 60% of the food produced in the whole country and this affects food security and food safety thereby undermining the capacity of Tanzania to meet the targets of Sustainable Development Goal 2. Moreover, post-harvest loss affects health due to high levels of food contamination which also affects the acceptance of food products especially cereals from Tanzania on the export market.

Capacity challenges identified in the research by REPOA cited above indicate that farmers lack education on proper harvesting, drying, processing, and storage and pest control practices. This reflects the lack of skills or capacity on the part of researchers or extension officers to support farmers. To address some of the challenges, the strategy established the National Food Security Department, a Tanzania Post-Harvest Management Platform (TPMP), a Platform for Post-Harvest Management Technology Developers and a Marketing, Infrastructure, Value Addition and Rural Finance Support Programme.

These challenges have been compounded by climate change, which affects all categories of farmers. In Tanzania, regions and communities are adversely affected by negative effects of climate change. However, the impacts of climate change are crop specific. Some crops flourish on moderate rainfall; prolonged periods of rainfall could adversely affect livestock and some crops while benefiting others. Therefore, any policy interventions and activities aimed at promoting climate smart agriculture need to be cognizant of the interface between crops and their local agronomy. In 2013 the government passed the National Climate Change Strategy (revised in 2021) and the Agriculture Climate Resilience Plan (ACRP) 2014-2019. The ACRP aimed at implementing a participatory, risk-based approach to climate action and strengthening institutional frameworks addressing climate change issues.

The ACRP identified specific action to be taken, including among other things, adaptation measures for improved water, soil, and land management; boosting productivity of cereal crops; building capacity for smallholder farmers to increase yields; and intensifying research on the impact of temperature and rainfall variability on key crops. Other measures include accelerating the uptake of climate smart agriculture by building capacity in the following:

i) Undertake cost benefit analysis and appropriate practices for specific crops and livelihoods zones.
ii) Develop guidelines and policy briefs for climate smart agriculture in order to mainstream it into broader policies such as ASDP I & II.

iii) Build capacity for mainstreaming climate smart agriculture and estimating emissions reduction effects of climate smart agricultural practices.
iv) Establish a Management Information System for climate smart agriculture.
v) Increase the capacity of farmers on climate smart agriculture through Farmer Field Schools, champion famers etc.
vi) Establish climate smart agriculture demonstration farms in each agro-ecological zone; and
vii) Establish Regional Resource Centres on climate smart agriculture.

There are many other challenges, which need to be addressed through policy implementation supplemented by transfer of knowledge and technology to farmers. We distinguish between knowledge and technology because while every set of technology involves new knowledge, not every set of knowledge has technological attributes. This chapter attempts to assess the contribution of research to agricultural transformation in Tanzania, and the institutional challenges research institutions face in trying to make the difference in agricultural production.

In section 5.3, we provide narration of selected cases of successful transfer of technology and knowledge to farmers, which took place in 1980s. The discussion points to identifying factors for the successes. In section 5.4 we examine transfer of technology and knowledge by research institutions under conditions of financial and human resources stress, identify the challenges that they have faced, and contributions they made. Section 5.5 presents findings arising out of interviews and focus group discussions with staff of four research institutions with the mandate of transferring knowledge to farmers, fishing communities and livestock developers. The case studies focus on their mandate, their goals, achievements, challenges and their recommendations to the government on how to increase their capacity to deliver on their mandates. The chapter ends with a short section on our conclusions and recommendations.

5.3 Adoption of new agricultural technology by farmers in the 1980s and 1990s

The research community is not unanimous about the extent to which agricultural research has contributed to the transformation of agriculture through increased food security and poverty reduction among smallholder farmers in Tanzania. However, as will be shown below, it is clear from research already done, that between 1980 and 1995, several programmes and projects dedicated to the transfer of knowledge and technology to farmers were very successful and with appreciable degree of adoption. Studies carried out in the late 1990s covering farmers' adoption of technology transferred by research institutions working closely with extension officers, indicated that high rates of adoption of fertilizer technology and improved maize varieties in the Lake and Sothern Highlands Zones. In the Lake Zone, the adoption rate of fertilizers was 38.9% for the low rainfall zone, 13.2% for medium rainfall zone and 61.1% for the high rainfall zone. Adoption of improved maize varieties was 100% in high rainfall zones, 45% in intermediate rainfall zones and 62 percent in low rainfall zones (Mafuru et. al., 199:32). In the Southern Highlands Zone, 36% of the farmers in the intermediate rainfall zone adopted improved maize varieties and 51% in the highland zone adopted these varieties (Bisanda, et. al., 1998: 24-25).

In both the Lake and Southern Highlands Zones, many factors contributed to successful adoption. One of these was that extension services were adequately available and funded through the projects, which supported the introduction of these seed varieties together with chemical fertilizers. The second and most important factor relate to the experts and extension officers provided the farmers with as much information as possible and guided them closely through all the stages of crop development. These include planting; types of fertilizers and their compatibility with agronomical and ecological conditions; weed, pest and disease control; maize harvesting, transportation and storage and how to sequence maize technology and innovations. Between the two zones, non-adoption was higher in the Southern Highlands Zone where in both the intermediate and high zones almost half of the farmers did not adopt. For the majority of those who did not adopt or discontinued growing new varieties, it was due to price changes. When the new varieties were introduced, they were supported by subsidies. However, during the implementation of austerity measures under the SAPs, it was gradually removed. Therefore, although the farmers found the new varieties productive and were eager to continue adopting them, some abandoned them and went back to their indigenous varieties (Bisanda, et. al., 1998:25).

The introduction and popularization of these new varieties was made possible by credit support under the Sasakawa-Global 2000 Project. It worked closely with the cooperative societies. However, it was during this period when cooperatives were facing severe challenges of governance and liquidity. As they lost momentum and became less transparent, they lost access to credit that used to go through them ceased. Although some NGOs and projects such as the Sasakawa- Global 2000 remained active, they also faced high rates of default due to improper credit management systems and some even collapsed leaving low level smallholder farmers without any alternative sources of credit (Bisanda, et. al., 1998:26).

Further, in both the Lake and Southern Highlands Zones information dissemination methods contributed to successful adoption of the new technologies such as improved maize seeds. In some of the areas where information provided was inadequate such as knowledge about herbicides, ox-driven tools and disease control, adoption was low. The study on the Southern highlands also found that after the acquisition of knowledge about various aspects of new technologies including maize and fertilizers, adoption was continuous at an average annual rate of 0.35% for the intermediate zones and 0.17% for the highlands. The difference in the adoption rates between the farmers in two parts of the Southern Highlands zone was because those in the highlands had started using improved varieties of seeds for longer time some of them since the colonial times (Bisanda, et. al., 1998:29-30).

Furthermore, the adoption of chemical fertilizers increased due to availability and affordability facilitated by trade liberalization when various suppliers such as the Tanzania Farmers' Association, the Tanzania Fertilizer Company and several wholesale and retail traders opened distribution centres in Iringa and other towns.

The demand for new maize varieties also increased. The use of fertilizers enabled farmers to grow more crops including cash crops like potatoes, tea, coffee and pyrethrum. At the same time, farmers raise livestock. Thus, the income from these crops provided them with the ability to purchase more fertilizers and new maize varieties seeds. It was pointed out by the researchers cited above that the new varieties were more drought resistant and required less moisture hence more attractive to farmers in low rainfall zones but less attractive to intermediate rainfall zones which are more suitable to pastoralism than agriculture. Also, the shortage of land in high rainfall zones of Lake and Southern Highlands led to intensive farming and therefore a higher demand for fertilizers.

These two cases may not be representative of farmer adoption of new technologies or innovations happened between the 1970s and early 1990s, however, they show that demand for such technologies, which can improve livelihoods, is quite high among smallholder famers. They also show that, the rates of adoption are determined by other factors such as adequate extension services, the quality of inputs such as seeds and fertilizers, and adequate information dissemination and training on all essential processes from cultivation to planting all through to harvesting and storage. As well, reliable and affordable credit facilities, supportive policies, and accessibility and affordability of inputs.

These conditions do not seem to have continued after the introduction of SAPs, which led to the reorganization of the public sector. SAPs characterized by downsizing of the civil service, closure of public institutions, which were regarded as a burden on public spending and reducing funding for non-administrative functions in the public service. Through these changes, research institutions suffered and there was drastic reduction in funding for extension services. By the early 2000s, the impact of research on farmer’s efforts to improve livelihoods drastically deteriorated. However, training became the main mechanism of transfer of technology and knowledge to farmers. In the next section, we examine the impact of training and its limitations during post-SAPs period.

5.4 Training as a primary mechanism for the transfer of technology to farmers

Training through farmer field schools has become the primary mechanism for reaching out to farmers given the limited resources available to research institutions following the reorganization of the public sector. Farmer field schools started during the colonial period in the 1950s and were used to introduce farmers to crops of interest to the colonial economy, mainly cash crops. Farmers identified as 'progressive' were selected and trained on new techniques for growing new crop varieties. This system was known as the 'focal point approach' through which a few farmers were supported to excel and the rest encouraged to work for them or to seek wage employment outside their localities.

Those selected were mostly from privileged echelons of local communities who were cooperating with colonial administration. The system created basis for stratification among farmers creating a class of farmers who were closer to the colonial state and who later in countries such as Kenya opposed the nationalist movement. The farmer field schools served as mechanisms for selective modernization of agriculture and for production in order to serve the interests of industries in the colonizing countries (Koponen, 2010). After independence, the focal point approach was abandoned because of its underlying negative policy outcomes of class formation and perpetuation of inequalities. A dual system was introduced which had two tiers namely 'improvement' and 'transformation'.

The earlier initiatives aimed at implementing the transformation approach involved the formation of village settlement schemes. These settlements were formed under the leadership of radical youth based in the ruling party, the Tanganyika African National Union. They did not succeed because they lacked support from the grassroots and some leaders within the ruling party and government were not enthusiastic about them (Mihyo, 2018). Village settlements were more political than technical and within them famers' training was organized more along political lines. After they failed, government left the training processes to experts within the ministry of agriculture who supported researchers and extension officers to work with farmers.

The ministry adopted the approach known as 'train and visit' introduced by the World Bank through the National Agricultural and Livestock Extension Rehabilitation Project (NALERP). In collaboration with extension officers, researchers based in the Ministry of Agriculture Training Institutes established several farmer field schools. The transfer of knowledge involved the use of research to reach out to farmers, training and counselling them and also training extension officers on various methods of transferring knowledge to farmers. The approach has been criticised for being a mechanism for grafting already packaged knowledge onto local systems as a way of modernization by externalization instead of transforming existing or indigenous knowledge (Seimu and Zoppi 2021).

Mvena and others (2013) provide a very detailed account of the development of the transformative approach underlying the farmer field schools (FFSs). They have argued that FFSs offer training tailored towards the needs of farmers and build on the farmers' experience. In addition, FFSs are community based and build upon local systems of organization and production. They pointed out that FFSs are not meant for transferring technologies to farmers, but to develop farmers' own capacities to critically analyse situations, think for themselves and develop their own solutions. They have also acknowledged that training on its own does not impact significantly on farmers' capacities, because apart from the knowledge imparted, increase in productivity depends on factors beyond the control of the communities involved such as climate and availability of inputs. As a result, some researchers have expressed a belief that transfer of knowledge to farmers through farmer field schools or other means has remained unsuccessful.

Mwaseba (2005), for example, argued that agricultural research had not directly addressed poverty reduction issues and agricultural extension services, which were supposed to transfer knowledge to farmers, were neither sufficient nor efficient. Giving specific examples, he further argued that there had been limited use of selected rice research-based innovations aimed at catering for different categories of farmers including the poor and as a result, for the poor there was very limited impact because the economic impact of fluctuations in productivity as rice farming was very dependent on rain among the smallholder farmers. Ochieng and others (2021) echoed similar views. They argue that, in spite of investments and immense efforts by researchers and extension officers, technologies for improved varieties and mineral fertilizers have not been easily and readily embraced.

Notwithstanding the general feeling that training and extension support have not delivered the expected rapid growth outcomes, it is important to avoid generalizations. This is because other studies such as the one on the adoption of integrated soil fertility management (ISFM) conducted in Babati and Kiteto in Manyara region and Kongwa in Dodoma region (Kahara et. al., 2022), indicate smallholder farmers readily adopted ISFM to various degrees depending on the soil and climate in those areas. The study found that 50% of the farmers overall, implemented various components of ISFM while only 35% of those in semi-humid areas adopted those techniques. It also found that in sub-humid agroecological zones (AEZs), 95% of farmers adopted improved maize seeds as compared to 11% in semi-arid AEZs. The main lesson to be drawn from this study is that not only are farmers ready to absorb the knowledge and technology passed to them by researchers and agricultural extension officers, but also their adoption, absorption and diffusion of this knowledge depend on climatic conditions in which they live and the relevance of the knowledge and technology to their local conditions.

It is undeniable that projects, which introduce technology to farmers, contain packages which are deemed necessary by those designing them while the transfer of technology is viewed from the surface as technological and its adoption, absorption and diffusion is influenced by a number of ‘extra-technological factors’ such as markets, credit systems and inputs among other things (Mwaseba, 2005). Cases in the next few paragraphs, identify some of these extra-technological factors.

5.4.1 Recognition of farmers' needs

A study by Kotu and others (2023) on farmers' readiness to invest in mechanized maize shelling in central Tanzania covering 400 households indicated that research based new knowledge was popular among farmers. However, low policy attention to the needs of the framers in relation to such technologies and their incapability to secure financial resources to enable them to acquire, use, service and maintain the equipment involvedlimited the adoption and absorption of such knowledge. Further, the study found that 65% of the farmers interviewed were only willing to invest in mechanized maize shelling through groups and only 18% of them were ready to invest individually. In addition, farmers suggested that for such technologies to be properly diffused, there was a need for targeted loan programmes accompanied by entrepreneurial and technical training, smart subsidies and supportive tax policies.

Extra-technological factors also include trade-offs between various knowledge systems especially between local and external knowledge on the one hand and compatibilities and complementarities between various technology packages and inputs on the other. A study by Ochieng and others (2021) indicates that efforts to promote improved varieties of vegetables in some parts of Tanzania did not succeed because farmers found new techniques requiring more financial resources than they had at their disposal. Therefore, they found trade-offs in sticking to their local methods and technologies. However, they easily adopted the combination of mineral fertilizers and manure on the basis of complementarity between the two. A similar study by Jahari (2016) indicated that the use of input support through voucher system and supply of the same fertilizers across various and differing agricultural ecological zones led to fertilizers having a negative impact on soil fertility and productivity in some areas because of incompatibility between inputs and local interface and ecological conditions.

5.4.2 Grafting technology on the cultural fabric of community

Missing from most of the content of training programmes and approaches, is a clear understanding of local culture and community beliefs, values and practices. Projects are viewed as technical initiatives, which are brought into communities to help them transform their livelihoods. The readiness and willingness of these communities to change and also to receive these technologies is assumed rather than ascertained. Lack of understanding of the local conditions removes the essential element of embeddedness. The knowledge introduced becomes parallel and is not fully integrated or absorbed in respective communities. Blanket transfer of knowledge or technology irrespective of socio-economic and cultural context of the host communities ends up becoming counterproductive. This has been evident in projects seeking to introduce IT based technology in rural areas (Avgerou 1995; Avgerou 2008). If there is too much emphasis on the technical aspects with less or no attention attached to the social contexts, diffusion is bound to be low (Zewge and Dittrich, 2017) and in many communities, peoples' perception of the capability of a certain technology being able to solve their problems differ.

Therefore, as has been argued by Ayum and others (2022), capacity of a technology to solve problems may differ between stakeholders and when those perceptions form the base, outcomes of the intervention may be drastically minimized. They give an example of introduction of computers in rural areas and indicate that while farmers were eager to use computers, they continued relying on radio and computers were mainly used by researchers. Rural communities tend to have a utilitarian approach to phenomenon because of their limitation of resources, and their choices often governed by the perceived utility of the intervention they want to adopt. In the case of technology, the benefits have to be visible and the potential to improve their lives and livelihoods in the short term verifiable (Mukti, et. al., 2023).

5.4.3 Poverty and the cost of change for the poor as a barrier to adoption

Studies have shown that knowledge resources with high potential for increased farm and off-farm production was only accessible to resource endowed households and less endowed households could not access it thereby remaining trapped in the vicious cycles of poverty (Katera, 2018; Hammond, et. al.,1996). This raises the question of whether technology per se is the panacea if introduced without bearing in mind the socio-economic contexts within which it is to operate or function. For example, in a very poor village introducing piped clean water scores lots of points for the political leaders or accounting officers involved. However, such a project will definitely find in place a local water system perhaps based on water wells spread across the village managed through kinship and neighbourhood systems. These systems are likely to be gendered in such a way that only women of particular clans or neighbourhoods fetch water from designated wells. Thus, power brokers and the guardians of gendered power structures may see providing a central water system at which women from all neighbourhoods and clans fetch water from the same point as subversive. Also, when women in such communities go to water wells which are designated within neighbourhood or clan systems, they do not have to put on special wear while going to a public water point may require better clothes than those worn within the neighbourhood.

These two examples are used to show that development brings with it new demands which may be beyond the beneficiaries' means. Therefore, the significance of 'lifting the bucket from a woman's head', which is a noble idea, may end up being eroded by gender-based practices which are used to perpetuate the control of women at the household level. There have been projects well intentioned and sought to make the life of women manageable, such as maize milling machines installed at central level in several villages in the 1970s, but rejected by leaders in the villages claiming they were making maize flour so soft that it was causing stomach upsets. Behind all these claims was the threat of exposing women, taking them out of the household thereby allowing them to interact and exchange experiences and strategies of resistance. Alongside this threat, were the new attendant demands such as buying new and presentable dresses as women went out into the broader public out of their clan and neighbourhood enclosures.

5.4.4. The learning curve and exposure

Project based transfer of knowledge or technology does not provide enough time for the farmers to learn over a long period. In the rural context, people who receive knowledge from outside prefer to build it into their day-to-day contexts and this requires time. Using an example of transfer of ICT based technology, Atinaf and others (2021) have advanced the theory of the link between context, resilience and sustainability. Its main premise is that information is about data and its use; both data and its use are context specific and unless the context well captured, the information may not adequately put into use. They argue that, to attain long-term resilience and sustainability there should be effective transfer of knowledge to the local communities and the context of local development built into the intervention strategy.

These limitations notwithstanding, where proper guidelines are given and knowledge transferred in simple language and farmers exposed to it over a long time, farmer field schools have enabled farmers to accumulate adequate knowledge to enable them to protect their crops from diseases and other challenges (Van der Berg and Jiggins 2007). In Tanzania, FFSs have empowered farmers in terms of widening their knowledge and enabling them to tame their environment, however several factors limit their successes. One of these is dependence on externally funded projects, which have fixed time limits and training fails to continue when project funds are exhausted.

Other limitations relate to chronic shortages of funds and human resources as well as limited capacity for effective programme implementation. In addition, lack of infrastructure such as buildings, laboratories, dormitories for trainees and equipment; lack of human resources development programmes which can help trainers and extension officers to adjust to technological and other changes, and many other factors as will be discussed in the four case studies in Section 5.5 below. These and other factors have drastically incapacitated national research institutes from delivering expected outcomes as defined by their mandates and strategic plans.

5.5 Case Studies on the persistent challenges for research institutions

5.5.1 Case Studies on the goals, achievements and challenges facing agricultural research institutions

In 2022, we carried out a comprehensive study of a selected number of public research institutions with the view to finding out their mandates, objectives based on their strategic or other plans, achievements and challenges faced. The study used a structured questionnaire to interview key informants, especially directors of relevant research departments and senior researchers, to elicit insights into their perceptions of what their organizations had set out to achieve, had achieved, shortfall and challenges encountered. In addition, we organized focus group discussions with the same and other key officials to get their views of the causes of the shortfalls, what they see as solutions and priorities should the government and or its partners decided to act on the identified gaps. Below we present a summary of the findings organized as four case studies.

Case Study 1: The Tanzania Agricultural Research Institute - TARI (Ministry of Agriculture)

The Tanzania Agricultural Research Institute (TARI) was established by Act No. 10 of 2016 to enhance and strengthen agricultural research system in Tanzania. It is a semi-autonomous body under the Ministry of Agriculture responsible for all agricultural research activities conducted by the National Agricultural Research System (NARS) in Tanzania. Within that mandate, it conducts basic and applied research; promotes and coordinates agricultural research and advises the government and other stakeholders on matters related to agricultural research for sustainable development. TARI has a network of 9 research centres and 8 sub-centres. The research centres are TARI Makutupora, TARI Ilonga, TARI Selian, TARI Ukiriguru, TARI Naliendele, TARI Mlingano, TARI Tumbi, TARI Uyole, and TARI Kihinga. The sub-centers are TARI Hombolo, TARI Dakawa, TARI Maruku, TARI Mikocheni, TARI Tengeru, TARI Kifyulilo, TARI Ifakara, and TARI Kibaha.

Objectives of TARI

TARI's 2019/20 - 2024/2025 Strategic Plan identified six strategic objectives as:

i) To improve the availability and use of agricultural technologies and innovations for improved crop production and productivity;

ii) To enhance the use of affordable and effective post-harvest and storage technologies;

iii) To increase the use of technologies for sustainable management of natural resources and climate-smart agriculture;

iv) To widen the use of appropriate mechanized operations for improved production and productivity;

v) To enhance food processing and value addition technologies for improved nutrition, quality and market access; and

vi) To strengthen and promote cutting-edge science applications in agriculture.

Achievements of TARI

From the interviews and focus group discussions the following were identified as achievements by TARI.

a) Measures for improving soil, water and land use

On improving soil fertility and bearing in mind that soil differs in terms of characteristics, there have been initiatives and projects on soil mapping in Tanzania to understand soil distribution and characteristics depending on the ecological nature of a particular area; understand the level of soil fertility and kind of fertilizers that can be used according to soil characteristics. In addition, the government has introduced the digital soil kit to facilitate and track the process of soil measurement. These Digital Soil Kits help in minimizing time used in measuring the soil and advising farmers on the characteristics of the soil and the kind of fertilizers to be used.

In the area of improved land use, not much has been achieved despite the government's efforts to establish the land master plan, to increase proper land use for various economic activities including the land for agriculture, animal grazing, national parks and reserves, water sources, and wetlands among others.

b) Supporting farmers to increase yields

The government has invested in improving agricultural extension services by providing motorcycles to extension officers to enhance movements to reach farmers and provide extension services. There have been initiatives to introduce irrigation schemes to help farmers increase production and address the issue of unreliable rainfall. There have also been efforts to increase accessibility to agricultural inputs for farmers. Recently the government has announced a fertilizers subsidy initiative to help to reduce the price of fertilizers. Furthermore, there also have been efforts to innovate simple and affordable agricultural technologies and machines through the Vocational Education and Training Authority (VETA) and the Small-Scale Industries Organization (SIDO) to facilitate agricultural mechanization and increase volume of production.

c) Research on the effect of temperature and rainfall on crops

TARI has conducted research on the effect of temperature and rainfall on crops; it has invested in research regarding drought where more than 11 different seeds of various crops that can sustain drought were developed. However, the development of those seeds failed due to lack of financing, including storage facilities such as cold rooms.

d) Accelerating the uptake of Climate Smart Agriculture

Many initiatives have been undertaken to accelerate the uptake of Climate Smart Agriculture (CSA) technologies through projects such as the Systems of Rice Intensification Practices in rice production whereby the practice ranges from sorting, sowing, transplanting younger seedlings, weeding and water management; all these for increasing paddy production. Other CSA projects include the Decentralized Climate Finance Project; Mitigation of Climate Change in Agriculture (MICCA) and Building

Capacity for Resilient Food Security all of which are intended to accelerate the uptake of CSA in Tanzania focusing on rice, maize and legumes.

e) Development of guidelines and briefs

TARI has produced and distributed guidelines and briefs on the production of food and commercial crops including maize, rice, cotton, potatoes, horticulture crops etc. It has also trained experts in the agricultural sector with diverse academic disciplines and levels.

f) Capacity for estimating emissions

In 2019, the National Bureau of Statistics (NBS) launched the first National Climatic Change Statistics Report - NCCSR, 2019 Tanzania Mainland; the report explained in detail the major sources of emissions and the extent of emission contributed by each source. The main sources mentioned include Land Use Change and Forests (LULUCF), Agriculture, Waste, Energy and Industrial processes and the potential emissions include Carbon dioxide, Methane and Nitrous oxide, Sulphur dioxide, Nitrogen oxide and non-Methane volatile organic compounds. TARI has few experts based at Sokoine University of Agriculture (SUA) who can estimate emissions and are involved in research on estimating carbon emissions. Moreover, the government through NBS and the Ministry of Agriculture have created various databases; including a farmers' database; agricultural input requirement database; land for agriculture and crops database.

g) Supporting Farmer Field Schools and champion farmers

The Farmer Field Schools are used to support farmers to through experiential learning, action learning and group dynamics. There are agricultural blocks built for initial field school programs; farmers are learning by doing to acquire experience through continuous and cumulative processes of solving problems in the value chain of agricultural production. The learning process is based on facilitation not teaching and mentoring farmers to understand how to prepare farms, sowing, weeding and harvesting and storage. There are blocks for various crops including paddy-rice, maize, sorghum and cassava. TARI has also been identifying champion farmers every year and the government has given them various prizes in form of money and agricultural inputs.

h) Establishing demonstration CSA farms in each agro-ecological zone

TARI has established many demonstration blocks of various crops; including maize, grain, legumes, sunflower, sorghum and millets. Nationwide, TARI has established agro-ecological zones including the hot humid coastal plain zone; the semi-arid central plateau, the high rainfall lake regions; and the temperate highland. These agro-ecological zones cover areas with similar soil, land and climate characteristics relevant to agricultural production.

Persistent challenges/shortfalls and their causes

***Soil improvement*:** In improving soil, the main challenge is climate change, which remains a setback in increasing the productivity of crops. The soil may be of high fertility and farmers have planted following all agricultural principles, but drought or excessive rainfall washes away all soil nutrients and hence low harvests. Another challenge is the mind-set of farmers; they are not ready to accept and adopt changes in agricultural production including modern ways of improving soil; applying modern agricultural practices including the application of inputs and plant spacing for soil conservation. The majority of them do not see the importance of improving their soil; measuring the soil to understand its characteristics and the level of soil nutrients and the kind of fertilizers that can be used to increase productivity. They often stick to their local practices.

***Water*:** Agricultural transformation required easily accessible water for farmers and systems of irrigation, which can keep crops adequately supplied with water. TARI lacks the technology to harvest rainwater and store it in large dams, and there are insufficient sustainable irrigation schemes across the country to demonstrate year-round crop production. Additionally, vast areas of land remain unsurveyed or unplanned for specific uses. These challenges, combined with inadequate water resources, hinder effective training of extension officers and farmers in modern agricultural technologies, limiting practical demonstrations and the adoption of innovative farming practices.

Challenges in supporting farmers to increase yields: The main constraints in this area include: high prices of agricultural inputs; unreliable implementation of various schemes including subsidized agricultural inputs which do not reach farmers at the subsidized prices; and poor structuring of the agricultural inputs supply chain. Others include ineffective extension services which are not accessible to farmers on time or at all stages; and farmers are not well-trained regarding land preparation, selection of seeds, plant spacing, timely weeding and application of appropriate fertilizers.

Persisting challenges in research on the effect of temperature and rainfall on crops. They include limited investment in research and development on the effect of temperature and rainfall on crops; lack of short-term and long-term training for researchers on new technologies that enhance research on the effects of temperature and rainfall on crops and excessive dependence on donors and donor preferences in research.

Persisting challenges in accelerating the uptake of CSA. They include inadequate infrastructure such as g roads, and irrigation schemes due to high costs of equipment needed and installation skills. Others include lack of agricultural equipment and machines that can be accessible to the majority of farmers in terms of price and technical know-how in the application of those machines to enhance accelerating the CSA as well as low acceptability and adoptability of new technologies among farmers. This is because of a lack of knowledge and farmers' rigidity to stick to traditional agricultural practices.

Persisting challenges on capacity for guidelines and briefs include shortage of financial resources to support guideline and briefs production; the majority of farmers as well as some agricultural extension officers have no interest in reading guidelines and briefs.

Persisting challenges on capacity for estimating emissions include lack of data that shows the extent of emissions; lack of investment in human capital to produce experts capable of estimating the extent of emissions from various economic sectors including agriculture; industrial processes; energy and waste; and lack of technology and equipment to enhance capacity for estimating emissions.

Persisting challenges in establishing MIS for CSA. They include lack of financial resources to facilitate the collection and organization of information to update the established agricultural database; and lack of facilities such as computers for agricultural extension officers to provide information from the grassroots to feed the database as well as infrastructure to enhance accessibility of MIS. In addition, limited internet accessibility especially in rural area where majority of farmers live.

Persisting challenges in supporting Farmer Field Schools and Champion Farmers. They include unfair selection processes for Farmer Field Schools, which currently tend to favour middle-income farmers, resulting in a lack of representation for lower-income farmers. Financial constraints further hinder the ability to engage a broader range of participants thus excluding many farmers due to insufficiency of funds needed to cover inputs such as fertilizers, pesticides, equipment as well as payment to farmers for transport and meals.

Persisting challenges on establishing demonstration CSA farms in each agro-ecological zone. They include TARI's inability to establish CSA demonstration farms in each agro ecological zone, because of low participation of local farmers in those demonstration farms/blocks as farmers are not participating fully in learning through the established demonstration CSA farms hence low rate of adaptation.

Persisting challenges in establishing regional CSA Resource Centres: Lack of financial resources has made it difficult to build the required resource centres' infrastructure such buildings; equipment and human resources.

Proposed solutions to address challenges in improving soil, water and land use

Invest more in training and capacity building to ensure that experts have the expertise needed to accurately assess soil conditions and provide farmers with detailed information on soil types, characteristics, and appropriate fertilizers.

To support water management, prioritize increase in irrigation schemes and the building dams to capture and store rainwater in drylands to ensure year-round irrigation and improved crop production and to promote optimal land use, consideration should be given to the increase of the budget for land survey and planning.

To enable TARI to support farmers to increase yields and promote more investment in the manufacture of domestic agricultural input industries, such as fertilizers, pesticides and seed. Also to support training institutions of TARI to offer programs aimed at equipping extension officers with the necessary skills and knowledge to pass on to farmers, ultimately leading to increased crop yields and provide adequate resources to enhance farmer training on modern agricultural practices, including soil testing, understanding soil characteristics, and the use of improved seeds.

Proposed solutions to address research on the effect of temperature and rainfall on crops

Invest more in capacity building and facilitate TARI researchers to access knowledge and skills and technology with modern equipment so that they can be able to do more research. In addition, put research in the top list of national priorities and put in place a proper mechanism of utilizing research findings especially those donor-funded research, which seldom used after the donors have completed their mission.

Proposed solutions to accelerating the uptake of CSA

Support TARI and its institutes to equip agricultural extension officers and graduates with practical field-based action-oriented skills and knowledge on Climate-Smart Agriculture (CSA) and how to modify applications and cropping systems to the needs of local communities to enhance acceptability and adoptability of knowledge within those communities.

Case Study 2: Livestock Training Agency-LITA (Ministry of Fisheries and Livestock)

The Livestock Training Agency (LITA)

LITA was established on September 1, 2011, under the Executive Agencies Act No. 30 (CAP. 245) of 1997 and officially announced in Government Notice No. 355 of 2011. It was created by merging six Livestock Training Institutes (LITIs), established in different years: Mpwapwa - Dodoma (1930), Morogoro - Morogoro (1948), Tengeru - Arusha (1952), Temeke - Dar es Salaam (1973), Buhuri - Tanga (1984), and Madaba - Songea (1989). Before that livestock training was managed by those LITIs under the Directorate of Training, Research, and Extension Services of the Ministry responsible for livestock development. Currently, LITA operates eight campuses: Mpwapwa, Morogoro, Tengeru, Temeke, Buhuri, Madaba, Mabuki, and Kikulula. It is mandated to provide quality livestock training and education; produce quality livestock products and by-products; engage in applied research and consultancy services and disseminate appropriate technologies to the public through appropriate service delivery mechanisms.

Objectives of LITA

LITA's 2020/21- 2024/25, Strategic Plan has spelt out eight objectives:
a) Effectively addressing crosscutting issues (environment conservation, HIV|AIDS, gender diversity and good governance;
b) Effective implementation of the National Anti-Corruption Strategy;
c) Strengthening Human Resources Management and Development;
d) Increased enrolment of paraprofessionals and livestock keepers;

e) Conducting applied research and consultancy services;
f) Improving financial management;
g) Upgrading agency infrastructure and;
h) Increasing productivity of agency farms by 5% annually.

Targets

Together with cross-cutting issues above, LITA has put the following capacity building targets by 2025. Comprehensive Training Programmes reviewed and implemented; 6,000 paraprofessionals trained on the long course at NTA level 4 – 6; and 5,000 livestock keepers trained. Also, quality and standards provision of training on animal health and production attained; 10 applied research projects developed, conducted and results disseminated; and 5 consultancy services conducted; revenues increased by 30%; financial management improved; infrastructures constructed, rehabilitated and retooled; a new campus established and production projects strengthened and maintained.

Achievements

The study findings identified the following achievements: a) LITA annually produces about 1000 graduates who are awarded certificates and diplomas in different specializations out of those enrolled ranging from 3000 to 4000 every year; b) The graduates of NTA level 5 and 6 are directly engaged in facilitating livestock farmers.

According to the Livestock Policy of 2006, the target is to produce more than 16,000 per year. However there is still a low capacity to increase the number of graduates despite increasing number of enrolments every year; c) The institute is producing extension officers who are capable of facilitating and sensitizing small farmers to practice livestock business in their localities; d) Livestock farmers are trained on short courses in good animal husbandry practices which normally last from one week to a month; e) At the time of the research, there was ongoing construction of a one-story hostel each in Morogoro and Mpwapwa campuses which when completed, would accommodate at least 208 students; f) Construction of a lecture theatre of 240 sitting capacity in Tengeru-Arusha and a classroom building of not less than 100 sitting capacity in LITA Mabuki Campus Mwanza was ongoing; g) For years up to 2022, LITA had managed to facilitate capacity building initiatives to many small scale farmers countrywide on the basics of livestock husbandry; h) LITA has participated in the developing and producing experts on hides and skins industry.

Challenges/shortfalls and their causes

Findings from focus group discussions revealed the following challenges: a) most enrolled students don't complete their studies due to financial constrains as the government has ceased to provide free sponsorship; b) shortage of building infrastructures to accommodate more students in LITA institutes; and c) lack of reliable transport for student during field and or practical excursion and outreach programme exercises. Also, d) lack of long distance learning facilities which can help LITA to reach the larger students' population unable to pay tuition fees for face to face learning; and e) limited number of qualified trainers on milk, meat and skin processes; periodic eruption of animal diseases leading to escalation in treatment costs and loss of animals and incomes. In addition, f) lack of appropriate technological knowhow on indigenous information and knowledge most farmers rely on; and g) lack of affordable technological skills and machines in hide and skin processing to respond adequately to increased demand of hides and skins products in the local and international market.

Causes of shortfalls

According to staff interviewed the challenges are due to the following: a) withdrawal of government loan schemes, through the National Education Loan Board (NELB), to students who are taking certificate and diploma programmes b) negative mind-sets of parents on paying school fees; and c) lack of entrepreneurship and marketing skills on the part of graduate students. Also, d) inability to cope with the technological changes in areas of milk, meat and skin processing; e) lack or absence of specialized curriculum for milk, meat and skin processing; and f) some small-scale farmers still rely on traditional practices of livestock husbandry valuing quantity rather than quality of animal stock. In addition, h) lack of capacity to take timely measures during eruption of animal diseases and unpreparedness of farmers on preventive measures; i) lack of balance between students enrolled and space available in the hostel for accommodation; j) most of hide and skins products are underutilized during processing due to use of outdated technologies in their identification, treatment and preservation; and j) inappropriate teaching methods which do not prepare students to compete in otherwise competitive East African job market.

Suggested solutions/interventions

Staff interviewed suggested that in order to improve the capacity of LITA to discharge on its mandate better, the government may consider taking the following measures: a) support education exchange programmes for students and trainers and facilitate research visits between China and Tanzania for mutual benefit; b) comprehensively update curriculum especially for milk, meat and skin processing; and c) improve the physical infrastructures: classrooms, laboratories and dormitories. Also, d) provide appropriate means of transport to animal field officers during clinic visits to different villages; e) provide scholarships or study tours for trainers outside the country to address identified human resources gaps; f) facilitate the capacity building on appropriate technologies to trainers and support provision of training facilities such as establishment of demonstration processing campus.

Case Study 3: Veterinary Services Department – Ministry of Livestock and Fisheries

Veterinary services department and its mandate

The Veterinary Services Department aims at managing livestock diseases, ensuring animal health, protecting public health, and supporting safe trade in livestock and related products. Its key functions include: i) developing and reviewing veterinary policies, guidelines, and standards; ii) coordinating veterinary services across the country; iii) overseeing the implementation of these services; iv) enhancing the skills of veterinary professionals; and v) conducting disease surveillance. The Department has four sections: Transboundary Animal Diseases Control, Zoo Sanitary and Animal Welfare Services, Vector and Parasitic Diseases Control, and Veterinary Public Health Services.

Objectives

Among the objectives of the Veterinary Services Division are: i) Managing and controlling livestock diseases through surveillance, monitoring, and response measures to prevent outbreaks and ensure animal health; ii) Safeguarding public health by ensuring that livestock and livestock products are safe for consumption, which includes monitoring and controlling diseases that can be transmitted from animals to humans; iii) Developing, reviewing, and implementing veterinary policies, guidelines, and standards to guide the management of livestock health and disease control; (iv) Coordinating veterinary services across various regions to ensure a unified approach to livestock health management and disease control; v) Enhancing the skills and knowledge of veterinary professionals through training and development programs to improve the quality of veterinary services, and vi) Promoting and facilitating safe trade in livestock and livestock products by ensuring compliance with international standards and regulations.

Targets

Under the Tanzania Livestock Master Plan 2017-20222 (TLMP) the main targets were:

- Production of red meat up to 742,000 tons.
- Production of 465,600 tons of chicken meat and 4.2 billion eggs.
- Production of 37,000 tons of pig meat.

Achievements

In the red meat sector, Tanzania has five abattoirs accredited by the World Animal Health Standards (WAHS). In 2022 Tanzania sold 14,000 tons to external markets up from 7,000 tons in 2021. The country has about 36 million cows, 25 million goats, and 10 million sheep, making it the second-largest livestock producer in Africa after Ethiopia (Poultry and Livestock Africa, 2024; Food Business Africa, 2023). In poultry sector, in 2022 Tanzania had approximately 96 million chickens, primarily improved Tropical Chickens (TIC) and over 23 chicken production farms, alongside 23 parent and 26 commercial hatcheries (Kilimo Kwanza, 2024; Dutch Africa Poultry, 2020). Achievements in animal vaccines include the presence of three companies, one public and two private, producing poultry vaccines. The government has eliminated taxes and levies on poultry vaccines to enhance accessibility while maintaining price controls to protect poultry farmers and the Ministry has prioritized vaccines for 13 key poultry diseases, which has increased vaccination rates and improved disease control. Consequently, this has boosted consumer confidence in poultry products.

Challenges/shortfalls and their causes

The red meat sector in Tanzania faces several challenges which include: i) low genetic potential of livestock, which affects overall productivity and quality; ii) insufficient domestic livestock production to meet demand; and iii) a high incidence of diseases such as foot-and-mouth disease, which impacts animal health and meat quality. Causes of shortfalls include a) limited capital to maintain and invest in genetics and b) low awareness of livestock production by producers.

Poultry development in Tanzania faces the following shortfalls: i) hatcheries operate below capacity, with a demand of 4-5 million chicks per month but a production capacity of only 2 million as of 2022; ii) many poultry abattoirs are small-scale and unable to meet domestic market needs; iii) shortage of poultry feed drives up prices, negatively impacting the quality of poultry products; and iv) poor bio-security measures contribute to disease outbreaks, further compromising poultry health and productivity. Causes of shortfalls are a) poor knowledge of poultry production by producers and limited financial resources; b) shortfalls in animal vaccines and high prices of vaccines unaffordable by small poultry farmers and (c) low capital investments in the production vaccines.

Suggested interventions

Staff interviewed suggested that the department's performance on red meat could improve if the government strengthened the use of bio-security measures to control the migration of livestock and support the training of livestock producers in order to increase the level of awareness by injecting capital to maintain and improve livestock genetics. To improve poultry, it was opined that the causes of shortfalls are poor knowledge of poultry production by producers and low capacity of financial resources which need to be addressed. To improve supply of vaccines and to make them accessible to small producers, it was recommended for the government to support increased investment in the production of vaccines.

Case Study 4: Tanzania Fisheries Research Institute

The Tanzania Fisheries Research Institute (TAFIRI) was established by the Act of Parliament No. 6 of 1980 to promote, conduct, and coordinate fisheries research in Tanzania. The institute became operational in 1983 with the appointment of its Board of Directors and its Director General. TAFIRI comprises four centres and one substation: Mwanza Centre and Sota Substation on Lake Victoria, Kigoma Centre on Lake Tanganyika, Kyela Centre on Lake Nyasa, and Dar es Salaam Centre on the Indian Ocean. TAFIRI's mandate includes promoting, initiating, conducting, and coordinating research on fisheries, aquaculture, and related fields in Tanzania's mainland waters.

Objectives of TAFIRI

TAFIRI conducts, coordinates, and promotes research on fisheries and aquatic ecosystems to ensure sustainable utilization and management of aquatic resources in Tanzania. The objectives are, to:

i) Conduct scientific research to improve the understanding of fish biology, fisheries resources, and aquatic ecosystems;

ii) Conduct comprehensive research on fish stocks, habitats, and ecosystems. This includes developing and recommending sustainable fishing practices and management strategies, as well as monitoring and assessing the impact of fishing activities on aquatic resources;

iii) Promote and enhance aquaculture practices through research and technological innovations, develop best practices for fish farming to increase production and efficiency, and support the establishment of fish farming enterprises to boost local economies;

iv) Study and document aquatic biodiversity, including endangered species, develop strategies for the conservation and restoration of critical habitats and monitor the effects of environmental changes and human activities on aquatic ecosystems;

v) Provide training and capacity-building programs for local communities, fishermen, and other stakeholders, enhance the skills and knowledge of fisheries managers and researchers, and promote awareness and education on sustainable fisheries practices;

vi) Offer scientific data and recommendations to inform policy-making and regulatory frameworks, and provide advisory services to government agencies, private sector, and non-governmental organizations as well as support the implementation of national and international fisheries management agreements;

vii) Foster collaboration with national and international research institutions, universities, and organizations, participate in regional and global initiatives to enhance fisheries research and management, and share knowledge and research findings through publications, conferences, and workshops; and

viii) Develop and promote innovative technologies for fisheries and aquaculture, facilitate the transfer of technology and best practices to stakeholders, and support research and development projects that address emerging challenges in fisheries.

Achievements of TAFIRI

In the implementation of the National Fisheries and Aquaculture Research Agenda (NFARA) for 2020-2025, TAFIRI is expected to address nine thematic issues including: stock assessment and fisheries statistics, fish biology, hydrobiology and water pollution, gear technology, aquatic ecosystems and biodiversity, climate change and environment, capture fishery, aquaculture, and socio-economic and marketing. During the research, TAFIRI staff declared the following achievements:

Rediscovery of Silocant Fish Species: TAFIRI has successfully rediscovered the once-disappeared fish species known as 'Silocant'. This significant achievement has contributed to the understanding and preservation of marine biodiversity.

Establishment of a Modern Website: TAFIRI has established an attractive and user-friendly website, www.tafiri.go.tz which serves as a crucial platform for disseminating information and engaging with the public and stakeholders.

Introduction of Mobile Data Collection System (ICAS): TAFIRI has revolutionized data collection in the fishery industry by introducing the Mobile Data Collection System, known as ICAS. This application has transformed the data collection process from a paper-based system to an electronic-based one. With the introduction of this application, data are now obtained in real-time at all levels, facilitating faster decision-making and improving the efficiency of the process.

*Highly Qualified Human Capital***:** TAFIRI boasts a highly qualified workforce in the fishery industry, with more than 18 PhD holders and 100 master's graduates. This highly skilled team plays a vital role in advancing the industry's research and development.

*Extensive Publications and Reports***:** TAFIRI has produced and distributed numerous publications and reports related to the fisheries industry. At the time of the research in 2022, more than 100 international publications and periodic reports had been produced and disseminated. These publications are used to inform policy decisions and serve academic purposes, contributing to the global body of knowledge in the field.

Development of Marine Parks: In collaboration with stakeholders from Japan and South Africa, TAFIRI has developed marine parks in Kigombe, Tanga region. These parks aim to preserve marine ecosystems and promote sustainable tourism, enhancing environmental conservation and local community development.

Challenges/shortfalls and their causes

Alongside its achievements, TAFIRI has also encountered several significant challenges, which include:

i) *Unreliable Fish Stocks:* TAFIRI has faced challenges with maintaining reliable stocks of fish, particularly for species found in deeper waters. The available statistics on these stocks are often fragmented and incomplete, hindering effective management and conservation efforts.

ii) *Research Delays in Quality Fish Food Production*: There have been delays in researching high-quality fish food to meet the ever-growing market demands. The fish foods currently available are of poor quality, and sold at prices that are unaffordable for many. As a result, customers often forced to rely on limited imports, which fail to meet the demand adequately.

iii) *Inadequate Laboratory Equipment:* TAFIRI's research activities are hampered by a lack of adequate laboratory equipment. This shortage of essential tools and resources significantly impacts the institute's ability to conduct comprehensive and advanced research, limiting the scope and effectiveness of its scientific endeavours.

Causes of Shortfalls

Several factors have contributed to the shortfalls in our research capabilities:

i) Insufficient Deep-Sea Research Equipment: The lack of essential equipment, such as large research vessels, has significantly hindered TAFIRI' ability to conduct comprehensive deep-sea studies;

ii) *Lack of Financial Resources*: Between 2019 and 2022 there was no budget allocation dedicated to research activities. Consequently, the limited research that has been conducted was funded by stakeholders, each with their specific objectives. This fragmented funding approach has prevented TAFIRI from acquiring modern technology essential for researching quality fish food and providing informed advice to producers. Additionally, it has delayed the purchase of necessary laboratory equipment to outfit the state-of-the-art laboratory built in collaboration with development partners. These financial and equipment deficiencies have severely limited TAFIRI's research capacity, scope and effectiveness and its ability to support the fishing industry with the latest scientific insights and technological advancements.

Suggested interventions and priority areas for intervention

The government is requested to consider increasing its support to TAFIRI to enable it to:

a) Acquire big modern vessels for fish stocks assessment in the deep sea and enable it to ensure reliable fish stock statistics;

b) Enhance collaboration in fishery research with external institutions to learn and exploit the new technology and skills practices;

c) Acquire modern laboratory equipment to facilitate fishery research, especially on hatchery;

d) Acquire technology and skills for production of quality aquaculture foods that would be sold at affordable price to cater for market demand.

To enhance the fisheries sector, several priority activities were identified, on which collaboration with development partners is crucial. They include:

i) *Provision of a Modern Large Fishing Vessel and Funding for Deep-Sea Assessments*: A state-of-the-art fishing vessel and accompanying funds needed to conduct comprehensive fish stock assessments and gather reliable fisheries statistics in deep-sea waters;

ii) *Investment in Technology and Skills for Fish Food Production:* Locally produced fish foods are expensive due to high production costs. TAFIRI has been unable to conduct research in this area due to inadequate technology and skills;

iii) *Investment in Laboratory Facilities*: TAFIRI has a large laboratory building supported by development partners, but it remains unfurnished, hampering research activities. Investment in equipping this laboratory is essential for advancing fishery research;

iv) *Processing and Value Addition in Fish Processing Plants:* Currently, there are 12 large fish processing plants (eight around Lake Victoria with a combined processing capacity of 685 tons per day, and four along the coast of the Indian Ocean with a combined capacity of 140 tons per day). Major export markets include the European Union, USA, Middle East (Saudi Arabia, Israel, UAE), and Asia (Hong Kong, Taiwan, Japan), Australia, and Colombia. There are significant investment opportunities in processing and value addition;

v) *Fishing in the Exclusive Economic Zone (EEZ):* There is substantial potential for fishing tuna and tuna-like species in Tanzania's EEZ. Investments in fishing vessels, possibly through joint ventures with the Tanzania Fishery Corporation (TAFICO) or Public-Private Partnerships (PPP), are encouraged.

vi) *Construction of Fishing Harbours*: Investments are needed for constructing fishing harbours and supporting infrastructure, such as fish processing plants, ice-making facilities, cold storage facilities, and wet and dry-docking facilities;

vii) *Manufacturing Modern Fishing Boats and Gear:* Most fishing boats are traditional, and most fishing gear is imported.

Other significant investment opportunities are in manufacturing modern fishing boats, gears, and accessories such as fishing nets, buoys, ropes, twines, hooks, and lines.

viii) *Providing Technology and Skills for Aquaculture Food Production*: It is imperative to invest in the technology and skills necessary for producing high-quality aquaculture foods. Ensuring these foods are affordable will help meet market demand, supporting the growth of the aquaculture industry and contributing to food security. By prioritizing these interventions, TAFIRI can significantly enhance the fisheries sector's capacity, efficiency, and sustainability, benefiting both local communities and international markets.

5.6 Summary of findings, conclusion and recommendations

5.6.1 Summary of findings

This study started with a short expose of the state of funding for the agriculture sector and agricultural research characterize by a systematic decline of allocations to the sector from the 1970s to the 1990s and the impact of this on the organizational structure of the National Agricultural Research System (NARS). Public sector reforms, which accompanied structural adjustment programmes (SAPs) during the 1990s, drastically reduced the number of research institutes and funding for research. The biggest casualties were livestock developers, small stock developers mostly women and smallholder farmers generally. Section 5.2 was devoted to the context in which transfer of technology and knowledge to farmers was taking place after these policy changes.

Notable was increased food production and food security leading to favourable stocks of food reserves. But this has been accompanied by a rise in malnutrition affecting more negatively women and children in regions regarded as Tanzania's food baskets. This paradox of the cohabitation of food abundance and malnutrition was attributed to more emphasis being put on ending hunger and less attention to diseases, which arise from lack of vitamins and minerals that can only be found in fruits and vegetables.

Section 5.3 was devoted to the golden age of adoption of new technology by farmers supported by research institutions and extension officers using the case of new maize varieties and chemical fertilizers in the Lake and Southern Highlands. The high adoption rates were attributed to adequate extension support, which was well resourced and financed. In addition, readiness and availability of extension officers to stay in villages and offer effective training which was for a long period covering all the essential processes of crop development from tilling to harvesting; adequacy of credit support and availability of affordable inputs because of project-based subsidies; equitable distribution of subsidized inputs which ensured they reached the targeted groups. Other factors include viable and supportive cooperative societies, which were more accountable and transparent as channels for credit and distribution of inputs. However, it was noted that after affordable credit and input subsidies were withdrawn, and those households could not afford these facilities at market rate abandoned adoption and reverted to their old systems of production.

In Section 5.4 focused on the easiest mechanism that has been used by research institutes to transfer knowledge and technology to farmers in the post-structural adjustment period, i.e., training using the farmers' field schools. Findings from this study indicate that while the transfer is continuing it is slow in reaching poor smallholder farmers who cannot afford the non-technical aspects of the transfer, which make adoption and diffusion of technology possible, such as enough land, secure tenure, accessible and reliable public extension services, and affordable credit and agricultural inputs.

The findings also indicate that transfer of technology and knowledge may become more successful if packages of the knowledge and technology take into consideration the actual rather than the perceived needs of farmers; build on their existing systems of power, production and governance; upgrade and use local experts for sustainability of the transfer process; and if the transfer processes recognize and respect the contextual, cultural and social aspects of the communities with which they interact.

Section 5.5 covered four case studies of public research institutions which are mandated to use research to transform the agriculture, livestock and fisheries sectors and the challenges these institutions face as they grapple with their mandates and plans in the contexts of diminished funding and human resources constraints. These constraints are presented in Table 5.2 (below). They are divided into three categories, and the table is not exhaustive because they are documented in details in the section itself. They are divided into constrains emanating from government action or inaction; those emanating from action or inaction by the research institutes and those emanating from community cultures and practices. In each category the actor mentioned has capacity for taking remedial action.

Table 5.2: Challenges visible in the transfer of technology to farmers and who can address them

Challenges within Government's power	**Challenges which research institutions can address**	**Challenges which community leaders can address**
Land issues: slow implementation of the land masterplan; slow pace of land titling; long standing land conflicts.	*Knowledge management*: lack of courses on entrepreneurship and marketing; limited knowledge on indigenous and local systems of knowledge; failure to train subject specialists e.g. on milk, meat and skins; persistence of lack of knowledge by farmers on livestock development	*Rigid mind-sets*: phobia about new seed varieties and chemical fertilizers; poorer households selling inputs to other farmers instead of using them; fear of and resistance to change which can be removed by local mobilization.
Funding: Inadequate budget allocation to the sector and to research	*Disease control:* Persistent challenges in controlling eruptive and recurrent animal and plant diseases.	*Unfair systems of selecting farmers for training*: poor small holders are not given priority in some communities - this can be rectified by leaders
Infrastructure: inadequate buildings, classrooms, labs and dormitories; poor rural roads, abattoirs, and		*Reading culture:* poor reading culture which limits reading of guidelines by farmers. Adult

supply chain infrastructure.		education operators could reduce this challenge.
Reliable data: scattered data related to emissions, fish stocks		*High dropout rates from farmer field schools*: many training activities attracting good numbers of farmers who drop out in the course of training causing loss to training institutions reflecting poor mobilization by local leaders
Biosafety/biosecurity: minimal enforcement of bio-security regulations on animal movements and biosafety regulations in general.		*Unrealistic expectations*: expectations by farmers to be paid for being trained which causes some to them to drop out when expectations are not met reflecting a mobilization deficit on the part of community leaders.
Field work: limited support for practical training; weak enforcement of apprenticeship policies		

5.6.2 Conclusion

The conclusion from this is that farmers are eager and ready to adopt new technologies but they need to be assured that these new technologies are within their interests and not driven by other interests. To give them this assurance, the researchers and extension services providers need to adopt a participatory approach in the development of the training packages, tailor them to the needs and expectations of the farmers, their leaders and local experts. They need to include in the design and implementation teams, local leaders and experts who are very conversant with the local contexts of culture, systems of power and production. They are critical in helping the marketing of new approaches and make them acceptable and sustainable in the long run.

The lessons from the case studies is that all of them are capable of reaching out to farmers, livestock owners and fishing communities if they are adequately funded and enabled to enhance their capacity in six key areas: governance and leadership; infrastructure such as office buildings, classrooms, dormitories, laboratories, equipment, boats, gear, computers etc.; programme development including capacity to design fundable programmes that can be used to mobilize resources from the private sector and development partners; programme management involving capacity to develop strategies to handle challenges within their capability such as developing courses and experts on issues they handle such as milk, meat and skins as well as capacity for monitoring, evaluation, learning and innovation and capacity for programme delivery including retraining of staff using online. Table 5.2 shows some of the areas where the government can increase efforts to ensure these institutions succeed in their mandates in more sustainable manner. It also indicates areas where the research institutions themselves can step back and take stock of their shortcomings and look for new avenues of bridging manageable gaps. Community leadership through the ministry responsible for community development in collaboration with agricultural, livestock and fisheries extension officers, can contribute to mobilizing farmers to view new technologies as a key that can unlock them from vicious circle of poverty instead of viewing training as a new avenue for community welfare.

5.6.3 Recommendations

Further to the specific and succinct recommendations to government made by staff interviewed as documented in Section 5.5, it is further recommended that the government consider:

- Increasing budget allocation to agriculture, livestock and fisheries and within that budget increase funding for research, outreach and transfer of knowledge and technology to farmers.
- Scaling up support for capacity building of extension officers, researchers and farmers to ensure research and training lead to the acquisition of appropriate and dynamic state of the art technologies suitable for easy adoption, adaptation and diffusion by farmers.
- Upgrade and upscale irrigation schemes and support farmer based irrigation schemes in order to ensure water is available to all farmers to enable them to use the acquired knowledge and technology gainfully.
- Revitalize extension services and incentivize extension officers to be attracted and to remain in villages and provide long term and comprehensive guidance to farmers at all stages of the crop development cycle.
- Revive staff and farmer exchange programmes with countries succeeded in lifting smallholder farmers out of poverty in a short time.
- Increase investment in infrastructure for teaching and learning at the institutions responsible for training farmers and professionals.
- Promote increased investment in local production of fertilizers, vaccines and other inputs whose production is still very low but demand very high.
- Extend the implementation of the public private partnerships to research institutions with the aim of enabling them to acquire facilities that the government cannot afford on its own.

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Chapter 6 Upgrading and Integrating Farmer-Focused Innovations in Tanzania: SAGCOT Experience

Anthony Muchoki

6. I Introduction

This chapter examines the evolution and impact of farmer-focused agricultural innovations in Tanzania, with a primary focus on the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) and its transition to the national Agricultural Growth Corridors of Tanzania (AGCOT) framework. It also traces Tanzania's agrarian reforms from post-independence Ujamaa policies through Structural Adjustment Programs and subsequent strategies, such as Kilimo Kwanza, which introduced the growth corridor concept. Drawing on spatial development and cluster theories, SAGCOT was launched in 2010 as a public-private partnership to catalyse investment and productivity in the Southern Highlands.

Further, the chapter details SAGCOT's multifaceted interventions between 2014 and 2024, including its cluster development model, infrastructure advocacy, soil health initiatives, climate-smart agriculture adoption, and efforts in inclusivity and empowerment through tools like the Inclusive Green Growth (IGG) guides. It analyses SAGCOT's achievements in mobilising investment, increasing land under profitable production, integrating smallholders, and generating employment, while also acknowledging challenges related to equitable benefit distribution, land tenure, and policy consistency. The Chapter then explores the rationale and framework for AGCOT, launched in 2025, which aims to scale SAGCOT's successes nationwide across four strategic corridors. It underscores AGCOT's alignment with national development plans (ASDP II, Vision 2050 and Agriculture Master Plan 2050) and continental agendas. The Chapter concludes that while AGCOT presents a significant opportunity for Tanzania's agricultural renaissance, its success hinges on robust policy coordination, sustained investment, institutional capacity building, and a steadfast commitment to inclusive and climate-resilient development.

Agriculture remains the cornerstone of Tanzania's economy and livelihoods, yet the sector has historically underperformed. According to the National Bureau of Statistics (NBS) 2022/23 Annual Agricultural Sample Survey (AASS)[8], agriculture supports the livelihoods of 44.85 million Tanzanians, accounting for 98% of all rural households (NBS, 2023). This demographic centrality underscores the sector's pivotal role in ensuring food security, fostering employment, and contributing to national economic stability. The sector contributes significantly to the national economy (approximately 26% of GDP, 20% of export earnings) and employs about 65% of the workforce, yet it faces systemic weaknesses like low productivity, minimal irrigation, and declining extension services (World Bank, 2024b). However, since 1964 the performance of the agricultural sector has often failed to meet national expectations for growth and poverty reduction. In response, Tanzania has periodically adopted bold reforms driven by the belief that empowering farmers is the key to unlocking sustainable development and economic transformation.

A key strategy in this transformation has been the development of Agricultural Growth Corridors (AGCs), underpinned by spatial development theory and cluster-based development models. These theoretical perspectives posit that strategic, geographically concentrated investments in infrastructure, input systems, and market access can catalyse regional economic transformation. Michael Porter's cluster theory (1990) provides a conceptual foundation for such initiatives, where the colocation of related industries, institutions, and infrastructure enhances competitiveness and innovation. Projects such as the Maputo Development Corridor in Southern Africa, further demonstrate the potential effectiveness of corridor-based strategies in driving inclusive

[8] The AASS 2022/23 is a comprehensive household-based survey, utilised direct interviews and covered both large-scale and smallholder farming, drawing its frame from the 2022 Population and Housing Census and employs a stratified two-stage sampling methodology to produce reliable regional estimates (50x2030 Initiative, 2024; FAO, 2024; IHSN, 2024; NBS, 2024; World Bank, 2024a, 2025a, 2025b, 2025c).

growth, despite challenges related to equitable benefit distribution and the complexity of coordination (Sequeira, 2015; University of Pretoria Repository, 2008). The Beira Agricultural Growth Corridor in Mozambique also offers lessons on increasing yields and farmer resilience through targeted input support and supply chain strengthening (IFDC, 2025). However, critics of AGCs in Africa often point to a focus on commercial, export-oriented production at the expense of local food security, potential infringements on land rights, and the exclusion of vulnerable communities (Smalley, 2017).

Tanzania's post-independence agrarian history evolved through various ideologically driven reforms. The Ujamaa and Villagisation policy (1967–1985), grounded in African socialism, emphasised communal ownership and collective farming practices. While initially aimed at promoting equity and rural development, contributing to national unity, and expanding social services, it faced resistance and declining productivity due to operational inefficiencies, forced resettlement, and a disregard for local agricultural knowledge (Le Luel, 2024). The state's model of agricultural self-reliance led to Tanzania becoming a net importer of maize in the 1970s (Le Luel, 2024). The Structural Adjustment Programs (SAPs) of 1986–2000 introduced liberalisation and privatisation. While achieving some macroeconomic stability, SAPs weakened state support systems, such as agricultural extension services, increased input costs for farmers, and left smallholders vulnerable to market shocks (Tietenberg, n.d.-a).

The removal of input subsidies from 1991 onwards was linked to a decline in maize production (Van der Geest, 1998). SAPs also had adverse environmental consequences, including deforestation and soil erosion, as farmers expanded cultivation to marginal lands due to the unaffordability of inputs for intensification (Tietenberg, n.d.-b). The 1997 Agricultural and Livestock Policy and the National Strategy for Growth and Reduction of Poverty (NSGRP/MKUKUTA I & II), 2001–2010, sought to balance liberalisation with social development but fell short in transforming Tanzania into a competitive agricultural exporter due to implementation gaps and insufficient investment (URT, 2023; World Bank, 2019).

Recognising the shortcomings of these past initiatives, Tanzania launched the Kilimo Kwanza (Agriculture First) initiative in 2009 after broad consultations between the public and private sectors. It was a visionary and home-grown strategy aimed at revitalising the agricultural sector as a driver of economic growth, poverty alleviation, and food security. Kilimo Kwanza was designed to address persistent challenges, including rudimentary farming practices, low technology adoption, poor infrastructure, and limited access to finance (Social Watch, n.d.). Of most importance, it established the concept of agricultural growth corridors for focused development. Four main corridors were initially conceptualised: the Southern Highlands Corridor (emphasising staple crops and horticulture); the Mtwara Corridor (capitalising on the port for export-driven agriculture like cashews and sesame); the Central Corridor (facilitating movement of agricultural products); and the Northern Corridor (leveraging favourable conditions for high-value crops, livestock, and horticulture).

However, implementing all these simultaneously was not feasible, necessitating prioritisation. Following broad stakeholder consultations, the government, through the Kilimo Kwanza framework established the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) in 2010 as a pilot model to operationalise the corridor approach. The Southern Highlands were chosen due to their strategic potential, high agro-ecological productivity, established transport corridors, and proximity to export markets. The World Economic Forum on Africa (2010) endorsed the corridor as a public-private investment platform designed to crowd in capital and institutional support into one of Tanzania's most promising food production zones (SAGCOT, 2014). Introduced to global stakeholders at this forum, SAGCOT was envisioned as a transformative mechanism to attract private investment, leverage public-private partnerships, and position agriculture as a modern, competitive, and sustainable sector.

Concentrating on the Southern Highlands, known as Tanzania's "breadbasket" due to its fertile soils and favourable climate, SAGCOT embodied a bold vision to redefine agricultural development. Between 2010 and 2023/2024, it reportedly facilitated approximately USD 6.34

billion in combined public (USD 5.02 billion, primarily in enabling infrastructure) and private (USD 1.32 billion) investments in agriculture and rural development, thereby enhancing rural infrastructure and facilitating better connectivity and market access. By directly connecting over one million smallholder farmers to dynamic markets and indirectly benefiting millions more, SAGCOT fostered widespread growth and inclusivity (Kilimo Kwanza, 2025a). It introduced cutting-edge innovations such as biochar production for improved soil fertility, laser land levelling for enhanced water use efficiency, and inclusive growth tools, ensuring equitable value chain participation for all stakeholders.

Moreover, it focused on building adaptable, sustainable agricultural systems to mitigate risks and enhance productivity. SAGCOT catalysed a transformation in Tanzania's agricultural sector by focusing on productivity, sustainability, and inclusivity in its interventions. Its farmer-focused innovations and emphasis on strategic collaboration demonstrated that agriculture can be a cornerstone for national development.

To accelerate this agricultural transformation, Tanzania officially launched the Agricultural Growth Corridor of Tanzania (AGCOT) Framework on 27 April 2025, in Dodoma. The initiative received significant political support from the top leadership including Her Excellency President Samia Suluhu and Prime Minister Kassim Majaliwa (Kilimo Kwanza, 2025b; The Citizen, 2025a). As a comprehensive, farmer-centric framework, AGCOT is designed to scale innovative agricultural practices nationwide, bolstering productivity, enhancing climate resilience, and ensuring equitable access to resources, markets, and opportunities across all regions.

The ASDP II Mid-Term Review (2023/24) highlights SAGCOT as a critical model for fostering sustainable agricultural growth, recognised for its corridor approach linking vital stakeholders (URT, n.d.). The Tanzania Agriculture Master Plan 2050 builds on this transformative success to enable a seamless transition to the AGCOT framework, positioning AGCOT as Flagship Project No. 7 (Kilimo Kwanza, 2025c). By leveraging strategic partnerships and facilitating private sector engagement, SAGCOT exemplifies how coordinated interventions can address systemic challenges while aligning with Tanzania's broader goal of transforming its agricultural sector. This Chapter explores the transformative interventions spearheaded by SAGCOT and their potential for broader integration under AGCOT. It highlights how farmer-centric innovations, rooted in collaborative partnerships, advanced and appropriate technologies, and inclusive policies, have laid the foundation for Tanzania's agricultural renaissance.

6.2 SAGCOT's Impact on the Agricultural Landscape (2014-2024)

6.2.1. Cluster Development

SAGCOT's innovative Cluster Development Framework has significantly reshaped Tanzania's agricultural landscape between 2014 and 2024. This model emphasises collaboration, resource pooling, and strategic interventions, delivering transformative impacts across the nation's farming communities. Born from the understanding that agricultural development thrives on focused, localised efforts, the framework organises activities into geographic clusters. These clusters, such as Kilombero, Ihemi, Mbarali, Ludewa, and Sumbawanga, serve as hubs of concentrated resource allocation, fostering dynamic interactions among farmers, agribusinesses, service providers, and institutions. The advantages of this clustered strategy are manifold: it optimises resource distribution, enhances collaboration, supports context-specific interventions, and leverages economies of scale by facilitating shared infrastructure and services. SAGCOT employs this unique cluster model to connect investors with smallholder out-grower schemes in the vicinity of large-scale farms, enabling participation from farmers of all scales.

At its core, the framework prioritises collaboration and resource pooling. SAGCOT actively integrates smallholder farmers into commercial value chains by linking them with agribusiness firms. These partnerships enable farmers to access vital markets, modern inputs, and advanced technologies, thereby enhancing their productivity and profitability. Contract farming models have flourished, offering smallholders guaranteed markets and resources. Institutions and service providers, from government agencies and NGOs to financial organisations, complement these efforts by aligning support services, training programs, and economic solutions with farmers' needs. The results have been profound. Strengthened agricultural value chains have emerged, focusing on crops such as soy, tea, dairy, avocado, and sunflower. Strategic investments, such as those in Kilombero's rice processing facilities, have enhanced farmers' bargaining power, enabling them to command better prices for their produce.

Enhanced market access was possible through collective marketing, improved infrastructure, and advanced market information systems, allowing the smallholders to engage more effectively with broader markets. Productivity and incomes have risen significantly, exemplified by a reported 375% increase in potato yields within the Ihemi and Mbarali clusters, which has risen from under 8 to approximately 30 tones per hectare, thanks to improved farming practices such as the adoption of clean seed, mechanisation, stronger regulatory oversight, and agronomy support. This dramatic yield improvement has correspondingly delivered a fourfold increase in farmers' per-hectare incomes, alongside stronger market demand and the emergence of new seed enterprises. For instance, rice yields in Mbarali reportedly jumped from 2.1 to 10 tons per hectare through the adoption of the System of Rice Intensification (SRI) (Kilimo Kwanza, 2025a).

Table 6.1: Illustrative Impacts of SAGCOT's Cluster Development

Cluster Area	**Key Value Chains**	**Reported Impacts/Interventions**	**Supporting Evidence/Source**
Ihemi & Mbarali	Potato, Dairy, Rice, Sunflower, Avocado	Significant potato yield increases (375%); rice yield increases (Mbarali: 2.1 to 10 tons/ha with SRI); prioritised value chains.	SAGCOT data; Kilimo Kwanza (2025a, n.d.-a)
Kilombero	Rice, Sugarcane	Launch of Kilombero Cluster; rice processing	Kilimo Kwanza (n.d.-a); *Geography Case*

		facilities; KATRIN research.	*Study: SAGCOT Tanzania* (n.d.)
General (Multiple Clusters)	Tea, Tomato, Soy, Dairy, Horticulture	Farmer integration into out-grower schemes, increased market access, and technology adoption.	SAGCOT Centre Ltd. & IFC (2024); Kilimo Kwanza (n.d.-a, n.d.-b)

Empowerment has also been a hallmark of the framework, particularly for women and youth. Through targeted training and access to resources, these groups have achieved notable economic participation. Women's collectives, for instance, have led successful cooperative farming and marketing ventures, improving household incomes and community well-being. SAGCOT's strategy explicitly includes championing the inclusion of women and youth in its cluster-based activities via platforms like the Green Reference Group (GRG). However, the journey has been challenging. Managing diverse stakeholders within clusters has highlighted the need for robust governance structures and leadership. Infrastructure limitations, climate change vulnerabilities, and persistent financial access barriers underscore ongoing obstacles (Kilimo Kwanza, 2025a; Makundi, 2023; SAGCOT and IFC, 2024; Sulle, 2025).

Key lessons have emerged from these challenges including the importance of transparent governance, adaptability to changing conditions, and the necessity of continuous monitoring and evaluation to drive improvement. Academic critiques also point to the complexities of ensuring equitable benefit distribution and addressing land tenure issues within such large-scale investments (Makundi, 2023). Despite these, SAGCOT's Cluster Development Framework has demonstrated the transformative power of strategic partnerships, collective action, and focused resource allocation.

6.2.2 Establishment and the Role of TARURA in Infrastructure Development

Infrastructure development has been crucial in unlocking the agricultural potential within the SAGCOT corridor. The Tanzania Rural and Urban Roads Agency (TARURA), officially launched on July 2, 2017, as an executive agency under the President's Office, Regional Administration, and Local Government, has played a crucial role. Its primary mandate is to oversee the development and maintenance of rural and urban road networks across Tanzania.

SAGCOT's consistent advocacy for improved rural infrastructure laid the groundwork for TARURA's mission to enhance connectivity in rural areas. According to the report "*Transforming Tanzania's Agriculture: A Decade of Public Investment in SAGCOT (2012–2023)*," TARURA spearheaded the enhancement of rural road networks, investing TZS 618.9 billion from its establishment until 2023 (SAGCOT, 2024). This investment played a crucial role in connecting remote farming communities to markets.

The development of these rural road networks has resulted in a significant reduction in transportation costs for farmers. Improved roads have reduced travel times and lowered vehicle operating expenses, allowing farmers to transport their produce to markets more efficiently and economically. This reduction in transportation costs, combined with minimised post-harvest losses (reportedly reduced by 25% over the decade due to quicker transit of perishable goods), has directly contributed to increased incomes for farmers, boosting rural livelihoods and economic stability (SAGCOT, 2024).

Beyond rural roads, mainstream road projects undertaken by the Tanzania National Roads Agency (TANROADS), which align with agricultural objectives, have also been critical. A significant infrastructural milestone within the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) was achieved with the inauguration of the Kidatu–Ifakara road and the Ruaha Bridge by President Dr. Samia Suluhu Hassan on August 4, 2024. Conceived from the outset as part of a broader strategic effort to advance the SAGCOT region, these projects reflect the deliberate integration of transport infrastructure with agricultural development goals. Situated in the Kilombero district, the 66.9 kilometre Kidatu–Ifakara road and the 133 meter Ruaha Bridge now serve as critical logistical arteries, reducing travel time, lowering transportation costs, and facilitating the timely movement of agricultural goods to local, national, and export markets. During the inauguration ceremony in Ifakara, President Samia reaffirmed the significance of these investments in addressing rural infrastructure deficits and catalysing inclusive economic growth. These developments exemplify SAGCOT's model of leveraging infrastructure to enhance agricultural productivity, improve market linkages, and stimulate value chain participation across the region.

6.2.3 Soil Health and Fertility Management Initiatives

Soil health forms the cornerstone of agricultural productivity. Recognising this, SAGCOT has emphasised soil health as a critical driver since 2014. This sustained effort contributed to the adoption of soil testing as a mainstream agrarian practice by the Tanzanian government in 2021/22. SAGCOT's advocacy and collaboration have also helped address challenges such as soil acidity and alkalinity, thereby fostering new business opportunities in gypsum and agricultural lime production. As a facilitator, SAGCOT's primary contributions lie in training and advocacy. Through its robust collaborative farmer-to-farmer training initiatives, SAGCOT has educated thousands of smallholder farmers on soil sampling, interpretation of test results, and sustainable soil management techniques. By partnering with the Ministry of Agriculture and the Tanzania Agricultural Research Institute (TARI), SAGCOT has helped make soil testing a standard practice for informed farmers.

One critical challenge identified is the prevalence of acidic and alkaline soils. To address soil acidity, SAGCOT collaborated with the Guiding Acid Soil Management Investments in Africa (GAIA) project to promote the use of agricultural lime. Field trials in regions such as Geita have demonstrated yield improvements, with maize farmers reporting up to a 50% increase in productivity (GAIA, 2023). SAGCOT and TARI also developed National Lime Application Guidelines. For alkaline soils, SAGCOT has promoted the use of gypsum as a soil amendment leading to rising demand for these amendments thus spurring local businesses.

SAGCOT has integrated sustainable practices, including the use of organic fertilisers (compost, biofertilizers), erosion control measures (terracing, cover cropping), and crop diversification (crop rotation, intercropping), to reduce nutrient depletion and dependency on chemical inputs.

The impact is evident: in the Southern Highlands, where maize yields historically ranged between 1.3 and 3 metric tons per hectare, farmers adopting best practices have reportedly achieved yields as high as 13 metric tons per hectare. While maize farmers successfully doubled corn yields to six metric tons per hectare through the adoption of conservation agriculture, the most dramatic yield intensification in the region has been observed among rice producers in the Mbarali Cluster. They achieved yields up to 10 metric tons per hectare and are now targeting global best practice yields of 13 metric tons per hectare. (SAGCOT, 2024) (SAGCOT data). This has translated into higher incomes and reduced environmental pollution. Despite successes, challenges persist, including limited access to lime and gypsum for farmers, inadequate soil testing facilities, and gaps in awareness. Addressing these requires increased government investment, subsidies for soil amendments, leveraging digital platforms for information dissemination, and expanding partnerships.

6.2.4 Climate-Smart Agriculture

The Green Growth Partnership (GRP), a key SAGCOT initiative, has played a pivotal role in fostering the adoption of climate-smart agricultural (CSA) practices. This initiative aims to enhance productivity while safeguarding environmental sustainability by promoting agroforestry, conservation farming, and integrated pest management (IPM) (CGIAR, 2021; Digest Tanzania, 2023; EcoAgriculture Partners, 2013a, 2013b; IUCN, 2024; Kilimo Kwanza, n.d.-c; WWF, 2013). Agroforestry, integrating trees and shrubs into crop and livestock systems, enhances soil fertility, reduces erosion, creates protective microclimates, and diversifies income (timber, fruits, and non-timber forest products). In regions like Morogoro, spices like lemongrass and cloves have been integrated, offering high-value export opportunities while preserving biodiversity (Digest Tanzania, 2023).

Conservation farming emphasises minimal soil disturbance, crop rotation, and maintaining soil cover. These practices improve soil structure, enhance water infiltration, reduce erosion, and sequester carbon. Farmers adopting these methods have reported higher yields and reduced input costs (Digest Tanzania, 2023). Integrated Pest Management (IPM) incorporates biological control, cultural practices, and mechanical methods to control pests sustainably, minimising reliance on chemical pesticides and reducing environmental contamination. These practices collectively contribute to the resilience of Tanzania's agricultural sector by improving soil health, water retention, and reducing vulnerability to pests and diseases (Digest Tanzania, 2023; IUCN, 2024). The GRP has also supported ecosystem services by promoting biodiversity and sequestering carbon. The success in Morogoro with integrating spices into agroforestry systems, particularly lemongrass and cloves, highlights the economic and ecological benefits of such Community Supported Agriculture (CSA) approaches.

6.2.5 Inclusivity and Empowerment

The Inclusive Green Growth (IGG) Guiding Tools, a product of SAGCOT that have undergone several updates since their formalization in 2017 (in 2024 in collaboration with The Nature Conservancy, Sokoine University of Agriculture, WWF Tanzania, CARE International, and IUCN), play a central role in balancing economic growth, environmental conservation, and social inclusiveness. These tools cater to diverse stakeholders, from small-scale producers to large processors, guiding them in adopting sustainable practices to enhance food security, improve livelihoods, and align operations with national and international standards (AGCOT, n.d.).

The IGG tools are structured for four groups: medium-to-large processors, medium-to-large producers, small processors, and small producers. Two main components exist: a checklist for compliance with legal requirements and best practices in inclusivity/social sustainability, sustainable business operations, and environmental sustainability; and a detailed annexe guiding regulatory requirements, processing times, costs, and penalties. For small-scale producers, the tools provide recommendations on labour practices, gender equality, environmental management, climate adaptation, efficient resource use, waste management, and Community Supported Agriculture (CSA) techniques.

This improves competitiveness, resilience, and reduces ecological footprints, while supporting biodiversity and climate mitigation. Processors benefit through collaboration opportunities with government agencies and development partners, gaining access to technical support, finance, and market linkages. Compliance enhances credibility with investors. The tools also facilitate knowledge sharing and dialogue. This collaborative approach has strengthened partnerships across the sector, accelerating the adoption of sustainable practices. SAGCOT's IGG Guiding Tools underscore a commitment to inclusive and responsible agricultural investment, demonstrating the power of innovation and collaboration in driving sustainable agricultural transformation.

6.2.6 Other Innovations

SAGCOT has spearheaded several other innovations to bolster Tanzania's agricultural sector:

- **Revitalising Neglected Value Chains:** Concerted efforts have focused on crops like potatoes, soybeans, and spices. This involved introducing improved seed varieties, disseminating best agronomic practices, and facilitating knowledge sharing among farmers. For instance, adopting disease-resistant potato varieties and training on proper planting techniques have increased yields and quality, opening new market opportunities for smallholders. The Tanzania Sustainable Soybean Initiative (TSSI) is one such example of partnership transforming a value chain (AGCOT, n.d.).
- **Commodity Associations:** These have empowered farmers by fostering collective bargaining and operational scalability, enabling better market access, price negotiation, and access to inputs, credit, and extension services.
- **Youth Empowerment:** SAGCOT has focused on engaging young people through innovation hubs, entrepreneurship training (e.g., YEFFA project supported by Mastercard Foundation (AGCOT, n.d.)), and leadership development programs to tackle youth unemployment and cultivate a new generation of agricultural leaders. The "Building a Better Tomorrow" (BBT) initiative is a key government programmes aligning with these goals (Africa Food Systems Forum, 2023a; The Guardian, 2025a, 2025b; URT, 2024a).

- **Farmer-to-Farmer Knowledge Sharing:** Experienced farmers act as trainers and mentors, accelerating the adoption of new technologies and fostering collaboration.
- **Commodity-Specific Associations:** Associations for crops like rice, avocados, and potatoes enable farmers to advocate for their interests and negotiate favourable market conditions.
- **Market Access Improvement:** Creation of roadside markets and structured market systems, along with aggregation centres, has reduced reliance on intermediaries and post-harvest losses.
- **Laser Land Levelling:** Introduced in rice-growing areas, this technology optimises water use and boosts productivity by ensuring uniform soil surfaces.
- **Biochar Production:** Promoting biochar production from rice husks enhances soil fertility, water retention, and sequesters carbon, addressing waste management and soil degradation.

6.3 Transitioning to AGCOT: Scaling and Adapting Innovations

A review of SAGCOT's performance reveals significant achievements that have laid the groundwork for a national scale-up. Regarding food security, SAGCOT surpassed its 2030 target of 350,000 hectares under profitable production, reaching 859,298 hectares by 2023/24 (EcoAgriculture Partners, 2013c; Green Policy Platform, n.d.; Kilimo Kwanza, 2025c; SAGCOT, 2023a). Some reports suggest up to 1.3 million hectares were brought under climate-resilient cultivation (Kilimo Kwanza, 2025c). This expansion contributed to increased agricultural output for local consumption and export. On the social front, SAGCOT has created over 253,000 new employment opportunities (Kilimo Kwanza, 2025c), surpassing its target of 420,000 jobs by 2030 (Green Policy Platform, n.d.).

Furthermore, 36,888 commercial smallholder farmers were reported as integrated into the initiative in earlier user-provided figures, with broader estimates suggesting nearly 1 million farmers were reached or empowered through various value chains (Kilimo Kwanza, 2025a; SAGCOT and IFC, 2024). These efforts improved livelihoods and enabled a transition from subsistence to commercially viable operations.

SAGCOT's emphasis on green growth demonstrated its commitment to sustainability and resilience. The initiative aimed to lift a significant number of people out of poverty, with initial targets of 2 million, although some sources cited 20 million (EcoAgriculture Partners, 2013c; Green Policy Platform, n.d.). However, precisely verified figures on actual poverty reduction across all reports are complex to ascertain. By promoting climate-smart agricultural practices, SAGCOT has ensured that growth in the agricultural sector does not come at the expense of environmental health.

The economic impact of SAGCOT has been reflected in cumulative farming revenues reaching over USD 606 million by the 2023/24 fiscal year (Kilimo Kwanza, 2025c). This represents substantial progress toward the 2030 annual target of USD 1.2 billion (EcoAgriculture Partners, 2013c; Green Policy Platform, n.d.). In addition, SAGCOT successfully mobilised USD 5.02 billion in public investment and USD 1.32 billion in private investment, far exceeding its original 2030 total investment target of USD 3.5 billion (or USD 5.7 billion according to some sources) (EcoAgriculture Partners, 2013c; SAGCOT and IFC, 2024). To advance agricultural transformation, the President of the United Republic of Tanzania, Dr. Samia Suluhu Hassan, launched the African Food Systems Platform on March 17, 2023, at the State House in Dar es Salaam (AFS Forum, 2023a, 2023b; URT, 2023a). During the launch, the President acknowledged the remarkable achievements of SAGCOT and directed its expansion to other regions, emphasising its potential as a national model for agricultural development (AFS Forum, 2023c; URT, 2023b).

This directive marked a critical milestone. By scaling and adapting the successful SAGCOT model to a nationwide framework, AGCOT seeks to address regional nuances while advancing food security, rural development, and economic growth. SAGCOT demonstrated how targeted agricultural interventions could transform livelihoods and economies. Its success was rooted in a cluster-based approach that concentrated resources geographically, fostering efficiency and collaboration among stakeholders. Public-private partnerships played a vital role, bringing together governments, private investors, and NGOs to address systemic challenges and attract significant investment. Inclusive development strategies that focus on empowering women and youth have been particularly impactful, resulting in tangible social and economic benefits and underscoring the importance of equity in agricultural growth (Kilimo Kwanza, n.d.; Sulle, 2020; UK Government Publishing Service, n.d.).

The transition from SAGCOT to AGCOT marks a crucial turning point. The Kilimo Kwanza initiative laid the foundation for AGCOT. The four key corridors under AGCOT are: the Southern Highlands Corridor (expanded SAGCOT core zone), the Mtwara Corridor, the Central Corridor, and the Northern Corridor, each critical to Tanzania's agricultural transformation strategy (Kilimo Kwanza, 2025c). By scaling up SAGCOT's achievements and addressing its challenges, AGCOT aims to further unlock Tanzania's agricultural potential. Despite SAGCOT's accomplishments, challenges such as infrastructure gaps, inconsistencies in policy enforcement, and limited climate resilience strategies have become evident (Digest Tanzania, 2023; KTH Diva Portal, 2024; Kilimo Kwanza, 2025a; Sulle, 2025; World Bank, 2024b; World Bank, n.d.a). These hurdles highlighted the need for enhanced coordination and a stronger emphasis on sustainability.

Building on SAGCOT's successes, AGCOT embraces the challenge of scaling its innovations while tailoring approaches to diverse conditions. Expanding the cluster model requires careful adaptation to local agro-ecological and socio-economic realities. Climate resilience is a central pillar, with strategies like agroforestry, conservation farming, and water-efficient irrigation integrated to reduce risks and enhance productivity (ASPIRES Tanzania and MSU, 2022; EcoAgriculture Partners, 2013d, 2013e; Green Policy Platform, n.d.; Kilimo Kwanza, 2025a, 2025d; URT, Tanzania, 2024b; URT, n.d.; RATIN, 2025; The Citizen, 2025a. Empowering stakeholders, particularly women and youth, through targeted capacity-building, training, resources, and market access is vital for inclusivity and sustainability (AFS Forum, 2023b; The Guardian, 2025a, 2025b; Kilimo Kwanza, 2025c, n.d.-d; The Citizen, 2025a).

AGCOT's success will depend on robust policy and institutional support, strong government leadership under national frameworks such as

Tanzania Vision 2050 and Agenda 2030, multi-sectoral collaboration, and farmer-centric policies. Monitoring and evaluation systems will be integral for accountability and adaptability. As Tanzania transitions from SAGCOT to AGCOT, the focus remains on three critical themes: enhancing productivity, fostering sustainability, and embedding inclusivity. SAGCOT's interventions have been pivotal in amplifying yields, diversifying incomes, and strengthening value chains. The initiative has also been instrumental in scaling climate-smart practices and building resilient systems. Moreover, by placing women, youth, and marginalised groups at the centre of agricultural progress, SAGCOT has unlocked their potential as change agents. It is a commitment to transforming farmers into entrepreneurs, environmental stewards, and drivers of economic growth and transformation. The success of Tanzania's agriculture lies in feeding its people and fostering a prosperous, inclusive, and sustainable future for all.

6.4 Conclusion

The journey from SAGCOT to AGCOT represents a strategic and ambitious scaling of farmer-focused innovations in Tanzania. Building on over a decade of SAGCOT's experiences in the Southern Highlands, marked by significant investment mobilisation, increased agricultural productivity, and the integration of hundreds of thousands of smallholder farmers into commercial value chains, AGCOT aims to replicate and adapt these successes nationwide. The core principles of cluster development, public-private partnerships, climate-smart agriculture, and inclusive empowerment, which were central to SAGCOT's operational model, form the bedrock of the AGCOT framework. The transition acknowledges both the triumphs and the challenges encountered by SAGCOT.

While SAGCOT demonstrated the transformative potential of targeted interventions in infrastructure, soil health, and market access, it also highlighted persistent issues such as land tenure complexities, the need for consistent policy implementation, and the imperative for deeper inclusivity to ensure equitable benefit distribution. AGCOT is designed to address these lessons by embedding localised adaptation within its four strategic corridors, strengthening policy and governance reforms, and maintaining a steadfast focus on climate resilience and the empowerment of women and youth. The alignment of AGCOT with Tanzania's overarching national development strategies, including ASDP II, the Agriculture Master Plan 2050, and Vision 2050, provides a robust policy anchor and signals strong political will.

However, the realisation of AGCOT's vision of a national agricultural renaissance hinge on overcoming significant hurdles. These include ensuring effective multi-stakeholder coordination across diverse agro-ecological zones, mobilising sustained and substantial investment in both hard and soft infrastructure, building the institutional capacity for effective implementation and governance, and proactively managing environmental risks and social safeguards.

Ultimately, AGCOT's success will be measured not merely by increased export figures or aggregate production volumes, but also by its tangible impact on the livelihoods of millions of Tanzanian farmers, its contribution to national food and nutrition security, and its ability to foster a truly sustainable and resilient agricultural sector. The shift from SAGCOT to AGCOT is more than an expansion; it represents a generational commitment to transforming Tanzania's agriculture into an engine of inclusive economic growth, environmental stewardship, and shared prosperity, positioning the nation as a leader in transforming African food systems.

6.5 Recommendations

To maximise the potential of the Agricultural Growth Corridors of Tanzania (AGCOT) and effectively mitigate the inherent risks, the following targeted and actionable recommendations are proposed:

Policy and Governance:

1. **Strengthen Multi-Stakeholder Platforms (MSPs):** Within each AGCOT corridor and its constituent clusters, establish and empower MSPs that ensure the genuine and active participation of all stakeholders, particularly smallholder farmers, women, youth

representatives, and pastoralist communities. These platforms should be integral to participatory planning, ongoing monitoring of interventions, and transparent grievance redressal mechanisms (Lwenje, n.d.).

2. **Establish Clear and Streamlined Regulatory Frameworks:** Develop and implement transparent, predictable, and efficient regulatory frameworks specifically for agricultural investment, land acquisition processes (including clear guidelines for public-private land partnerships), and contract farming arrangements within the AGCOT zones. These frameworks must aim to prevent land conflicts by providing clarity and security for all parties (Tietenberg, n.d.a).
3. **Enhance Inter-Agency Coordination:** Institute robust coordination mechanisms at national, regional, and local levels to ensure seamless collaboration between the AGCOT Centre, relevant government ministries, local government authorities, and private sector entities.

Investment and Finance Mobilisation:

4. **Develop Tailored Financial Mechanisms for Smallholders and SMEs:** Actively promote and support the development of innovative financial products and services specifically designed to meet the needs of smallholder farmers and agricultural Small and Medium Enterprises (SMEs), addressing collateral challenges and reducing transaction costs (Social Watch, n.d.) andleverage institutions like the Cooperative Bank of Tanzania (CBT) (The Citizen, 2025a).
5. **Prioritise Public Investment in Enabling Infrastructure:** Continue and strategically expand public investment in foundational infrastructure critical for agricultural development within the corridors, including rural feeder roads, sustainable irrigation systems, post-harvest storage facilities (including cold chains), and reliable energy supply (SAGCOT and IFC, 2024).
6. **Promote Responsible Private Sector Investment:** Actively seek and incentivise private sector investment that aligns with AGCOT's principles of inclusivity, sustainability, and smallholder empowerment, including fair out-grower schemes and joint ventures.

Inclusivity, Social Safeguards, and Land Rights:

7. **Implement and Enforce Robust Social and Environmental Safeguards:** Mandate comprehensive Social and Environmental Impact Assessments (SEIAs) for all significant AGCOT-related investments. Develop and strictly enforce robust safeguard policies to protect local communities and the environment, with independent monitoring (Kilimo Kwanza, 2025a; Makundi, 2023; Smalley, 2017; Sulle, 2025; World Bank, n.d.b).

8. **Address Land Tenure Ambiguities:** Prioritise the systematic clarification and registration of land rights within the AGCOT corridors, including formal recognition of customary tenure. Establish transparent, fair, and legally sound procedures for any necessary land acquisition, ensuring timely and adequate compensation (Kilimo Kwanza, 2025a; KTH Diva Portal, 2024; Sulle, 2025).

9. **Targeted Empowerment Programs for Women and Youth:** Design and implement specific programmes within AGCOT to enhance the participation and benefits for women and youth in agricultural value chains, including access to land, finance, technology, training, and markets (The Citizen, 2025a; The Guardian, 2025a, 2025b; Kilimo Kwanza, 2025c, n.d.-d).

Climate Resilience and Environmental Sustainability:

10. **Integrate Climate Risk and Adaptation into All Planning:** Mandate the integration of comprehensive climate risk assessments into all AGCOT planning. Actively promote and support the widespread adoption of climate-smart agricultural practices, including water harvesting, efficient irrigation, drought-tolerant crop varieties, agroforestry, and conservation agriculture (Digest Tanzania, 2023; IUCN, 2024; Kilimo Kwanza, 2025a; World Bank, 2024b).

11. **Strengthen Environmental Management and Monitoring:** Enforce stringent environmental management practices to prevent deforestation, soil degradation, water pollution, and biodiversity loss. Promote sustainable land use planning and agro-ecological approaches (Tietenberg, n.d.-b).

Institutional Capacity Building and Coordination:

12. **Invest in Comprehensive Capacity Building:** Implement a significant and sustained programme to build the technical, managerial, and operational capacity of all key institutions involved in AGCOT, including the AGCOT Centre, local government authorities, agricultural extension services, and farmer organisations (World Bank, 2024b).

13. **Foster Research-Extension-Farmer Linkages:** Strengthen linkages between agricultural research institutions (like TARI), extension services, and farmers for effective dissemination and adoption of innovations (Kilimo Kwanza, 2025b).

Monitoring, Evaluation, and Adaptive Management:

14. **Establish a Robust and Participatory Monitoring, Evaluation, and Learning (MEL) Framework:** Develop a comprehensive MEL framework for AGCOT with clear, measurable indicators for economic, social, and environmental outcomes, disaggregated to track impacts on different groups.

15. **Ensure Independent M&E and Promote Adaptive Management:** Incorporate independent verification in the M&E system and involve community stakeholders. Utilise MEL findings to inform adaptive management and facilitate timely course corrections.

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Chapter 7 Indigenous knowledge and practices on improving agricultural productivity in Kagera region: A case study

Jane Mpapalika

7.1 Introduction

Holistically, Indigenous Knowledge (IK) refers to the local knowledge used by indigenous people as part of a survival mechanism in sustaining livelihoods. IK consists of the skills and practical experiences gained by local communities through their interaction with the natural surroundings and passed down to future generations through folklore, such as stories, and songs (Zhang and Nakagawa, 2018). In other words, IK is traditionally gained within a specific culture or community to fit the environmental and socio-cultural context of that area (Mensah, et. al., 2023). As the adage goes, "practice makes perfect," and over time, individuals who repeatedly engage in certain tasks discover more efficient ways to execute them, resulting in higher yields/returns at lower costs and risks. Local communities, particularly the indigenous people, are well-equipped to adapt to environmental challenges due to their continuous exposure to the changing environment. In this context, agricultural IK is accumulated through traditional farming practices adopted by smallholder farmers with limited access to mechanized and modern farming techniques.

The significance of IK lies in its sustainability, resilience, and holistic problem-solving approach. Indigenous communities have long relied on these knowledge systems to manage natural resources, predict weather patterns, conserve biodiversity, and ensure food security. Traditional farming techniques, such as intercropping, agroforestry, weather predictions, and organic pest control, have proven to be ecologically sustainable and climate-resilient (Altieri, 2004). Similarly, indigenous medicine, based on herbal remedies and spiritual healing practices, provided healthcare solutions long before modern pharmaceuticals were introduced (Battiste, 2002). Despite its importance, IK faces significant challenges due to modernization, globalization, and the unprecedented climate change. Many traditional practices are being lost as younger generations increasingly move toward formal education systems that often overlook indigenous wisdom. Moreover, policies and development interventions tend to prioritize scientific knowledge, often marginalizing local knowledge systems (Agrawal, 1995). Addressing these challenges requires recognizing IK as a valuable resource for sustainable development and integrating it with modern scientific approaches.

In many African communities, Indigenous Knowledge (IK) plays a critical role in addressing health and environmental challenges. It enables people to treat various ailments and manage risks associated with floods, droughts, and earthquakes. For instance, Ethiopia hosts a diverse range of food and medicinal plants that have evolved in response to local climatic and soil conditions, offering vital nutritional and therapeutic value during famines and crises (Gitima et al., 2025). Herbs, shrubs, and trees are widely used to treat ailments such as diarrhoea, eye diseases, snakebites, and malaria, particularly in areas where access to modern medicine is limited. In addition, cultural beliefs and environmental observations also strengthen resilience. In some coastal communities, gulls are revered as spiritual messengers symbolizing adaptability and survival, while in tsunami-prone areas, communities rely on natural signs and animal behaviour, such as buffalo herds gathering before an earthquake, as early warning systems (Mikulecky et al., 2023). These practices not only reduce disaster risks but also preserve intergenerational knowledge and cultural identity.

Women in rural African communities are at the forefront of applying IK to water management and agriculture. They use ecological indicators such as the presence of trees like Mukute (*Syzygium cordatum*) and grasses like Magungira to identify underground water sources and dig traditional wells without relying on modern geotechnical methods (Gwandure and Lukhele-Olorunju 2023). Similarly, soil texture and colour help determine water availability, while traditional methods used to purify and store water. Women also sustain agricultural traditions by cultivating indigenous crops such as cowpeas, sorghum, millet, pumpkins, and cucumbers, using organic inputs like compost and animal manure. These practices not only enhance food security but also serve niche markets that demand organic produce. Traditional seed preservation ensures the continuity of indigenous varieties, safeguarding biodiversity and cultural heritage. For instance, African horned cucumber (*Cucumis metuliferus*), Bambara nuts (*Vigna subterranea*), and finger millet (*Eleusine coracana*) remain integral crops across several African countries (Sipeyiye and Muyambo, 2021; Abady et al., 2019). Such agricultural resilience highlights the enduring value of IK in promoting sustainable livelihoods while maintaining ecological balance.

7.2 Socio-economic profile of Kagera region

Located in the north-western parts of Tanzania, the area around Lake Victoria that includes the Kagera region, named after the river Kagera, is one of the most densely populated with fertile red soils suitable for arable farming, supporting the cultivation of a wide variety of crops such as bananas, beans, maize, cassava, and coffee. Its favourable climate, characterized by bimodal rainfall patterns, ensures relatively stable agricultural productivity compared to other parts of the country prone to prolonged droughts. The proximity of Kagera to Lake Victoria not only enhances soil fertility but also provides abundant freshwater resources that sustain fishing, livestock rearing, and irrigation practices.

The region borders Uganda to the north, Rwanda and Burundi to the west, and Lake Victoria to the east as shown in Figure 7.1.

Figure 7.1: Map of Kagera region

With a population of approximately 3 million (2022 Census), the region is home to diverse ethnic groups, including the Haya, Nyambo, Zinza, and Subi among others. Kiswahili is the official language, though Haya is widely spoken. Administratively, Kagera region is subdivided into eight (8) councils, namely: Missenyi DC, Kyerwa DC, Karagwe DC, Muleba DC, Ngara DC, Biharamulo DC, Bukoba DC and MC as shown in Table 7.1.

Table 7.1: Councils and population rates in Kagera region

	Council	**Population**
1.	Karagwe District	385,744
2.	Bukoba District	322,448
3.	Bukoba Municipal	144,938
4.	Muleba District	637,659
5.	Biharamulo District	457,114
6.	Ngara District	383,092
7.	Kyerwa District	412,910
8.	Missenyi District	245,394
	Total	**2,989,299**

***Source*:** Administrative Units Population Distribution Report, NBS (2022).

Each of the seven districts has its own unique economic and geographical characteristics. **Missenyi DC** that shares a border with Uganda is known for cross-border trade, livestock keeping, and coffee farming. **Kyerwa DC**, situated in the west, is an important agricultural zone, particularly for banana and coffee produce. **Karagwe DC** is recognized for its historical significance and cultural heritage, with a strong agricultural base focused on coffee, bananas, and beans. **Muleba DC**, one of the largest in Kagera, is notable for fishing activities along Lake Victoria and extensive banana and coffee farming. **Ngara DC** in the southwest features a diverse landscape and plays a crucial role in cross-border trade with Rwanda and Burundi. Meanwhile, **Bukoba DC** serves as an administrative and economic hub, with a mix of agriculture, trade, and small-scale industries and **Biharamulo DC** located in the southern part of the region, is known for its forest reserves, gold mining and agriculture (e.g. banana, maize, cassava, and beans) being the primary food crops.

Therefore, the economy is primarily driven by agriculture, with key cash crops such as coffee, tea, and cotton, alongside food crops like bananas, vanilla, cassava, maize, beans, and sweet potatoes. Fishing in Lake Victoria also plays a crucial role, with Nile perch and tilapia being major catches. Livestock keeping, mainly cattle, goats, sheep, and poultry, supports local markets, while cross-border trade with Uganda, Rwanda, and Burundi facilitates the exchange of food products, textiles, and household goods. Despite its economic potential, the region faces several challenges, including the impacts of climate change, such as droughts and erratic rainfall. These environmental factors disrupt agricultural productivity and food security, affecting livelihoods and economic growth. Additionally, poor rural road networks hinder market access, limiting trade opportunities for farmers and small-scale businesses. Addressing these challenges requires investment in climate-resilient agriculture (Climate-Smart Agriculture)[9], infrastructure development, and policies that support sustainable economic growth in the region.

[9]As part of awareness-raising efforts on climate change, REPOA carried out a scoping mission in February 2022 in Kagera region. The scoping mission was aimed at understanding on climate change and challenges they face in agriculture to inform the Climate-Smart Agriculture Training Programme. The scoping mission revealed capacity gaps in their understanding and responses to the effects of climate variability to improve their livelihoods.

7.3 Theoretical Framework

Indigenous Knowledge (IK) has long been recognized as the unique, traditional, and local wisdom accumulated by communities over generations, deeply rooted in cultural practices, belief systems, and livelihoods (Warren, 1991, Chanza and Musakwa 2022). Unlike Western scientific knowledge, which is typically codified and standardized, IK is dynamic, adaptive, and transmitted primarily through oral traditions. It evolves in response to lived experiences and interactions with local environments, making it context-specific and highly relevant to local realities (Berkes, 1999). Theoretical perspectives such as Constructivist Theory, Ecological Systems Theory, and Resilience Theory reinforce the value of IK, emphasizing the interdependence of humans and ecosystems while demonstrating how communities draw on adaptive knowledge systems to address social, economic, and environmental challenges.

Over time, IK has been described using multiple terms—including "traditional ecological knowledge," "indigenous technical knowledge," and "endogenous knowledge" (Hadlos et al., 2022). These varied terms reflect both its richness and ongoing debates over its scope and definition. Some scholars prefer the term "local knowledge" to underscore its evolving and adaptive nature (Matti & Ögmundardóttir, 2022). IK often defined as an accumulated body of wisdom transmitted intergenerationally through lived experience, cultural practices, and intimate interaction with ecosystems (Ijatuyi et al., 2025). For example, it encompasses land-use systems, agriculture, medicinal plants, healing practices, and ecological stewardship, all of which support food security, health care, and environmental sustainability. Tassell-Matamua (2025) frames IK as empirically grounded wisdom that sustains natural equilibrium, rooted in worldviews recognizing the interconnectedness of humans, nature, and the spiritual realm.

Across Africa, IK remains integral to resilience in agriculture, natural resource management, health, and disaster risk reduction. Communities have long relied on indigenous methods of flood control, drought coping mechanisms, and climate adaptation, many of which continue to shape resilience strategies today (Bol & van Niekerk, 2024). IK represents collective coping practices that strengthen community responses to shocks such as floods in urban centres (Echendu, 2024) or broader climate crises (Datta et al., 2024). In agriculture, farmers apply biophysical indicators—including plant flowering patterns, animal behaviour, and cloud formations—to forecast weather and floods (Fabiyi & Oloukoi, 2013; Mahoo et al., 2015; Munsaka & Dube, 2018; Mapedza et al., 2022). Similarly, indigenous practices such as selecting resilient crop varieties, adjusting cropping calendars, and conserving biodiversity foster sustainable livelihoods while enhancing adaptive capacity (Andrew 2009; Wang et al., 2023). These practices illustrate how IK contributes directly to food security and environmental stewardship, complementing scientific knowledge systems.

Despite its importance, IK faces several challenges that threaten its transmission and long-term relevance. Foremost, much of it remains undocumented, passed orally across generations, which risks loss as younger generations turn to modern practices (Wall, 2006). Also, social and political factors, including age, gender, marital status, and wealth, also shape who accesses, controls, and transmits IK within communities, leaving it fragmented and unevenly preserved. In addition, modernisation and reliance on external technologies further marginalise indigenous practices, often leading to neglect of locally grounded solutions. Yet, studies on food security demonstrate that IK remains vital as evidenced by households across Zimbabwe, Zambia, and Malawi who collect indigenous fruits and vegetables, as well as edible insects, as coping strategies during droughts and lean seasons (Kiptot et al., 2014; Niassy et al., 2016). Likewise, in West and Central Africa, these same practices serve as critical buffers against hunger in semi-arid regions. Such evidence underscores the urgency of preserving, documenting, and integrating IK with contemporary science to safeguard its role in resilience, climate adaptation, and sustainable development.

7.4 Application of IK

The application of indigenous knowledge in the socio-economic, environmental, and cultural aspects plays a vital role in fostering sustainable development, preserving biodiversity, and maintaining cultural heritage. Indigenous knowledge, often passed down through generations, based on a deep understanding of local adaptive mechanisms in the ecosystems, social structures, and cultural practices. Its application includes:

7.4.1 IK on agricultural practices

Indigenous agricultural knowledge is deeply valued in Kagera, where farming remains a primary means of subsistence. However, agriculture in Kagera faces increasing challenges due to climate change, with extreme weather events like droughts and floods affecting productivity. The region experiences two rainy seasons, from October to December and from March to May, with peak rainfall occurring in April and November. These conditions, combined with the region's fertile red soils, create a favourable environment for agriculture, which predominantly practiced by smallholder farmers using traditional methods such as intercropping and crop rotation. Thus, local communities possess extensive understanding of soil composition, climate patterns, and crop varieties, which will enable them to cultivate resilient indigenous crops such as millet, sorghum, cassava, yam, and various traditional vegetables. These crops are well-adapted to the region's environmental conditions and natural pests.

Further, traditional farming techniques emphasize sustainability and biodiversity, incorporating water conservation strategies, drought-resistant crops, and seasonal weather awareness to boost productivity. Agro-ecological practices like intercropping and crop rotation play a crucial role in maintaining soil fertility and reducing pest infestations without relying on synthetic fertilizers and pesticides. Organic farming techniques, including the use of animal manure, further enhance soil health and promote sustainable agriculture. Women in rural areas particularly contribute to indigenous farming by cultivating crops such as cowpeas (*kunde*), bambara nuts (*njugu mawe*), finger millet (*mtama*), and pumpkins (*maboga*), ensuring food security and preserving traditional knowledge (Gwandure and Lukhele-Olorunju 2023).

Indigenous seed preservation techniques, such as sun-drying and storage in ash-lined calabashes, help protect drought-resistant and pest-resistant seed varieties like maize, millet, cassava, and banana. Additionally, organic soil enrichment methods, including composting biodegradable waste and using biofertilizers derived from fermented banana leaves and legume residues, contribute to sustainable farming (Hettiarachchi, 2020; Anokye and Mohammed, 2024). Mulching with banana leaves, grass, and wood ash helps retain soil moisture and prevent erosion, especially in the region's hilly terrain, further showcasing the effectiveness of traditional farming knowledge.

7.4.2 Indigenous Knowledge on livestock and fish farming

The Kagera region is rich in indigenous livestock breeds, including local cattle, goats, and poultry, which play a crucial role in the livelihoods of rural communities. These livestock breeds are well-adapted to the region's climate and ecological conditions, contributing to food security and providing income through their sale and by-products such as milk, eggs, and meat. In addition to livestock farming, fish farming is widely practiced along the shores of Lake Victoria, with indigenous fish species such as Nile tilapia (Oreochromis niloticus) and the local catfish being harvested for both local consumption and trade. Traditional knowledge of sustainable fishing practices, including selective harvesting, proper fish stocking, and the management of water quality, is essential for maintaining the health of aquatic ecosystems in the face of increasing pressures such as overfishing and pollution.

Local communities have developed strategies to ensure the sustainability of their fish resources, such as maintaining fish breeding sites, avoiding destructive fishing methods, and respecting seasonal fishing bans. Studies such as those by Obiero, et al., (2023) have highlighted the use of traditional fishing technology such as traps and spears with minimal fishing pressure on the fishery resources. These practices not only support biodiversity but also contribute to the resilience of local economies, enhancing both food security and income generation opportunities for communities dependent on aquaculture.

7.4.3 Indigenous knowledge on cultural practices

Ritual events tied to farming, cultural heritage celebrations, and family life serve as vital opportunities to strengthen community bonds and pass down knowledge to future generations. Indigenous communities engage in traditional ceremonies, dances, and rituals that honour ancestors, celebrate harvests, and mark significant life events, fostering unity and a sense of belonging. While folklores are cultural expressions, which are essential in preserving the identity, history, and social cohesion of an indigenous community (Thompson et al. 2024), in this case they encompass a community's tradition, customs, stories, and songs passed down orally across generations. It is categorized into verbal folklore (folktales, myths, proverbs), material folklore (food, clothing, tools), and customary folklore (dances, rituals, and festivals).

Additionally, cultural practices around antenatal and postnatal care, such as consulting traditional healers and using herbal remedies, underline the importance of IK in health practices (Shopo, et al., 2024). These practices, passed down through generations, support the understanding of community-based health, which highlight how IK serves as an alternative to Western medical approaches.

7.4.4 Indigenous knowledge on food preservation techniques

The indigenous people of Kagera region have developed several traditional methods to preserve food, ensuring year-round availability. These practices include drying fruits, vegetables, and fish to prolong their shelf life, as well as fermenting foods like cassava. For the case of maize, the harvested crops are stored in either cobs or shelled traditionally, the local communities preserve their produce by hanging them on the ceilings over the cooking place to allow the smoke and heat from the fire below to destroy weevils. On the other hand, shelled grains from millet, rice, and sorghum are safely stored in air-tight cylinders or containers locally known as *"kunti."* Moreover, sand is added in the *kunti* to occupy the air spaces between the grains while forcing out the air, leaving no room for the gradual formation of grain weevils. In another district, in

Muleba DC, Mama's Hope Organization for Legal Assistance (MHOLA) has been supporting women farmer groups and agribusinesses to grow sunflower, habanero "*pili pili*", beans, *cassava*, and thereafter, processes them by drying them for either storage or for sale as shown in Figures 7.2 and 7.3.

Figure 7.2: Storage of *pili pili* in Muleba

Figure 7.3: Storage of cassava in Muleba

Smoking and salting are also commonly used to preserve fish and meat, especially along the shores of Lake Victoria. According to Mmari, et al., (2017), the Haya people in Kagera utilize indigenous technologies and processing methods for consuming senene (edible bush crickets), which are mainly harvested through wild collection, including setting traditional traps. Additionally, farmers in the region store seeds using materials such as ash, orange peels, clay pots, glass containers, and hessian bags. Traditional seed preservation methods also include hanging grains in cool places, smoking seeds, and storing them in paper bags. It is common to test seed quality by placing them in water, where good seeds sink and bad seeds float (ACB, 2018).

7.4.5 Indigenous knowledge on weather predictions

Indigenous communities around the Lake Victoria basin have developed a deep understanding of weather patterns and climate changes, using local indicators to predict seasonal shifts. They rely on a range of natural signs, including the behaviour of plants, insects, birds, and astronomical observations, to forecast planting and harvesting times (Filho, et. al., 2022, 2025). For instance, the flowering of coffee, changes with cloud types, and the direction of winds—whether shifting from east to west or from south to north—are key signs that signal the onset of wet or dry seasons (Bol and Van-Niekerk, 2024). Additional indicators include the appearance of longhorn grasshoppers (*Senene*), frog croaks at night, bird songs, and fluctuating swamp levels. This extensive knowledge helps communities in Kagera make informed decisions about farming practices, including the best times to plant and harvest crops. By observing these natural cues, indigenous people can plan agricultural activities and food storage in harmony with local seasonal changes, ensuring food security throughout the year.

7.4.6 Indigenous knowledge on soil types

Indigenous Knowledge on assessing soil varieties in terms of their texture, colour and the types of crops that are suitable in a particular plot of land is vital for farmers. The region has three different types of soil: the dark brown to reddish brown clay loamy sandy soils, with low to medium water holding capacity; greyish brown loamy sands soils, well drained and highly weathered; and the leached very dark grey silts and clay with dark brown sands and loams, with low fertility and poorly drained (Kagera Regional Commissioner's Office, 2019). Dark, greyish brown to reddish loamy sand is found in the midlands, while the greyish brown loamy sands are gathered in the lowlands. For instance, in Bukoba Rural and Muleba District Councils that are covered with soils portraying dark brown to reddish brown clay loams and dark, greyish-brown loamy sands, are suitable for the cultivation of permanent cash and food crops like coffee, bananas and tea. According to Izadi and Aghamir (2024), local farmers recognize differences in soil fertility levels based on local experience and indicators that depend on the crop performance, native species, soil characteristics, type of weeds, pests, diseases, and agricultural management, to improve, or restoring soil fertility.

7.4.7 Indigenous Knowledge on climate adaptation practices

Indigenous knowledge (IK) offers significant benefits for climate adaptation in Africa, allowing communities to utilize traditional practices, crop varieties, and land management techniques that have evolved in response to local climatic conditions. This knowledge enables communities to adapt by leveraging their deep understanding of local ecosystems, weather patterns, and context-specific practices—such as crop selection, cropping calendars, livestock breeds, and land management strategies—all tailored to their unique environmental conditions. In Africa, IK is particularly valuable in agriculture, where local communities rely on biophysical indicators like the behaviour of animals, insect activities, plant flowering, astrological signs, and the timing of seasonal changes to guide their farming practices.

7.4.8 Indigenous indicators based on birds

A wide range of local indicators, such as plants, animals, insects, meteorological and astronomical signs, are used by indigenous communities for weather prediction (Mahoo et al. 2015). In Lushoto, for example, birds such as swallows, hornbills, owls, coucals, and golden orioles, along with insects, animals like baboons, monkeys, and antelopes, plants, moon, sun, and wind serve as key indicators. Additionally, insects, including thrips, ants, bees, locusts, and butterflies, as well as specific shrubs and trees play a role. Regarding birds, indigenous knowledge is based on observing their behaviour, appearance, and movement patterns to forecast weather conditions. These observations are made informally, and over time, experience has helped locals identify distinct bird characteristics linked to weather changes. For instance, the sighting of large flocks of swallows and swans migrating from the South to the North between September and November is typically seen as a sign of the approaching short rains. Additional bird indicators are detailed in Table 7.2.

Table 7.2: Indigenous knowledge based on birds

Name*	**Scientific name**	**Behaviours related to the rainy season**
Swallows (*Vizewe*)		Flocks of swallows moving from south to north in the area are seen as a key indicator of the onset of the ***Vuli*** rains. In many cases, rainfall begins within **two to three days** after this migration pattern is observed.
Coucal (*Dudumizi*)	Centropussp	The loud singing of ***Dudumizi*** birds is considered a natural indicator of the onset of ***Vuli*** rains. This vocal activity is traditionally observed as a sign that rainfall is approaching.
Owl (*Bundi*)	Nocturnalis strigiformes	The sighting of an owl flying in the sky is regarded as a traditional sign that the planting season has begun. This observation is used by local communities as an indicator of the right time to prepare and sow crops.
Duck (*Bata*)	Anatidae anseriformes	When ducks stretch their wings and play in the dust, it is seen as a sign of the impending onset of rains, particularly during the ***Vuli*** season. This behaviour is considered a natural indicator that rainfall is approaching.
Chicken (*Kuku)*	Gallusgallus	Chicken stretching their wings repeatedly is a sign of onset of *vuli* rains
Wild bird (*Shemkoko)*		The loud singing of ***Shemkoko*** birds is considered a sign of the onset of the **Vuli** rains. Their vocalizations are traditionally interpreted as an indicator that the rainy season is about to begin.
Hornbils (Hondohondo)	Buceros bicornis	Flocks of ***Hondohondo*** birds are considered an indicator of the ***Vuli*** rains. Their presence and movement are traditionally seen as a sign that the rainy season is approaching.
Fischer's Lovebird (*Shundi*)	Agapornis fischeri	The crying of ***Shundi*** birds is regarded as a sign of the ***Vuli*** rains. Their calls are traditionally interpreted as an indicator that the rainy season

		is about to begin.
Goldenoriole (*Kurumbizi*)		The loud singing of ***Kurumbizi*** birds is considered an indication of a good rainfall season ahead. Their vocalizations are seen as a traditional sign that favorable weather and abundant rains are expected.
Wild bird (*Nyombe*)		When ***Nyombe*** birds walk towards the valley or wetlands, it is seen as a sign of the impending ***Vuli*** rains. This behaviour is traditionally interpreted as an indicator that the rainy season is about to begin.
Wild bird (*Njerunjeru*)		The presence of ***Njerunjeru*** birds is considered a sign of the upcoming ***Masika*** rains. Their arrival is traditionally interpreted as an indicator that the long rains are about to start.

***Source*:** Mahoo, et al., (2015).

Note: *Local or Kiswahili name in parenthesis

7.4.9 Indigenous indicators based on animal behaviour

Local communities utilise the presence and behaviour of both wild and domestic animals to forecast weather and climate patterns. For example, the appearance of wild animals in villages is considered a significant indicator. When baboons enter the village during the dry season, it is interpreted as a sign of an upcoming favourable rainy season. Similarly, domestic animals such as goats, sheep, and cattle repeatedly flapping their ears during the dry season signal the imminent onset of rain and the likelihood of a productive season. Additional indicators related to animal behaviour are presented in Table 7.3.

Table 7.3: Indigenous knowledge based on animal behaviour

Name*	**Scientific name**	**Behaviours related to the rainy season**
Baboons (Ngedere), monkeys (*Nyani*), leopards (*Chui*) and antelopes (*Pofu*)	Alouatta caraya-black monkeys, Pantherapadus-Leopard, Antelope Cervicapra-antelopes	The presence of wild animals in the village is considered a strong indicator of an approaching season with good rainfall. Their movement into human settlements, especially during the dry season, is believed to signal favourable weather conditions and an abundance of rain in the coming season.
Sheep (*Kondoo*)	Ovisaries	Sheep flapping their ears is recognized as a traditional sign indicating the onset of rainfall and the likelihood of a favourable season ahead. This behaviour is commonly observed during the dry season and is interpreted by local communities as a natural predictor of changing weather conditions.
Goat (*Mbuzi*)	Capraaegagrushircus	Goats flapping their ears is considered a natural indicator of the imminent onset of rainfall. This behaviour, observed during the dry season, is used by local communities as a sign of approaching wet conditions.
Cattle (*Ng'ombe*)	Bostaurus	Cattle repeatedly flapping their ears is recognized as a traditional sign indicating the onset of rainfall. This behaviour, observed during the dry season, is used by local communities to predict the arrival of rains.

***Source*:** Mahoo, et. al., 2015.

Note: *Local or Kiswahili name in parenthesis

7.4.10 Indigenous indicators based on insects

Indigenous indicators based on insects are widely used to predict weather patterns and seasonal changes, especially in agricultural communities. Some common examples include the appearance of ants in large numbers or their behaviour, such as moving to higher ground or building larger nests, is often considered a sign of imminent rainfall. Ants are believed to sense changes in atmospheric pressure and humidity, signalling the start of the rainy season. Also, bees that are observed in large groups or exhibit heightened activity, indicating a sign that rainfall is near. In some cultures, the behaviour of bees is also linked to the intensity of the rain while the appearance of green grasshoppers in large numbers in the fields is an indicator of the onset of rains, particularly during the short rainy season (***Vuli***). Their presence is believed to signal good rain for the upcoming season. Further insect-based indicators are detailed in Table 7.4.

Table 7.4: Indigenous knowledge based on insects

Name*	**Scientific name**	**Behaviour-related to the rainy season**
Armyants (*Siafu*)	Eciton burchellii, but there are many species	When ants appear in large numbers, even inside houses, and seem to be "celebrating," it is a sign of the impending onset of rains, particularly **Vuli** rains. This behaviour typically occurs about a week before the rains start, and it is often associated with the anticipation of heavy rainfall.
Insects (*Vidododo*)		The presence of ants on **Albizia** trees, especially when water is dripping from them, is considered an indicator of a good season. This behaviour is observed almost a month before the **Vuli** rains begin and

		is seen as a sign of favourable weather and abundant rainfall ahead.
Butterflies (*Vipepeo*)	Papilio spp. There are a great number of this insect species	The occurrence and migration of butterflies from the south to the north is seen as an indicator of the early onset of rains and a promising season. Specifically, the appearance of **black butterflies** is considered a strong sign of a good season with favourable weather and abundant rainfall.
East African long-horned grasshopper (*Senene*)	*Ruspolia differens (Leonard et al. 2020)*	In north-western Tanzania particularly in Kagera, Mwanza, Geita, Shinyanga, and Mara, "*senene*" (*Ruspolia differens*), commonly known as the East African long-horned grasshopper, appears seasonally in large swarms and is highly valued as a traditional food source rich in protein, especially among communities around Lake Victoria (Leonard et al., 2020). Their emergence occurs twice a year, first between May and July, aligned with or just after the *Masika* long and heavy rains, and second between November and December, aligned with or just after the *Vuli* short rains. Unlike birds, clouds, or other natural indicators that farmers use to predict the onset of rain, *senene* are not regarded as a sign of impending rainfall. Instead, their appearance

		reflects favourable post-rainfall conditions, humidity, soil moisture, and vegetation growth that support their breeding and survival. Thus, rather than predicting the rains, the seasonal swarms of *senene* signal ecological abundance and soil fertility, indirectly reinforcing seasonal cycles suitable for planting and harvesting.
Grasshoppers (*Panzi*)	Melanoplus differentialis	The appearance of **green grasshoppers** in large numbers in the fields is considered a sign of the onset of rainfall, particularly the **Vuli** rains. Their presence in the fields is traditionally interpreted as an indicator that the rainy season is about to begin.
Frogs/africanclawed frog (*Vyura*)	Xenopuslaevis. Various spp	When frogs start making a lot of noise, it is seen as an indication that rainfall is imminent. The louder their croaking becomes, the stronger the sign that a good rainy season is ahead, with abundant rainfall expected.
Bees (*Nyuki*)	Apismellifera	The appearance of **bees** in large groups is considered a sign that the **Masika** rains are about to start. Their gathering is traditionally interpreted as an indicator of the impending onset of the long rainy season.

***Source*:** Mahoo, et. al., 2015.

Note: *Local or Kiswahili name in parenthesis

7.4.11 Indigenous indicators based on plants

Indigenous indicators based on plants are essential tools for predicting weather patterns, agricultural cycles, and seasonal changes. For example, the flowering of trees such as coffee, avocado, and Albizia is commonly used to signal the onset of rains, with avocado trees producing numerous buds and flowers as a sign that rain is approaching. Similarly, the shedding of leaves or budding of plants like *Solanum incunum* indicates impending rains, while new leaf growth in certain trees marks the beginning of the rainy season. The behaviour of the Datura plant is also a reliable indicator—if it produces abundant flowers or drops leaves, rainfall is expected, but if it turns upside down, it suggests a cold, potentially destructive season. The growth of fresh grass is another indicator of the arrival of rains, signalling the right time for planting. Additionally, the flowering and fruiting of bamboo often precede the rainy season, while an unusual abundance of flowers on pigeon pea plants is seen as a sign of a good rainy season. The appearance of fruit on trees like Datura or Moringa is also linked to the start of the rainy season, and the growth of medicinal herbs like Moringa oleifera or Aloe vera signals changes in weather patterns, helping communities make informed decisions about farming and other activities as shown in Table 7.5.

Table 7.5: Local knowledge based on plants

Name*	**Scientific name**	**Rain-related signs**
Datura (*Mitura*)	*Solanum incunum*	Abundant fruit production and the dropping of leaves from the **Datura** plant are seen as indicators of the onset of rainfall. However, if the plant turns upside down, it signals that the season will be too cold, potentially harmful, and even destructive to crops. This behaviour is traditionally interpreted as a warning of unfavourable weather conditions ahead.

Albizia (Mishai)	*Albizia gummifera*	The appearance of insects locally known as ***vidododo*** on **Albizia** trees, with water dripping from the trees during the dry season, is considered a sign of the approaching **Vuli** rains. This occurrence is traditionally interpreted as an indicator that rainfall is imminent.
Pigeon-pea (*Mbaazi*)	*Cajanuscajan*	When a **pigeon pea** plant produces an unusually large number of flowers, it is seen as a sign of a good season ahead. This abundant flowering is traditionally interpreted as an indicator of favourable weather conditions and a bountiful harvest.
Venonia (*Tugutu*)	*Vernonia myriantha*	When a tree begins to produce flowers, it is seen as an indication of the early onset of rains. The flowering of certain trees is traditionally regarded as a natural sign that the rainy season is approaching.
Baobab/Fig tree (*Mkuyu*)	*Ficuscycomorus*	The flowering and generation of new leaves on certain plants is considered an indicator of the onset of rainfall. This is traditionally seen as a sign that the **long rains** are about to begin, with favourable conditions for agriculture and plant growth.
Coffee (*Kahawa*)	*Coffea arabica*	The flowering of **coffee trees** is considered a sign of the **Vuli** rains. This event is traditionally interpreted as an indicator that the short rainy season is about to begin.
Avocado (*Parachichi*)	*Percea americana*	Avocado trees appearing to have many buds and flowers are an indication of rains. When **avocado trees** display an abundance of buds and flowers, it is

		seen as a sign that rains are imminent. This flowering is traditionally interpreted as an indicator of the coming rainy season.

Source: Mahoo, et. al., 2015. Note: *Local or Kiswahili name in parenthesis

7.4.12 Indicators based on the moon, sun and wind

In comparison to Kagera, where indicators such as the appearance of *Senene* (Ruspolia differens) and specific bird behaviours signal the timing of rainy seasons, other regions like Lushoto rely on different signs. For instance, the appearance of a halo around the moon, a yellow ring encircling the moon, is considered an indicator of the onset of both the short and long rains. Additionally, the north-to-south wind direction in September is interpreted as a sign of the approaching short rains and a predictor of heavy rainfall in the following months. These examples highlight how Indigenous Knowledge (IK) is locally adapted, with communities relying on region-specific environmental cues to guide agricultural and seasonal planning as shown in Table 7.6.

Table 7.6: Local indicators based on the moon, sun and wind

Indicators	**Characteristics related to the rainy season**
North-south wind direction in September and in late February	Frequent winds are seen as an indication that rains will occur within the next week, particularly signalling the onset of either the **Vuli** or **Masika** season, often accompanied by heavy rainfall. Winds that blow without drying the vegetation and soil are also interpreted as a sign that rain is imminent. These natural cues are important in predicting weather patterns in the region (Agrawal 1995; Altier 1995, 2005 and Battiste 2002
Moon-surrounded-with-heavy clouds	A sign of a good rainfall season
Halo moon (yellowish ring around the	An indication of on set for both *vuli* and *masika* seasons

moon	
Slanted position of the moon crescent	An indicator of a bad season especially towards the slanted side
Moon	Appearance of the moon in a circular shape (normal) is an indication of onset of rainfall, while a moon with different colours like rainbow, indicates the onset of *vuli* and *masika* Rains
Redmoon	Indicates onset of *vuli* rains
Sun	Prolonged periods of intense sunshine followed by sudden cooling or cloud formation are interpreted as precursors to rainfall, helping farmers plan planting and other agricultural activities.
Whitemoon	Indicates the onset of rain of *masika* season

Source: Mahoo, et. al., (2015)

However, despite these advantages, IK faces key obstacles across paradigmatic, geopolitical, socio-cultural, and practical issues, which can hinder its full integration into broader climate adaptation strategies as shown in Table 7.7.

Table 7.7: The various dimensions of indigenous knowledge (IK)

Measure	Narrative	Socio-economic importance	Obstacles
Oral traditions	Knowledge is passed down through storytelling, songs, and oral history.	Protects the use of traditional practices like rotational farming, water conservation, and controlled farming to reduce unforeseen climate vulnerabilities	Increased western influence diminishes the transmission and its importance to the younger generation who are accustomed to modern practices such as Climate-Smart Practices or social media (Instagram, Facebook, TikTok instead of storytelling folklores, etc.) (Filho, et. al., 2022)
Cultural events	Festivals, ceremonies, and	Through early warning systems based on natural	IK studies are often set in geographic and sociocultural specificity, lack uniformity,

	gatherings celebrate and teach traditional practices.	indicators such as animal behaviour, flowering or cloud patterns, IK enhances community preparedness and minimizes risks from extreme weather events like floods, storms, and droughts. Teachings on traditional agricultural practices enhance food security and consequently improve livelihoods and poverty reduction	and may be additionally impacted by issues of colonisation, globalisation, urbanization, migration, structural challenges, and dissimilar underlying development patterns (Ahenakew, 2016)
Community meetings	Hands-on sessions allow elders to share skills, crafts, or practices with younger generations.	Strengthens community-based knowledge-driven strategies for locally adapted solutions	Modernization has contributed to the erosion of traditional practices and the weakening of community bonds or meetings. Families are increasingly shifting from extended to nuclear structures, resulting in changes in roles and responsibilities, (Angkasawati 2024). There is a visibly growing inter-generational gap between the custodians of the knowledge and the younger generation's willingness to continue with the practice (Filho, et. al., 2025)

Documentation	Recording IK through written texts, audio, or video facilitates preservation and sharing.	Preserve the cultural norms and traditions that enhance their adaptive capacity to the changing and challenging environment	The lack of systematic documentation and diminishing oral knowledge transmission create a growing inter-generational gap between IK custodians and younger generations (Jones, 2024) Further, endangerment of indigenous knowledge poses a challenge to transmit IK
Educational integration	Incorporating IK into school curricula and community education initiatives ensures its sustainability (Jones, 2024)	Ensures the sustainability of the IK for future generations	

7.4.13 Indigenous Knowledge on herbal remedies

Indigenous communities in Kagera Region have a rich tradition of using local plants and herbs for medicinal purposes, with knowledge passed down orally through generations by traditional healers, known as *"waganga wa kienyeji"*. Essentially, the region is richly endowed with a strong culture of herbal[10] remedies extracted from indigenous plants to treat different ailments ranging from malaria to maternal health, peptic ulcers, asthma, infections, yellow fever, skin conditions and the deadly Sexually Transmitted Diseases (STDs) (Moshi et al. 2009). Medicinal plants such as moringa, artemisia, bitter leaf (*Vernonia amygdalina*), and *Sida acuta* are commonly used to treat ailments including malaria, digestive disorders, and skin infections among Haya communities. Traditional healing is deeply intertwined with cultural beliefs, incorporating rituals, prayers, and charms alongside herbal treatments, reflecting an

[10] They are famously credited for discovering herbal medicines which are prepared by either boiling or drying them in the sun as well as soaking in cold waters.

indigenous perception of health that sees physical and spiritual well-being as interconnected.

Despite the availability of modern healthcare, many people in Kagera continue to rely on traditional medicine, highlighting its enduring significance, home to a wide variety of medicinal plants, including *Eucalyptus* ("*Mkaratusi*"), *Euphorbia hirta* ("*Mti wa Mziwaziwa*"), and *Ageratum conyzoides* (Billygoat weed, "*Kundambara*"), used for treating conditions such as peptic ulcers, infections, yellow fever, and maternal health issues. According to Moshi et al. (2012), flowering plants from the Euphorbiaceae and Asteraceae families, such as the rubber tree (*Hevea brasiliensis*), castor oil plant (*Ricinus communis*), cassava (*Manihot esculenta*), sunflowers, daisies, and dandelions, have traditionally been used in herbal medicine to treat various ailments, including malaria, bacterial infections, skin diseases, and digestive disorders. Other significant plants in Tanzania, such as *Cherimola* (Mtopetope), Soursop (*Mstafeli*), Jackfruit (*Fenesi*), and *Margosa (Neem) tree* (*Mwarobaini*), serve multiple purposes, including medicinal use, food, firewood, and timber, further demonstrating the diverse applications of indigenous plant knowledge. Given the crucial role of traditional medicine in Kagera, integrating indigenous and modern medical approaches could enhance healthcare accessibility and sustainability while preserving valuable cultural knowledge.

7.5 Conclusion and Recommendations

This chapter illuminates the profound role of indigenous knowledge in shaping the socio-economic, environmental, and cultural fabric of the Kagera region. It reveals a rich tapestry of traditional practices ranging from herbal remedies to adaptive farming techniques that have long enabled local communities to navigate uncertainty and sustain their livelihoods. Beyond mere survival, these practices reflect a deep wisdom accumulated over generations, guiding communities in responding to environmental, health, and societal challenges.

As urbanization and modernization continue to reshape the landscape, the preservation and active management of this knowledge become not just an academic concern but also a societal imperative. Indigenous knowledge, often safeguarded in the memories and experiences of elders, holds invaluable insights for climate adaptation, disaster risk governance, and sustainable development. Its loss would not only erode cultural identity but also diminish the resilience of communities facing an increasingly uncertain future. Therefore, recognizing, documenting, and integrating this knowledge into contemporary policy and practice is essential in ensuring that the wisdom of the past continues to illuminate pathways for generations yet to come.

From a policymaker's perspective, several measures are crucial to preserve and utilise indigenous knowledge effectively. First, indigenous knowledge should be systematically documented and made accessible to the public to ensure its preservation for future generations. Second, farmers should be empowered to share and transfer this knowledge within their communities. Third, it should be formalized and integrated into educational curricula to foster broader understanding and appreciation.

Fourth, the Government should support local communities in managing and safeguarding their traditional knowledge, while also facilitating its integration with modern agricultural practices to improve sustainable productivity. Additionally, capacity-building programs focused on managing and protecting indigenous knowledge are crucial, alongside awareness campaigns that emphasise its importance, particularly among youth, to ensure intergenerational transfer. Finally, blending indigenous knowledge with modern climate-smart and precision farming techniques can further enhance agricultural productivity and resilience.

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Chapter 8 Potential implications of public agricultural investment on economic outcomes in Tanzania

Asiya Maskaeva and Mgeni Msafiri

8.1 Introduction

Tanzania's economy has grown steadily over the past two decades, leading to the country's reclassification as a low-middle-income nation in 2020. The country's real Gross Domestic Product (GDP) growth rate was approximately 6.5% for the past eleven years from 2008 to 2019 (World Bank, 2023; Tanzania National Bureau of Statistics, 2023). The agriculture sector plays a critical role in socio-economic development in Tanzania, since the country's population is approximately 66% rural, with almost 34% working in crop sub-sectors (Tanzania National Bureau of Statistics & Office of the Chief Government Statistician, 2021; 2022). The agricultural sector accounts for approximately 61.1% of total employment, 65% of the industrial sector's raw resources, and nearly all domestic food requirements. The sector is therefore the key pathway to industrialization and poverty alleviation.

However, between 2016 and 2022, the average annual agricultural GDP growth rate stagnated at 5.4%. This growth rate is lower than the target of a minimum 6% growth rate set by the African countries under the Comprehensive Africa Agriculture Development Programme (CAADP). Thus, to boost the agricultural sector performance and attain the crop sub-sector's GDP growth rate of 10% by 2030, the Tanzanian Government initiated an agricultural transformation plan 'Agenda 10/30'. The Agenda intended to rally efforts of public and private investments to boost the agricultural sector's GDP growth rate, exports, food self-sufficiency, and employment opportunities, and alleviate poverty mainly for rural households (URT, 2024) [11]. Against this background, this chapter addresses two questions:

- Can public investment that promotes productivity in Tanzania's agriculture drive growth in agri-food production with positive effects on the economy and poverty reduction?
- Which agricultural sub-sectors should be prioritized by the government?

In this chapter, these questions are addressed by analysing scenarios of public investment in the agricultural sector using a recursive-dynamic, multisector computable general equilibrium (CGE) model for Tanzania. To provide insights on the distributional impacts, we link the CGE model with a micro-simulation tool to assess the potential effects of agricultural investment at the household level in terms of job opportunities, income generation, and poverty reduction.

The scenario analysis makes it possible to determine which agricultural sub-sectors would have the most significant effects of public investment on sectoral and national economic growth and poverty reduction. The study thus identifies the sectors where public investment is most cost-effective. Two sources of financing, such as (a) borrowing and (b) indirect taxes for productive public investment, are considered when designing the scenarios to determine their macroeconomic feasibility, ultimately opting for the source of financing considered most appropriate by the Government of Tanzania in line with budget frameworks and development plans.

Following this introduction, the remainder of the Chapter is organized into five sections. Section 2 describes the planned investments in the agriculture sector and the agenda 10/30. Section 3 summarizes the modelling approach and the structure of the Social Accounting Matrix.

[11]Agenda 10/30 is a strategic vision targeting a sustained 10 % annual growth rate in Tanzania's agricultural GDP by the year 2030. The initiative focuses on boosting agricultural productivity and commercialization through targeted investments in public irrigation infrastructure, strengthening agricultural extension services, promoting the active involvement of youth and women in agriculture, establishing and scaling up commercial block farms, enhancing access to financial services, and rebranding the agricultural sector to create an enabling environment that attracts increased private sector investment.

Section 4 describes the potential public investment scenarios and analyses the macroeconomic, sectoral, and distributional results. Finally, Section 5 presents conclusions and policy recommendations.

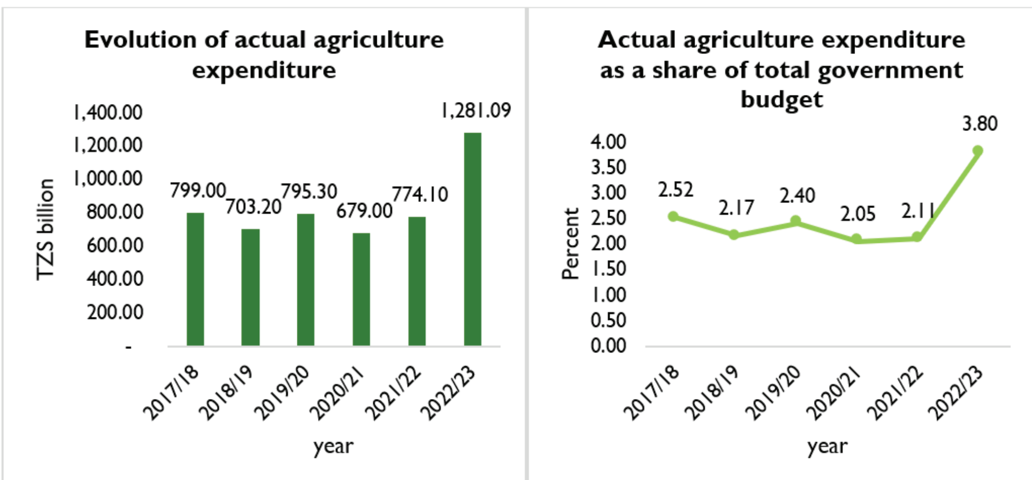
8.2 Planned investments in Agriculture and Agenda 10/30

The government of Tanzania has committed to undertaking massive investments in the agriculture sector to accelerate agricultural growth. Currently, the government implements the Agenda 10/30 Investment Roadmap for Accelerating Agricultural Growth in Tanzania (United Republic of Tanzania, 2024). Other agricultural strategies, such as the Agriculture Sector Development Programme (ASDP) I and II, the Agriculture Masterplan, the Livestock Master Plan, and others also implemented in the country. The Agenda 10/30 is a plan set to operationalize the current ASDP-II, which is under implementation until 2028, following completion of ASDP-1 spanned 2007 to 2015. It envisages ambitious goals to achieve more than 10 per cent growth for the crop sub-sector by 2030. Other goals include ensuring food security and supply to cater for domestic demand and export, increasing the value of export of agricultural produce from USD 1.2 billion to more than 5 billion by 2030. The government also intends to increase sales of horticultural produce from the current USD 750 million to USD 2 billion per annum by 2030, and this will primarily rely on stable and reliable irrigation infrastructure (URT, 2024).

The agriculture sector has been growing at an average of 5.4% between 2015 and 2020 below the 6% growth target in the Second Five-Year Development Plan by 2016/17-2020/21 (FYDP II) and the Comprehensive Africa Agriculture Development Programme (CAADP) minimum growth rate target of 6%. Agricultural production in Tanzania is driven by an increase in land size rather than an increase in labour and land productivity. Between 2015 and 2019, total factor productivity (TFP) averaged 1.8 % higher than the sub-Saharan average of 0.15% but less than a global average of 3.0% (World Bank, 2022). Moreover, for most crops, productivity lies between 20 and 30% below the potential and the best world producers, implying that only one-third of the potential is exploited (URT, 2024). Constraints to higher agricultural performance range from low levels of utilization of advanced production techniques, poor infrastructure such as roads, electricity, telecommunications, storage facilities, low levels of public expenditure, and underdeveloped markets. Improving productivity is thus an effective way of improving agricultural yield, particularly in the face of climate change.

Tanzania allocated approximately 2.5% of its budget on agriculture from 2017/18 to 2022/23 (Figure 8.1). This allocation is significantly less than the agreed investment of at least 10% of the total budget committed in the 2003 Maputo Declaration (and later Malabo Declaration of 2014) to achieve a 6% agricultural growth rate by 2025 and a 10% increase by 2030. In response, the government has initiated the Agenda 10/30 initiative (as previously mentioned) and intends to allocate TZS 33 billion over the seven-year period from 2024 to 2030, with funding to be sourced from the government, the private sector, and development partners. Much of the budget is expected to fund new irrigation projects, provision of fertilizer subsidy, controlling post-harvest loss, construction of warehouses, engaging youth in block farming, construction of a biological control unit in Kibaha, Coast Region, and securing reliable markets for agricultural produce, among others.

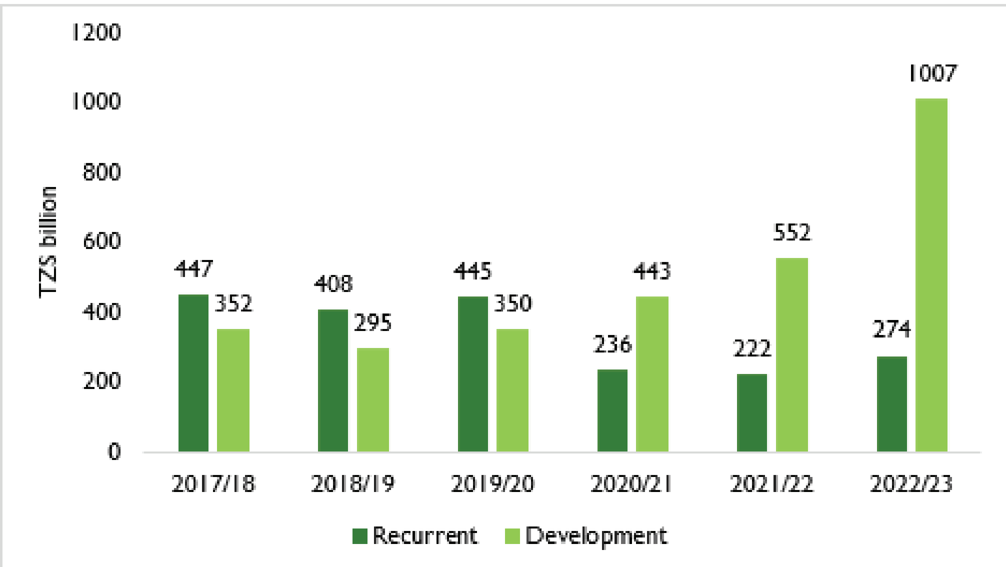
Figure 8.1: Actual agriculture expenditure between 2017/18 and 2022/23



Source: Data from World Bank (2022) and Economic Surveys of different years, NBS

The government has significantly increased public investment in agriculture between 2021 and 2023. In 2022/23, the government increased budgetary allocation to agriculture by more than 60% compared to 2021/22 (Figure 8.1). The government further increased the agriculture sector's budget by 21% to TZS 1,470 billion in the 2023/24 fiscal year, reflecting the government's commitment to expanding and transforming the sector (URT, 2023). Increased public investments facilitate higher availability and accessibility to improved inputs and infrastructure necessary for the modernization of agricultural production. This is evidenced by a budget shift to finance more development compared to recurrent expenditures since FY 2020/21 (Figure 8.2).

Figure 8.2: Recurrent and Development Agriculture expenditure between 2017/18 and 2022/23



***Source*:** Data from World Bank (2022) and NBS (2022a)

The government is committed to facilitating private sector investment by undertaking land registration to promote ownership, land banking, and investment. The government also aims to provide tax incentives through VAT and import duty waivers to support the utilization of the intermediate inputs and machines, which are imported to promote agricultural mechanization. Other government initiatives to spearhead public investment include investments in infrastructure and the promotion of agro-industrialization through an enabling policy environment and incentives for entrepreneurs to invest in manufacturing. These efforts are key to ensuring effective private sector involvement in financing the planned investments. In addition, a projected increase in real GDP growth of 5.7% in 2024 and 6% in 2025, driven by agriculture, manufacturing, and tourism, presents favourable conditions for the effective implementation of the plan (AFDB, 2024).

Between 2016 and 2021, the government has consistently reduced its reliance on foreign sources for agricultural budget financing. The share of donor resources in the agricultural budget sharply declined from 31% (or 169 billion TZS) in 2017/18 to 18% (96 billion TZS), in 2018/19 which significantly contributed to the overall decrease in the agricultural budget during that year. The overall increase in the agricultural budget for 2020/21 is presented by a jump in national funding from 402 billion TZS to 499 billion TZS. Similarly, the increase in the Ministry of Agriculture budget in 2023 comes from domestic resources (World Bank, 2022). The planned investments for Agenda 10/30 also depend heavily on public resources. For example, 18 billion, equivalent to 54% of the total investment costs, is sourced from public resources, while 15 billion is sourced from private investment, both domestic and foreign (Table 8.1). A central focus of this investment strategy is enhancing agricultural productivity, which is critical to achieving the initiative's broader development goals.

Table 8.1: Planned investment for Agenda 10/30 by source of financing

Year	Total Investment Cost	Public Investment	Private Investment	Donor/Development Partners
2024	2,264.15	1,359.38	878.44	26.33
2025	3,110.31	1,781.07	1,295.22	34.02
2026	3,967.10	2,208.02	1,717.29	41.79
2027	4,834.52	2,640.23	2,144.67	49.62
2028	5,712.59	3,077.71	2,577.35	57.53
2029	6,601.28	3,520.44	3,015.33	65.51

Year	Total Investment Cost	Public Investment	Private Investment	Donor/Development Partners
2030	7,500.60	3,968.43	3,458.61	73.56
Total	**33,990.55**	**18,555.28**	**15,086.91**	**348.36**

Source: Adapted from Agenda 10/30 Investment Roadmap document (URT, 2024)

8.3 Empirical Model and Data

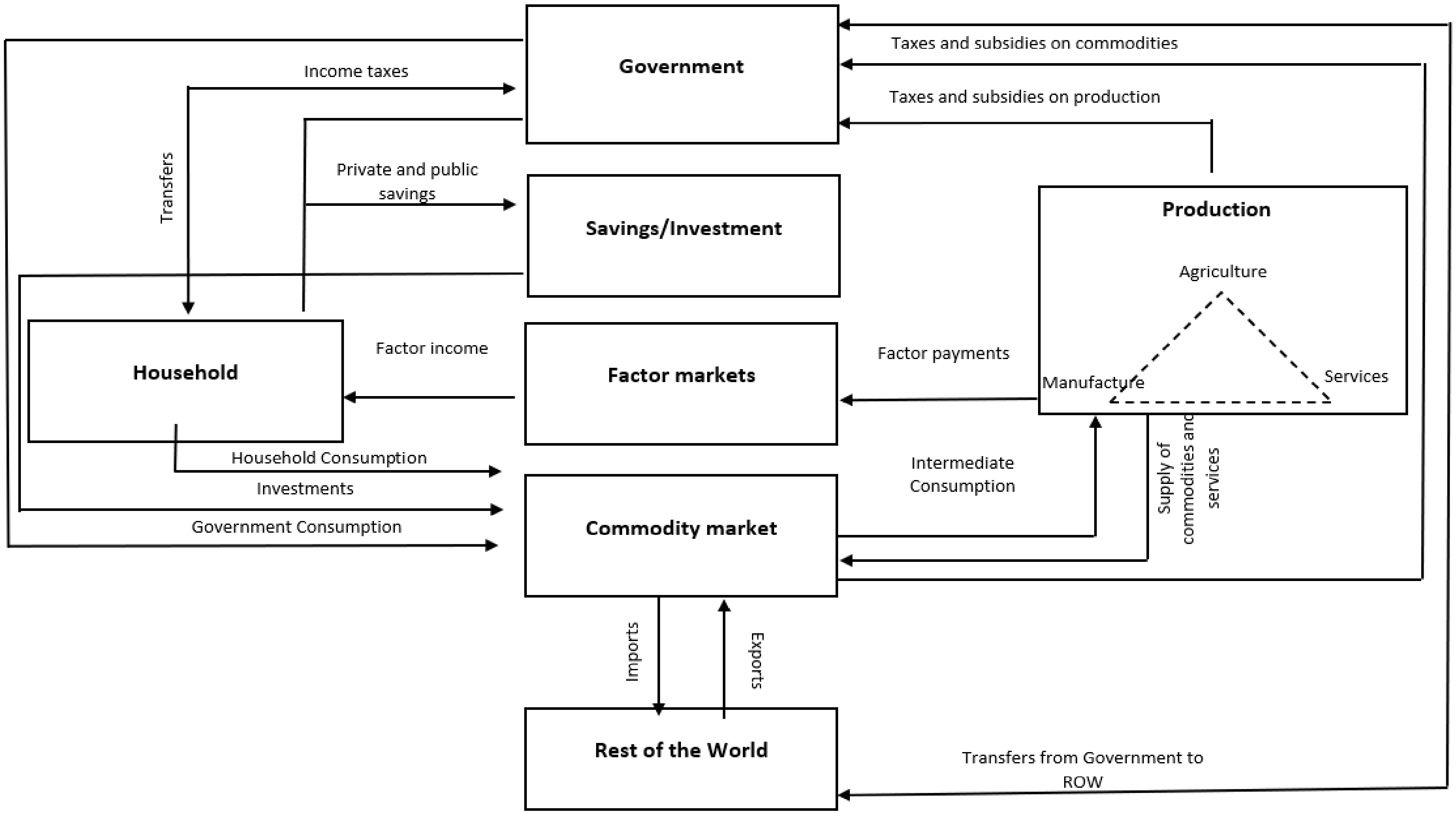
8.3.1 CGE Model for public investment policy analysis in the agricultural sector

8.3.1.1 Model specification and features

The basic empirical model used is a Computable general equilibrium (CGE). They are a class of economic models that use actual economic data to estimate how an economy might react to changes in policy, technology, or other external factors. The CGE model can as well examine the ex-ante impact of proposed policy reforms on key economic indicators, such as (i) GDP growth, (ii) labour force, (iii) income of economic agents, and others.

Figure 8.3 illustrates the flow of values within the General Equilibrium model, with a particular focus on the agricultural sector. The framework depicts the interconnections between the agricultural sector and other domestic industries through input–output linkages. It also shows how the sector contributes to the supply of commodities in the domestic market. A portion of these commodities enters export markets, complementing the supply side of the model.

Figure 8.3: Schematic presentation of the flows in a general equilibrium model



Source: Adopted from Henseler et al., 2022

On the demand side, households play a leading role. They receive income primarily from factors of production (e.g., labour, land, and capital) and transfers from institutions such as the government and the Rest of the World (ROW). Households then allocate their income toward the consumption of goods and services, savings, and tax payments, thereby influencing demand and market prices, which in turn affect production decisions in the agricultural sector and beyond.

The government collects revenue from direct taxes (e.g., income tax), indirect taxes (e.g., value-added tax), and import duties. The government use this revenue to fund public services and transfer payments.

ROW sector derives income from exports (i.e., foreign purchases of domestic commodities), returns on capital invested domestically, and transfers from domestic institutions, including both firms and the government. ROW expenditures include the purchase of domestic commodities (exports) and transfer payments to domestic households, such as remittances.

Together, these interactions define the circular flow of income and commodities in the CGE model, capturing the complex interdependencies between production, consumption, trade, and institutional behaviour within the economy, with agriculture serving as a key driver of growth and external linkages.

Overall, CGE analysis can identify the winners and losers of the policy simulation reform across distinct categories of the economy: sectors, households, labour (men and women), and government income.

Increasing public investment to promote agriculture would have effects on agricultural output both directly and indirectly (for example, through input-output relationships between agriculture and other sectors of the economy, such as the agri-food industry, transportation, trade, etc.). In the case of Tanzania, the effects could be significant if one considers that, as of 2019, agriculture accounts for 28.3% of GDP and 39.6% of private consumption, respectively, and that agri-food commodities account for a substantial share of total exports (16.4%)[12]. As a result, analysing the policy shocks that affect agriculture, including increased public investment in agricultural subsectors, requires capturing the interrelationships among economic agents, such as producers and consumers, while considering the direct and indirect effects that these relationships may generate. In other words, an analysis of alternative scenarios around agriculture should adopt a multisectoral approach that considers both the economy as a whole as well as the fiscal constraints, if the effects of public investment are to be taken into account. A computable general equilibrium (CGE) model is fit for purpose in aanalysing this wide range of potential impacts in the economy.

In this study, we employ a recursive-dynamic Computable General Equilibrium (CGE) model for country-level analysis of the Tanzanian agricultural sector's performance. The model primarily draws from the family of Partnership for Economic Policy (PEP) typical CGE models developed by Decaluwé, et al. (2013). The CGE model developed for this study includes some modifications to make it relevant to the Tanzanian agricultural sector.

Our empirical CGE model distinguishes six representative agents: Rural Farm Households, Rural Non-Farm Households, Urban Households, Firms, Government, and the Rest of the World (ROW). There are 56 production activities, of which 26 are agricultural and 18 are crop sub-sectors.

The assumption is that land only utilized in agricultural production. Farm labour entirely employed in agricultural production and is mobile across agricultural sub-sectors. The characteristics of this agricultural production process are discussed in detail in sub section 8.3.1.2.

8.3.1.2 Nature of the production process in agriculture

To account for the segmented nature of the agricultural sector in Tanzania, we model the agricultural sector differently from the non-agricultural sector. For this purpose, we follow Lewis's (1954) model, which assumes that in a developing country, there is a dual economy

[12] Figures are based on the data source from the NBS (2019 Supply Use Tables – preliminary version)

characterized by the separation of the traditional agricultural sector from the non-traditional (manufacturing and service) sector. We assume that labour in the agricultural sector is plentiful, frequently with zero marginal productivity[13], while the non-agricultural sector has a positive marginal product of labour. There is an income gap between the two sectors, and the rural surplus labour has incentives to move to the urban industrial sector, assuming it exists.

The agricultural sector is divided into the main branches of the Tanzanian economy, namely the crop sub-sector, fisheries (including both marine and inland fisheries), livestock, and forestry. Using this disaggregation, we assume that a producer combines different inputs to produce an agricultural commodity for each branch of production within the agricultural sector. The optimal combination is determined by profit maximization, constrained by production technology.

8.3.1.3 Dynamics of the CGE model

As noted above, the CGE model is recursive-dynamic; that is, the solutions for each year are linked to what happened in previous years only. Over time, production is determined by the increase in the use of production factors (labour, capital, and land) and the productivity of these factors. Using a recursive dynamic model implies considering the accumulation of capital and the labour force, as well as technological progress. The evolution of the capital stock is modelled using investment demand functions ($Ind_{i,t}$) that link the rate of accumulation to the rate of capital return ($r_{i,t}$) over its user cost (U_t) (Equation (1)) with a sector-specific elasticity

$$Ind_{i,t} = \varphi_i \left(\frac{r_{i,t}}{U_t}\right)^{\varepsilon_t} Kd_{i,t} \tag{1}$$

The unit cost of capital (U_t) is dependent on the (Pinvt), the depreciation of capital, and the interest rate, given the following function:

$$U_t = Pinv_t(ir + \delta) \tag{2}$$

[13] Zero marginal productivity refers to the point at which the addition of one more unit of input does not lead to any increase in output

The level of investment demand at the time t is used in the dynamic loop of the model by means of the equation for the accumulation of capital to establish the capital stock at the end of the period $t + 1$ as specified in the following equation:

$$Kd_{i,t+1} = (1 - \delta)Kd_{i,t} + Ind_{i,t} \tag{3}$$

Where $Kd_{i,t+1}$ is the capital stock of the period $t + 1$ established by the sum of the depreciated capital stock of the preceding period $(1 - \delta)Kd_{i,t}$and the investment decision $Ind_{i,t}$at time$t$. Moreover, the growth of agricultural productivity depends on the volume of public investment in the sector. Section 8.3.1.4 introduces the extension of the CGE model to include public investment in productive agricultural infrastructure.

Other adjustment mechanisms are also considered in the dynamic component of the model. Thus, as in Boccanfuso, et. al. (2014) and Cateia, et. al. (2023), labour force growth (LS_{t+1}) is introduced in a standard fashion using population growth rate (n):

$$LS_{t+1} = (1 + n)LS_t \tag{4}$$

The population growth rate used is the one published by the National Bureau of Statistics (NBS) for the working-age population (15–65 years old) for the period from 2015 to 2030. Other exogenous variables, such as government transfers to households, current account balance, and others, are increased by the population growth rate from one period to the other.

8.3.1.4 Public investment in productive agricultural infrastructure

The CGE model is extended to model the investment in productive agricultural infrastructure. Our model accounts for the spill over effects of investment in the agricultural sector, a feature not in the original PEP-1-t model.

Following Maskaeva, et. al. (2024), Boccanfuso, et. al. (2014), Estache et. al. (2012), Chitiga et, al. (2016), Vanduzai and Chitiga (2017), Sangare and Maisonnave (2018), and Cateia et. al. (2023), we model public investment externalities. We introduced TFP into the value-added equation to capture the effect of public investment externality on agricultural activity.

As mentioned, the value-added for each sector is modelled by a Constant Elasticity of Substitution (CES) function of composite labour and capital (i.e., farm, non-farm capital, and land). The sectoral value-added function (agricultural sector) is specified as equation 5 as;

$$VA_{agr,t} = TFP_{agr,t}[\beta_{agr}^{VA} LDC_{agr,t}^{-\rho_j^{VA}} + (1-\beta_{agr}^{VA})KDC_{agr,t}^{-\rho_j^{VA}}]^{\frac{-1}{\rho_j^{VA}}} \quad (5)$$

where $TFP_{agr,t}$ (a function of the ratio of new public investment in capital IT_PUB_t over the past public investment IT_PUB_{t-1}) is the agricultural sector's productivity effect of public investment and is specified as equation 6 as;

$$TFP_{agr,t} = \left\{\frac{IT\_PUB_t}{IT\_PUB_{t-1}}\right\}^{\rho_{agr}} \quad (6)$$

where ρ_{agr} is a sector-specific elasticity of public investment.

Examining studies that focus on public investment in agriculture in other African countries, we find that our elasticity of total factor productivity (TFP) falls within an acceptable range. Benin et. al. (2009) find that a 1% increase in public spending on agriculture is associated with a 0.15% increase in agricultural labour productivity in Ghana. Diao et. al. (2010) find that a 1% increase in agricultural spending is associated with a 0.24% annual increase in agricultural TFP in Nigeria. Thurlow et al. (2008) use elasticities of 0.20 for investment in irrigation and 0.15 for spending on extension services. In our model, we use an elasticity of public investment in agriculture of 0.30. Moreover, the growth of public investment in productive agricultural infrastructure is financed through (a) borrowing and (b) indirect taxes.

8.3.1.5 Non-parametric micro-simulation approach

This study combines a dynamic CGE model with a sequential micro-simulation (MS) model with a top-down approach, in which the CGE module feeds the market and factor price changes into a micro-simulation household model. Corresponding households within the micro-simulation model are linked to each representative household in the CGE model. This approach does not model household behaviour; however, it offers flexibility as the constraints of the CGE model need to be accepted. The integration of the CGE and MS model provides a systematic and consistent framework for combining macroeconomic and microeconomic policy effects that address economic growth and poverty.

To compute the headcount poverty measure, the MS model uses the standard Foster- Greer and Thorbecke (FGT) measure specified in equation 7 as;

$$PO_\theta = \frac{1}{Nz^\theta}\sum_{i=1}^{I}(z - x_i)^\theta \qquad (7)$$

where: i is an individual's sub-group with consumption below the poverty line (z), N is the sample size, x is individual i expenditure, and θ is a parameter distinguishing various FGT indices[14]. This measure calculates poverty incidence, depth, and severity. However, in this study, we present the results of poverty incidence only.

The 2017/18 Household Budget Survey data is used for the MS model. The survey is nationally representative and has information on demographic characteristics of household members, expenditure patterns, incomes, household size, location (urban/ rural), and sample weights.

8.3.2 Data: Social accounting matrix

This study uses Tanzania's 2015 Social Accounting Matrix (SAM), developed by Randriamamonjy et al. (2017). The original 2015 Tanzanian SAM has the following accounts: (i) 68 accounts of production activities; (ii) 70 accounts for commodities; (iii) three factors of production divided into land, capital and labour (labour is further disaggregated into three categories based on education); (iv) three household categories – rural farm households, rural non-farm households, urban households; (v) three other agents, firms, government and the rest of the world; and (vi) savings – investment account.

Based on the objectives of this study, the original SAM has been consolidated into 56 sectors and 58 commodities. Out of these, 26 sectors are agricultural, 19 are industrial, and 11 are service sectors. The service

[14] When θ=0 the expression simplifies to J/N, or the headcount ratio. This is a measure of the incidence of poverty. When θ =1 the expression gives us poverty depth measured by the poverty gap. When θ =2 the expression gives us the severity of poverty measured by the squared poverty gap.

sector contributes about 44.4% of the GDP, the highest of all, while agriculture and industry represent 30.3% and 25.3%, respectively. Since we are particularly interested in the agricultural sector, it is the agricultural sectors that undergo a detailed disaggregation of production factors. The capital factor is disaggregated into land, farm capital, and non-farm capital.

Agriculture accounts for 25.3 and 46.5 % of value added and employment, respectively. Additionally, agriculture exhibits relatively low values in the ratio of value added to employment. Specifically, the value added per worker in agriculture ranges from 0.13 to 0.64 (Table 8.2).

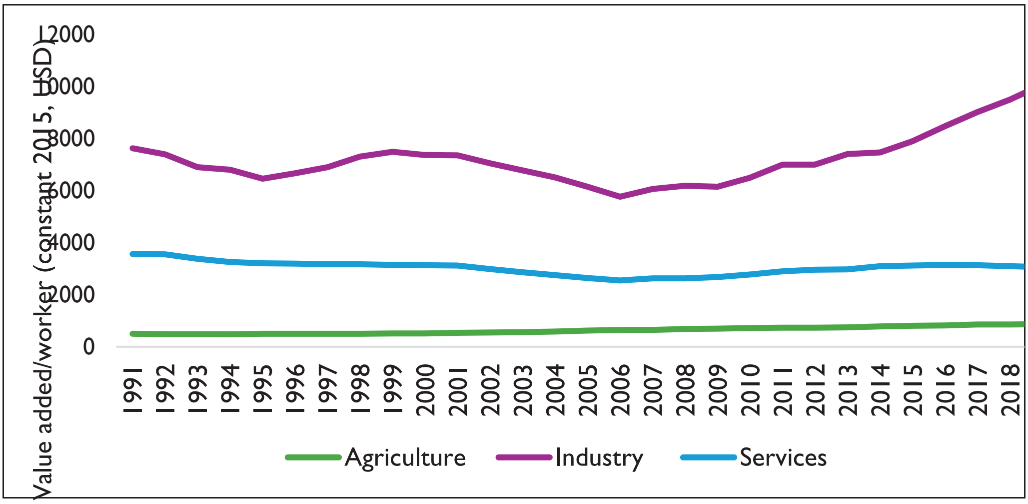
Table 8.2: Value added per worker in Agriculture based on 2015 SAM

Agricultural sub-sector	Value Added (TZS billion)	Labour contribution (TZS billion)	Value added per worker
Maize	2,398	411	0.17
Sorghum and millet	313	39	0.13
Rice	1,012	167	0.17
Wheat and barley	57	11	0.20
Pulses	21	4	0.19
Groundnuts	1,774	657	0.37
Other Oil seeds	531	191	0.36
Cassava	636	218	0.34
Vegetables	1,048	666	0.64
Sugar cane	1,157	372	0.32
Fruits and nuts	124	50	0.41
Cash crops (Aggregated: Cocoa, coffee and tobacco)	3,017	1,086	0.36
Tea leaves	217	98	0.45
Cut flowers	35	18	0.51
Other crops	66	18	0.27

***Source*:** Authors' calculations based on 2015 Tanzania SAM (Randriamamonjy, J., and Thurlow, J., 2017)

To increase agricultural production in Tanzania, emphasis must be placed on making the agricultural sector more productive, as it employs a larger number of labourers, compared to other sectors. Since the 1990s, agricultural labour productivity has been declining, although the change is not significant, indicating stagnation (Figure 8.4). Even though labour has shifted to more productive industries and services between 2015 and 2019, agriculture remains a dominant employer in the country.

Figure 8.4 : Value-Added per worker productivity in Tanzania (1991-2019)



Source: Own graph based on World Development Indicators data (World Bank, 2023)

It is expected that labour productivity increases in agriculture would allow for an expansion of employment in non-agricultural sectors. This expectation is consistent with the Surplus Labour Theory, which suggests that productivity gains in agriculture can release labour to more productive non-agricultural sectors, facilitating structural transformation. On the import side, agriculture and manufacturing represent 1.9% and 75.1% of total imports, respectively. Cotton, flowers, cocoa, and coffee are the most export-oriented agricultural products.

The different institutional accounts included in the SAM are households, firms, government, and the rest of the world. Households are categorized into farm rural, non-farm rural and urban households. There is a savings–investment account. There are taxes and margin accounts. Taxes include three types of taxes: import tariffs, indirect taxes (e.g., VAT and excise duties), and direct taxes.

8.4 Results

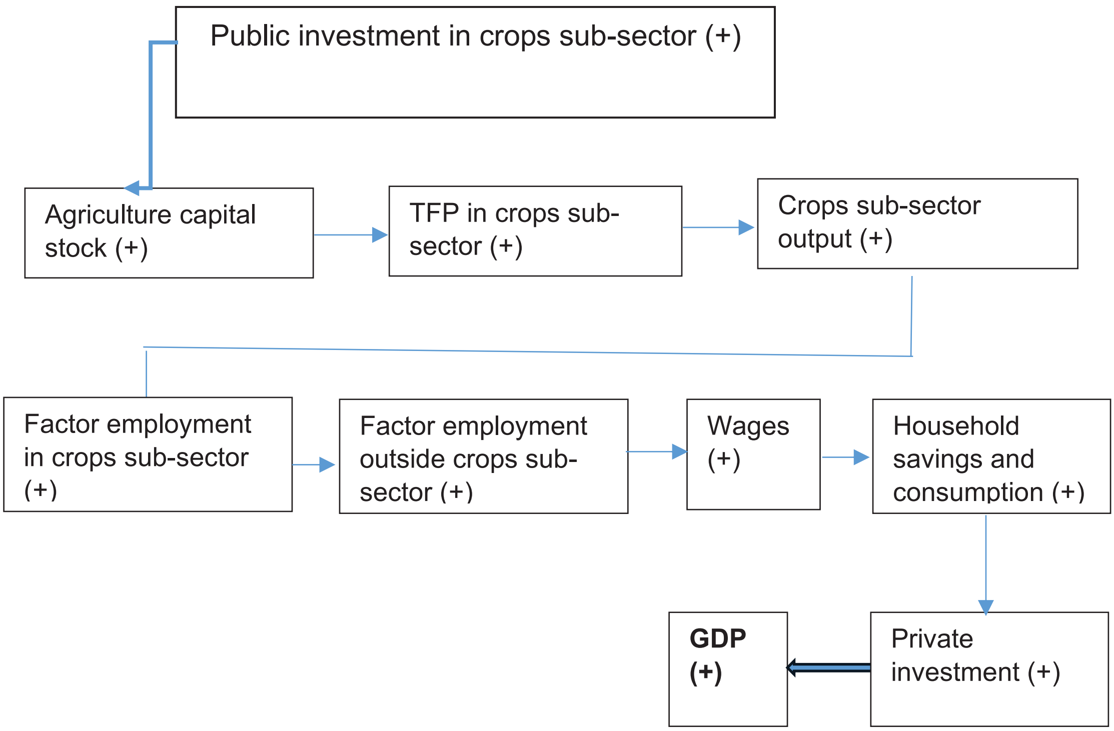
8.4.1 Simulation scenarios

Agriculture investment has both direct and indirect effects on agricultural output and other interlinked sectors of the economy through intermediate consumption effects. We implement two simulation scenarios under two alternative financing mechanisms. Given the government's increased commitment to financing the agricultural sector and the reduced budget dependency on foreign resources, we simulate a realistic amount of planned public investment in productive infrastructure for the crops sub-sector, as outlined in Agenda 10/30, over the period 2024 to 2030. The TZS 18 billion of the planned public investments is distributed unevenly (see Table 8.1) over seven years, with an average growth rate of 17.8%. Under the first scenario, the increased investment is financed by government borrowing, both domestic and foreign (SIM 1). In contrast, in the second scenario, indirect taxes are adjusted to raise the additional revenue (SIM 2). All scenarios assume that the increased investment will directly raise the total factor productivity (TFP) of the crop-sub sector, while other sectors affected indirectly.

The overall impact of increased public investment in agriculture is realized through an increase in TFP. Nevertheless, financing mechanisms of the planned investments may affect private investment and the overall economic production differently. On the one hand, if the source of financing is domestic and/or foreign borrowing, private investment growth is weakened by higher interest rates (SIM1). Flexible public savings allow a decrease in government revenue to be reflected in decreased savings, thereby increasing the government deficit. This means that the government could increase its level of borrowing to cover inadequate tax receipts but would then be required to repay those debts in the future.

Conversely, financing through indirect taxes (SIM2), leads to a reduction in private investment, through an adverse effect on household consumption and savings. However, in the medium- and long-term, financing through indirect taxes results in higher private consumption and a greater increase in GDP than financing through domestic borrowing. Figure 8.5 presents the transmission channels through which higher agricultural investment affects TFP and other variables in the economy.

Figure 8.5: Economic flows of increased public investment in productive infrastructure in the crops sub-sector through the effect on total factor productivity



Source: Authors' Own.

8.4.2 Impact on government revenue

Both scenarios of public investment in agriculture have different impacts on government revenue. In the first scenario (SIM1), results reveal an increase in government revenue from various sources, relative to the baseline, during the period of analysis (Table 8.3).

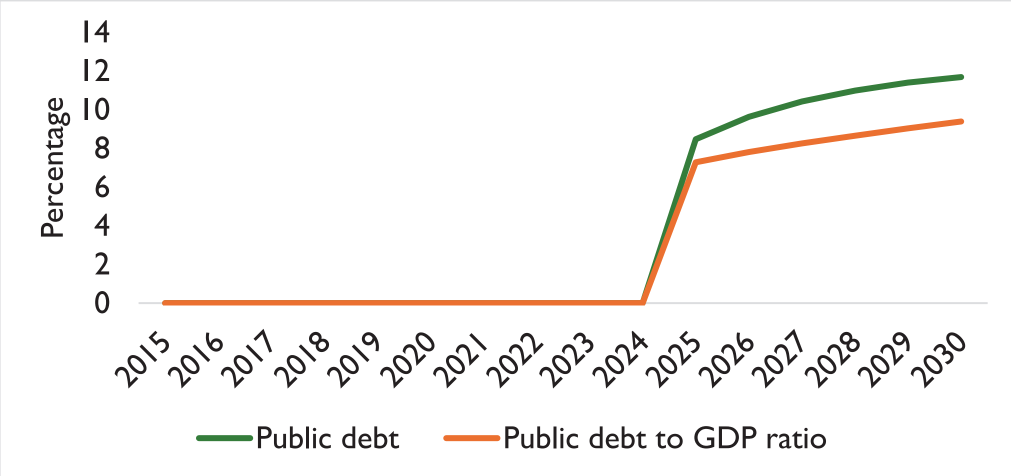
Table 8.3: Impact on government revenue under both scenarios in 2025 and 2030 (%age deviation from the BAU)

Source of Government Revenue	**SIM1**		**SIM2**	
	short run 2025	**long run 2030**	**short run 2025**	**long run 2030**
Gov revenue from indirect taxes on products	0.34	0.43	-0.09	-0.17
Gov revenue from import duties	0.17	0.29	0.17	0.29
Gov revenue from business income taxes	0.46	0.56	0.49	0.60
Gov revenue from household income taxes	0.16	0.17	0.18	0.21

Source: Authors' calculation

Indeed, in both the short and long terms, public investment in the agricultural sector through the domestic borrowing mechanism would increase the government's income from various sources, relative to baseline values in this simulation scenario. This scenario also indicates that the public debt-to-GDP ratio will increase from 7.2% to 9.3% between 2025 and 2030, compared to the base scenario (Figure 8.6).

Figure 8.6: Public debt and public debt to GDP ratio in public investment scenario under borrowing mechanism (%age deviation from the BAU)



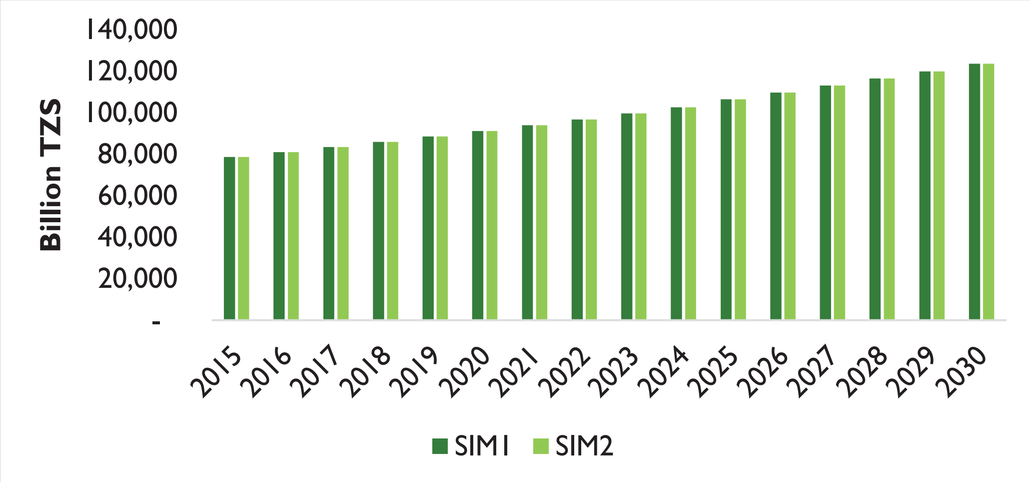
Source: Authors' calculation

Public investment in agriculture through indirect tax finance (SIM2) also has a positive impact on government revenue in both terms. Total government income exhibits an increasing trend relative to the baseline values. Since public investment design affects indirect taxes, the revenue received by the government from these taxes' decreases compared to other sources of government revenue. However, business and household income tax revenues are positive and even higher than in SIM1 (Table 8.3). The positive effect on direct tax revenue is a result of increase in employment and improved business infrastructure in Tanzania.

8.4.3 Impact on macro economy

Figure 8.7 presents the GDP in public investment scenarios under two alternative financing sources. An increase in public investment in productive agricultural projects has a growth impact on the economy, as real GDP at basic prices increases, relative to the baseline, by 0.67% and 0.79% in 2025 and 2030, respectively, in both scenarios. Alternatively, the cumulative increase in GDP between 2022 and 2030 is equivalent to 4.6% of the base-year GDP.

Figure 8.7: GDP in public investment scenarios under two alternative financing sources



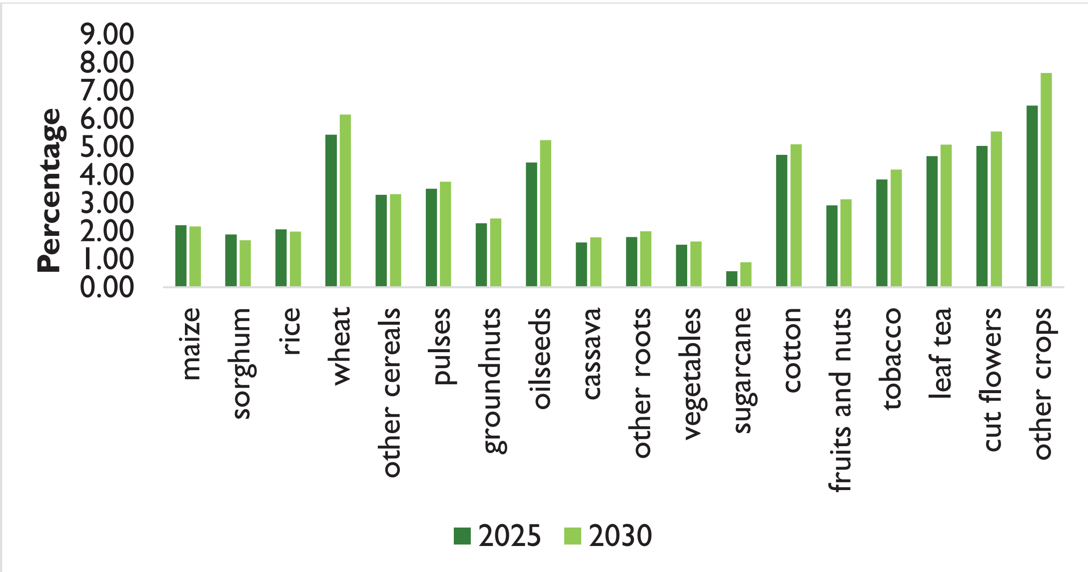
***Source*:** Authors' calculation

8.4.4 Impact on Production

Figure 8.8 shows that the impact of increased public investment on sectoral production is mixed under both scenarios. Output increases more for the targeted crops sub-sector with an average output growth rate of 3.23% over 2024 - 2030 compared to an average output growth of 0.33% for manufacturing and service sectors over the same period. This implies that, given the baseline average growth rate of 5.4% of the agricultural sector, planned public investment will boost the agricultural sector growth rate to over 8% by 2030, which is above the 6% target under the Malabo declaration, and close to the targeted growth rate of 10% under Agenda 10/30. Alternative financing mechanisms show similar results because the effects on production mainly rely on improved TFP due to increased agricultural capital stock.

Increased investment in productive infrastructure in the crops sub-sector raises agricultural capital stock, including irrigation infrastructure, modern machinery and farming technologies, storage facilities, which facilitate efficient input use and reduce post-harvest losses. As a result, an increase in TFP in the sector boosts agricultural output, particularly for capital-intensive crops, mainly cash crops such as cut flowers, cotton, tobacco, leaf tea, oilseeds, and wheat. Thus, a higher capital stock is crucial for agricultural intensification as it leads to higher yield per agricultural area. The increase in sugarcane output is low, as the crop is mainly cultivated on large private fields; thus, higher public investment in productive infrastructure benefits the sub-sector less compared to other sub-sectors.

Figure 8.8: Output of Agricultural Sectors under the public investment scenarios, 2025 and 2030 (%age of deviation from the BAU)

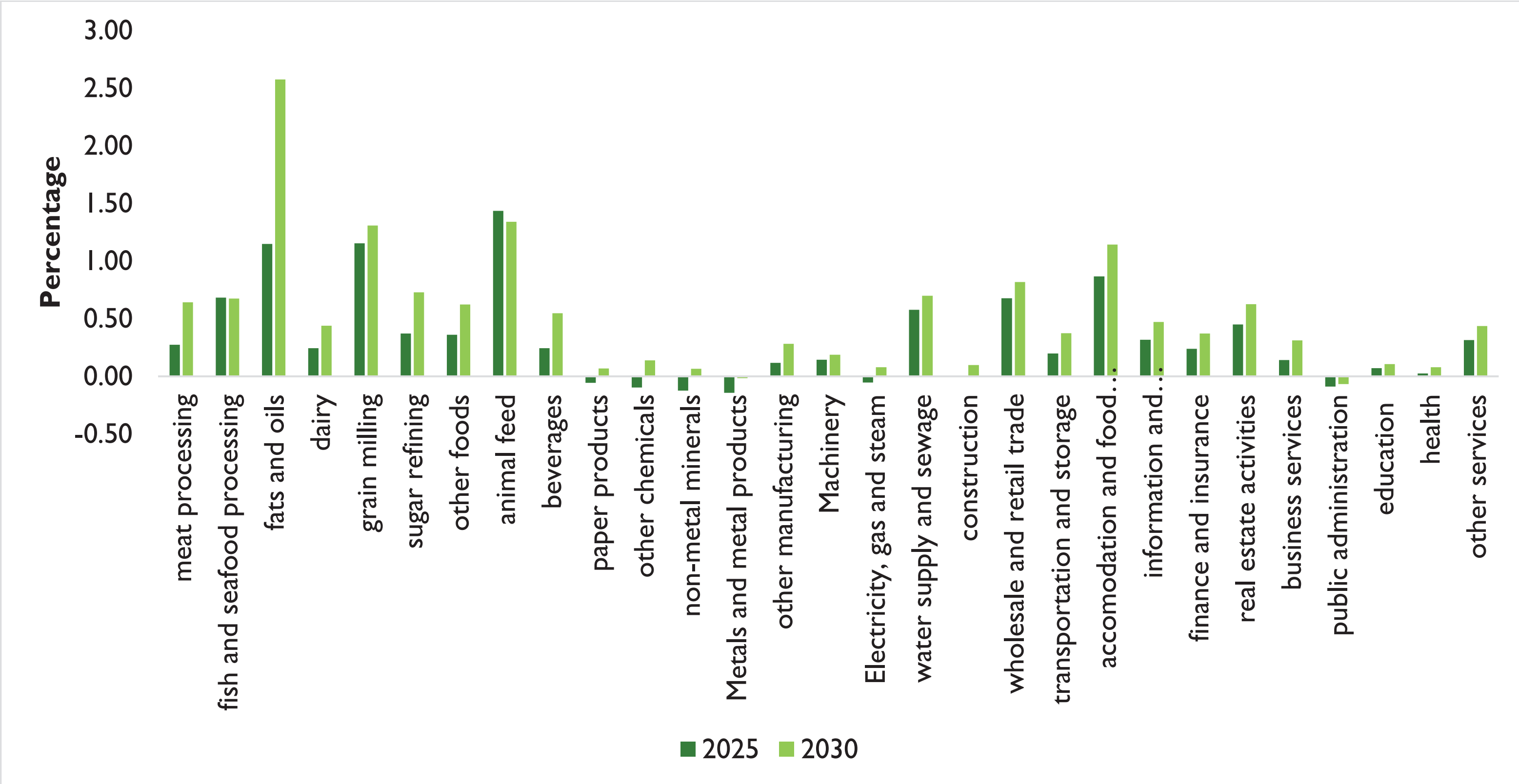


***Source*:** Authors' calculation

Faster growth in the agricultural sector stimulates output growth in non-agricultural sectors through higher demand for non-agricultural products, such as machinery, storage and processing facilities, energy, and transportation services. Additionally, higher agricultural output growth leads to lower prices, which in turn fosters other activities in the upstream value chain. Figure 8.9 shows that the output of agro-processing industries increases the most, especially in fats and oils, grain milling, and animal feed, compared to other manufacturing sub-sectors and service sectors. This is due to the strong backward linkages that the agricultural sector has on the agro-processing industries. The output of other manufacturing sub-sectors, such as metals, paper products, and non-metallic products, decreases in the short run due to low interlinkages with the agricultural sector.

However, production rebounds by 2030 due to higher private investment enhanced by increased household incomes and savings. In both scenarios, longer-term impacts of public investments are higher than short-term effects, since benefits on human capital, which complements physical capital, take time to be realized.

Figure 8.9: Sectoral Output of non-Agricultural Sectors under the public investment scenarios for the agricultural sector, 2025 and 2030 (% deviation from the BAU)



***Source*:** Authors' calculation

8.4.5 Impact on International Trade

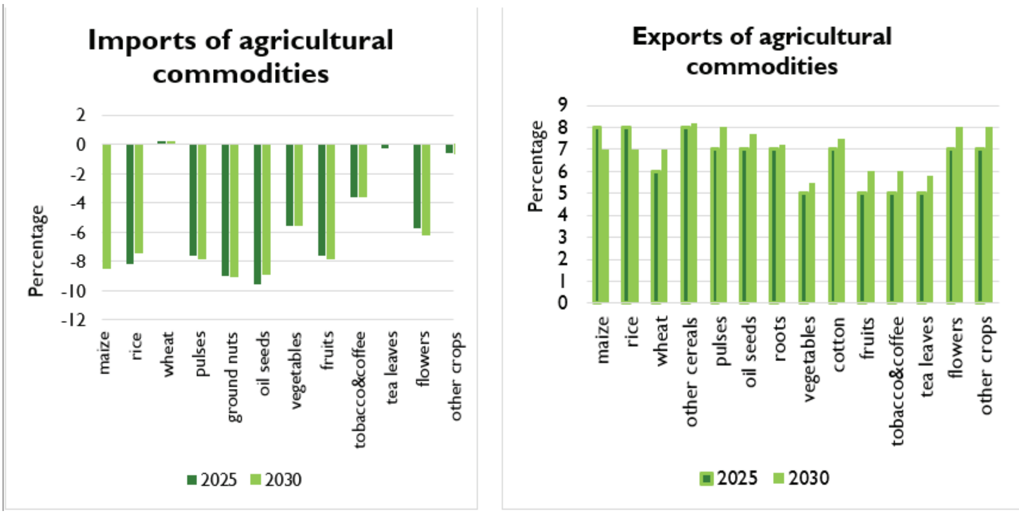
The results of both simulations in Figure 8.10 shows a significant increase in exports in both the short and long terms. This means that public investment policy in agricultural productivity has two crucial implications for the Tanzanian economy. First, there is a significant increase in exports of agricultural commodities. As a result, exports increase, and the country can potentially export food and services. This increase in exports aligns with the findings of other studies (e.g., Sangare et al., 2018; Cateia et al., 2023). They all emphasize that increased investment in agricultural infrastructure would boost trade.

Second, increasing domestic supply reduces import demand, leading to a potential positive trade surplus. A reduction in the need to import food commodities from abroad may have the potential to reduce food insecurity in the country. Tanzania is generally a food surplus country (BOT, 2023). The availability of food in the country has remained reasonably adequate and generally increased (URT, 2024). According to AfDB[15] estimation, the country's food security self-sufficiency ratio (FSSR) increased from 120% (for 2015/16) to 126% (2020/21) – achieving 84% of the ASDP II target of 150% for 2022/23. Investment in irrigation would amplify public investment in productive agricultural infrastructure and boost Tanzania's food surplus status, allowing it to achieve its goals of exporting more to other African countries and reducing food insecurity in the region.

Figure 8.10 illustrates the simulated impacts of public investing in the agricultural sub-sector on exports and imports in the short term (2025) and long term (2030). The sectors generating the highest export increases are maize, rice, oil and nuts, vegetables, fruits, coffee, flowers, and other crops.

[15] tanzania_country_food_and_agriculture_delivery_compact.pdf (afdb.org)

Figure 8.10: Exports and imports under the public investment scenarios for the agricultural sector 2025 and 2030 (% deviation from the BAU)



***Source*:** Authors' calculation

Targeting investments to increase the productivity of the total agricultural sector reduces imports, except for wheat. It is not surprising, as in the base year (2015), wheat accounts for 83% of imports of all agricultural commodities, and 65.5% of wheat demand is met through imports.

8.4.6 Impact on employment

As observed in previous sections, production increases in all agricultural sectors in both the short and long term (see Section 8.4.4). Obviously, to produce more, sectors must hire more workers; however, the demand for workers is not uniform across agricultural sectors, as it depends on the sectoral composition of the labour force and the farm capital used. According to the base year data, maize, sorghum, and rice are the agricultural sub-sectors with the lowest value added per worker.[16] Therefore, an increase in productivity in these sectors would allow more workers to be reallocated to other production activities.

Given the labour-intensive nature of agricultural production in Tanzania, demand for labour is expected to decrease due to an increase in labour

[16]Value added per worker is a measure of labour productivity. It is calculated by dividing the value added of a sector by the number of workers employed in that sector

remuneration rates in the overall agricultural sub-sectors in both the short and long term, as shown in Simulations 1 and 2 (SIM1 and SIM2) (Table 8.4).

Table 8.4: Evolution of variation of demand for labour in the agricultural sector (% change from the base year)

Agricultural subsectors	SIM1		SIM2	
	2025 short run	2030 long run	2025 short run	2030 long run
Maize	-10.49	-7.63	-10.43	-7.54
Sorghum and millet	-16.75	-9.82	-16.66	-9.72
Rice	-11.71	-8.31	-11.64	-8.22
Wheat and barley	6.51	5.40	6.46	5.33
Pulses	-1.54	-1.75	-1.54	-1.75
Groundnuts	-4.85	-4.57	-4.83	-4.53
Other Oil seeds	0.96	1.59	0.93	1.54
Cassava	-4.92	-4.95	-4.89	-4.91
Other roots	-3.49	-3.78	-3.47	-3.76
Vegetables	-7.68	-7.00	-7.64	-6.93
Sugar cane	-8.27	-7.38	-8.19	-7.25
Fruits and nuts	1.19	-3.20	-3.15	-3.18
Cotton	-3.16	0.79	1.18	0.77
Cash crops (Aggregated: Cocoa, coffee and tobacco)	-0.57	-0.81	-0.57	-0.82
Tea leaves	1.09	0.73	1.08	0.71
Cut flowers	3.35	2.62	3.28	2.52
Other crops	8.53	7.99	8.44	7.87

Source: Authors' calculation

The aggregate employment in the agricultural sector decreases by about 3% and 2.4% in the short and long terms, respectively. However, some sub-sectors (such as wheat and barley, fruits and nuts, cut flowers, tea leaves, and other crops) reflect an increase in demand for labour**.** The reason may lie in the substitution effect between labour and capital and interlinkages between value added and intermediate consumption in agricultural-related industries across the manufacturing and services sectors.

8.4.7 Impact on household welfare and poverty

The results of both simulations show that domestic production in the agricultural sector and related agri-food industries increases (see Section 8.4.4). At the same time, prices decrease, resulting in a decline in inflation (Table 8.5).

Table 8.5: Percentage change in Consumer Price Index from the base year

Macroeconomic aggregates	SIM1		SIM2	
	2025 short run	2030 long run	2025 short run	2030 long run
Consumer Price Index	-1.48	-1.47	-1.47	-1.49

***Source*:** Authors' calculation

Given the decrease in inflation, the real consumption budget of households increases (Table 8.6). However, these impacts are not uniform across both periods. For example, in the short term, there is a reduction in real consumption budget for rural farm households. This can be attributed to the significant reduction in labour remuneration in agriculture, which is the primary source of income for rural farm households, thereby affecting most rural farm households. This is explained by the fact that in rural areas, people tend to be more involved in agricultural activities and record the most significant drop in labour income (labour remuneration).

Table 8.6: Percent change in real consumption budget of households from the base year

Households type	SIM1		SIM2	
	2025 short run	2030 long run	2025 short run	2030 long run
Rural Farm Households	-0.10	0.07	-0.06	0.12

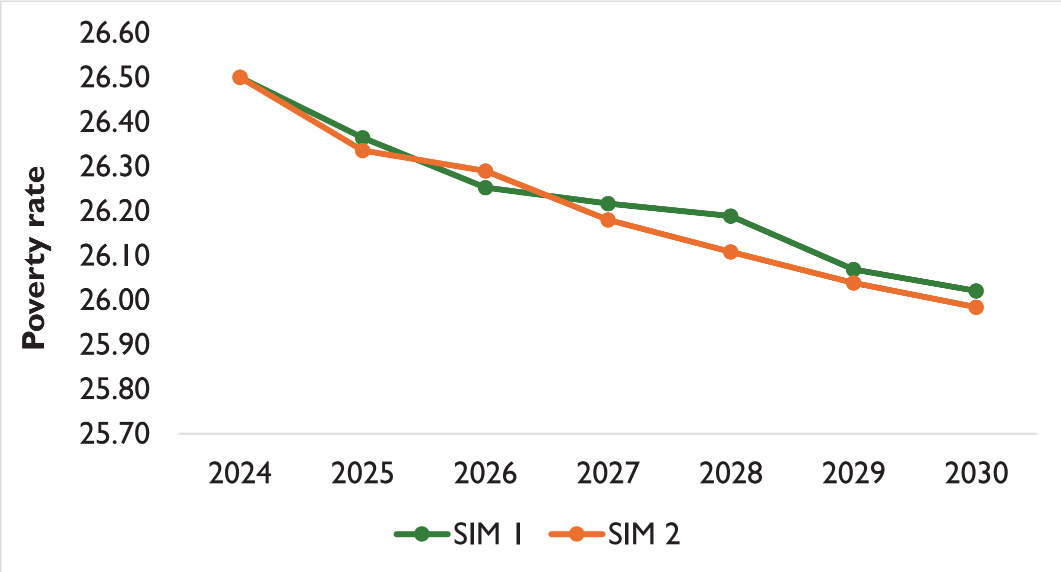
Rural Non-Farm Households	0.80	0.99	0.83	1.03
Urban Households	1.56	1.55	1.59	1.59

***Source*:** Authors' calculation

In the long term, all types of households have a positive impact on the real consumption budget (Table 8.6). In both simulations, the variations are slightly different. Therefore, the increase in household consumption has a positive impact on demand for all commodities, mainly agricultural commodities. In all cases, commodities from agriculture are directly or indirectly relatively important to the consumption basket of rural and urban households. For example, maize and other cereals are consumed by households in the form of milling products. Hence, any reduction in price resulting from an increase in supply will have a positive impact on private consumption. More precisely, increasing supply in these agricultural sectors due to higher productivity could lead to a decline in their relative price as demand increases (brought about by growth in household income and investment demand), which is generally lower than the supply increases.

Figure 8.11 shows that positive impacts on the real consumption budget are consistent with the effects of public investment in agriculture on the poverty rate of households. Since fluctuations in income and prices influence the poverty rate, the reduction in food prices, which constitutes a significant portion of poor households' consumption basket, explains the reduction in the poverty rate through 2030. Generally, poverty rates decrease by 0.30% on average over the study period, from 2024 to 2030, when public investment is financed through government borrowing. However, the average decline in poverty rate is slightly higher (0.33%), when the financing mechanism is indirect taxes. Despite the adverse effect of indirect taxes on private consumption, indirect taxes have a relatively lower impact on private investment compared to government borrowing, which raises the interest rates and constrains private savings, investment, and ultimately private consumption.

Figure 8.11: Evolution of Poverty rate under the public investment scenarios for the agricultural sector, 2024 – 2030



***Source*:** Authors' calculation

8.5 Conclusion

The Tanzanian government has made firm commitments to accelerate agricultural growth in Tanzania. The government has clearly set out key strategic investment areas to be financed during the implementation of ASDP II through the Agenda 10/30 roadmap. The commitment and political will to transform the sector is high as evidenced by a significant growth in the share of the agriculture budget in the total budget since 2021/22. Envisioned investment will facilitate private investment in the agricultural sector, improve irrigation infrastructure, modernize the sector, engage more women and youth, promote exports, and, more importantly, raise agricultural productivity that has remained stagnant for a long time. This study, therefore, provided an analysis of real investment scenarios stipulated in the Agenda 10/30, 2024–2030, based on a macro-micro modelling tool for the Tanzanian economy. Generally, simulation results are positive for most macro-economic indicators, household consumption, and poverty.

Public investment in the crop sector has a positive effect on growth. This is because crops are integrated into international trade more than other agricultural sectors, such as fishing and livestock. For example, increasing productivity through new public investment leads to a greater increase in exports and higher import substitution.

It is worth noting that the agricultural sector lacks productive dynamism and is one of the sectors with the highest rates of informal work and the lowest wages. Therefore, the results of this study indicate that public agricultural investment has a positive impact on both agricultural and non-agricultural employment incomes, exerting both direct and indirect effects. Rural households gain most of their income through direct effects, while urban households gain most of their income through indirect effects. Moreover, reduced prices, as measured by changes in the consumer price index, contribute to an increase in individual welfare and poverty reduction. Thus, a policy of public investment in productive agricultural infrastructure would lead to economic growth, resulting in improved well-being for the general population.

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Chapter 9 Impact of Agricultural Credit on Productivity in Tanzania

Derick Msafiri, Cornel Joseph, and Thadeus Mboghoina

9.1 Introduction

Agriculture plays a crucial role in propelling Tanzania's economic performance and livelihoods, contributing to 26.3% of GDP (BOT, 2024). Further, the sector employs more than half (58%) of the country's working population and most of the rural labour force (World Bank, 2023). Thus, the sector's significance in driving rural development, food and nutrition security, and poverty reduction efforts cannot be overemphasized. Despite the sector's inherent value, many countries especially in developing context suffer from persistent and pervasive low agricultural productivity, generating immense pressure on food systems. Factors associated with low agricultural productivity can be categorized into two: Exogenous factors such as climate changes, pests and floods, which are out of control of farmers; and endogenous factors linked to farmers decisions including the low rate of adoption of yield enhancing technologies, such as fertilizers, improved seed varieties, and poor agronomic practices (Assouto and Houngbeme, 2023).

Agriculture credit is a critical ingredient of agricultural productivity, influencing farmers' choice to purchase and apply productivity enhancing technologies including improved seed varieties, fertilizers, irrigation, mechanization, extension services, and other climate smart agronomic practices. In Tanzania, agriculture (crop and livestock) is heavily rain fed reliant. While the use of improved seed varieties has doubled since 2007/08, there is still limited but growing mechanization and only 2.5% of cropped area is under irrigation (URT, 2021). The benefits of technology adoption can go beyond enhancing productivity to include climate change adaptation for sustainable agriculture. It is evident that Tanzania's agricultural productivity has not reached its full potential for several reasons, one of which is smallholders' limited access to agriculture credit. Addressing the latter could potentially improve agriculture productivity in the country by boosting adoption of modern production technologies, and farmers' increased access to commodity markets and better prices.

The Government of Tanzania has implemented various initiatives to improve access of credit in the agricultural sector, recognizing its significance to economic growth. Key measures among others include the establishment of Agriculture Credit Guarantee Scheme (ACGS), which reduces lending risks for financial institutions, and tailored credit facilities for smallholder farmers, including low-interest loans and flexible repayment terms. Despite these combined efforts aimed to address the financing gaps in the sector, agriculture financing remains a critical policy issue in the country, both, at national and household level. Tanzania's agriculture sector has received relatively low budgetary allocations and spending over the years. Between 2017/18 and 2021/22, the sector's allocation hovered around 750 TZS billion, representing an average of 2.3% of the overall national budget-well below the 10% Malabo commitment. Budgetary constraints meant limited space to support growth of the agriculture sector and of its productive assets (World Bank, 2022). Some studies have shown that expanding agriculture financing has positive effects on the country's overall economic performance (Paul & Lema, 2018).

At household level, financial constraints can manifest through smallholder farmers' limited access to agriculture credit. Farmers' uptake of agriculture credit is linked to, both, demand, and supply-side constraints. The latter refers to issues such as limited availability of alternative credit sources in local areas, unavailability of financial products that suit the needs of smallholders, or high costs of borrowing. While a large portion of empirical evidence focus on supply-side constraints, a relatively smaller group emphasize on the importance of demand driven factors. These include: (i) collateral requirements and repayment schedules that most smallholders cannot afford; (ii) risk-aversion, specifically fear of not being able to pay back loans and the subsequent loss of collateral; (iii) farmers being able purchase inputs using their own resources; and (iv) high transaction costs due to complex loan application procedures are as important as supply-side constraints (Balana, 2022; Chirambo, 2016; Babu and Raghunathan, 2017). Gender inequality, where women and youth are more disadvantaged, is also a strong factor influencing access to credit (Mwonge, 2021).

While access to credit is important, its alone does not guarantee increased agriculture productivity. Katera (2018) posits that, knowledge accumulation through additional years of formal education, community development, and extension programmes have a positive effect on farm productivity. While, on the one hand, access to credit allows farmers to afford productivity enhancing technologies, on the other hand, the choice and the optimal use of such technologies is influenced by one's level of accumulated knowledge and skills. In many developing countries, access to credit and agricultural investment also strongly relate to the existing land tenure systems. In the context of Tanzania, a study by Msangi (2022) found that possession of formal land tenure certificates [Certificate of Customary Right of Occupancy (CCRO) or Certificate of Granted Right of Occupancy (CGRO)] improves investments in agricultural land as well as farmers' access to credit. The study also shows that possession of CGRO, as opposed to CCRO, enhanced one's chance of accessing formal credit. While the two certificates of tenure occupancy accorded equal legal status, lending institutions in the country are increasingly reluctant to accept CCROs as loan collateral as they are overly worried about the legal complications associated with appropriation of the land owned under CCRO in case of default.

This chapter is motivated by two key reasons: Firstly, it aims to explore the macroeconomic impact of agricultural credit on agricultural productivity in Tanzania, an area that has been relatively underexplored in existing literature. Most previous studies have focused on micro-level analyses, primarily at the regional level and often concentrated on specific crops. By shifting the focus to a national level, we seek to provide a broader understanding of how agricultural credit influences overall productivity across the entire agricultural sector. Secondly, this study adopts a comprehensive approach by employing three different measures of agricultural productivity. This allows for a more nuanced analysis of how agricultural credit affects productivity from multiple perspectives, offering valuable insights into the effectiveness of credit disbursements in fostering agricultural growth. Through these dual motivations, the study contributes to both the theoretical and practical understanding of agricultural finance in Tanzania.

This chapter, therefore, examined the impact of agricultural credit on agricultural productivity in Tanzania, using annual time series data from the Bank of Tanzania (BOT) and World Bank Development Indicators (WDI) covering 1990 to 2022. We also employed the Toda–Yamamoto (1995) Granger causality technique to investigate the causality among the variables. The findings showed that agricultural credit, rainfall, and capital formation have a significant positive effect on agricultural productivity in the long term. Conversely, lending rate, inflation, and labour have a significant negative effect on agricultural productivity in Tanzania. Furthermore, the analysis identified a bidirectional causality between agricultural credit and productivity in Tanzania.

The rest of the chapter is organised as follows: Section 2 presents the review of the literature, while Section 3 describes the data and empirical strategy used. Section 4 presents the empirical results and discussion of the findings while the last section is devoted to the conclusion and policy implications of the results.

9.2 Literature review

9.2.1 Theoretical review

Credit Rationing Theory elucidates how agricultural credit impacts productivity in developing countries by addressing the liquidity constraints faced by farmers. In these contexts, farmers often encounter barriers to accessing necessary funds due to limited financial infrastructure and high-risk perceptions among lenders. By providing credit, farmers can invest in essential agricultural inputs such as high-quality seeds, fertilizers, and modern equipment, which are critical for improving crop yields and overall productivity. Studies have shown that such investments significantly boost agricultural output by enhancing crop quality and increasing the efficiency of farming practices (Adesina and Zinnah, 1993; Stiglitz and Weiss, 1981).

Moreover, access to credit helps farmers manage risks associated with agriculture, such as price volatility and adverse weather conditions. By enabling the purchase of insurance and the diversification of crops, credit reduces the financial uncertainties that can hinder productivity. Additionally, credit allows farmers to smooth income fluctuations throughout the year, ensuring that they can maintain investments in their farms even during off-seasons. This financial stability fosters long-term productivity gains and supports sustainable agricultural practices (Morduch, 1999; Banerjee and Duflo, 2011).

This study applies dynamic model that explains the linkage between agricultural credit and productivity over time. Farmers seek credit to purchase or invest in inputs like fertilizers, seeds, machinery. However, returns to investment are subject to land productivity and agricultural seasonality. Equation 1 represents a production function which shows agricultural productivity is a function of credit available in the current period and agricultural output in the past period.

A_t=f (C_t, A_{t-1})................................ (1)

Whereby $A_t$the agricultural output at time t is, C_t represents credit available at time t and A_{t-1} represents agricultural output in the past period.

This signals that the credit available in the current period C_t influences the output in the future period by paving way for farmers to invest in inputs and productive modernized technologies and techniques. However, in the credit rationing situation, C_t is likely to be insufficient exerting to low productivity. This is represented by the equation 2.

$A_t = A_{t-1} + \delta . C_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2)$

Where

δ is a parameter that measures the productivity effect of credit on output. It reflects how effectively the farmer can turn credit into higher output. However, **credit rationing** means that C_t is constrained, and thus the increase in output from credit is smaller than it could be if credit were fully accessible.

9.2.2 Empirical Review

Previous studies analysing the macroeconomic impact of agricultural credit on agricultural productivity as seen Table 9.1 focused mostly on Asia, Europe and a few Sub-Saharan African countries. Limited studies have explored this nexus at a macro level within the Tanzanian context. Most of the studies such as Nakano and Magezi, (2020); Msulwa, (2016); Girabi and Mwakaje, (2013) and Mpeku and Urassa, (2022) explained the linkage between agricultural credit and agricultural productivity in Tanzania at a micro level. Therefore, this chapter seeks to fill the gap by analysing the macro-economic impact of agricultural credit on agricultural productivity in Tanzania.

Table 9.1: Previous studies on the impact of credit on productivity

Authors and Year	Country and duration	Methodology	Findings
Ngong et al. (2023)	Central African Economic and Monetary Community (CEMAC) from 1990 to 2019	Autoregressive distributed lag (ARDL) technique	Domestic bank credit, land, and physical capital positively affect agricultural value added. Conversely, broad money supply, inflation, and labour negatively impact agricultural value added to GDP.
Seven and Tumen (2020)	104 countries over 24 years	IV-2SLS, fixed-effects panel, and GMM regressions	Agricultural credit positively influences agricultural productivity.

	(1991-2014).		
Manoharan and Varkey (2022)	16 Indian states using panel data from 1991 to 2018	Fixed effects model	Agricultural credit and doubling of agricultural credit policy has positive impact on productivity while indirect credit has a significant negative impact on productivity.
Nascimento et al. (2023)	Brazil	Dynamic vector error correction model (VECM)	Found a positive long-term relationship between agricultural credit and agricultural GDP.
Patwary et al (2023)	Bangladesh over period 1991 to 2018	Johansen cointegration test and Vector Error Correction Model (VECM)	Bank agricultural credit, pesticide consumption, and use of cropped areas have a long-run relation with agricultural output
Anh et al., (2020)	Vietnam over period 2004:Q4–2016:Q4	autoregressive distributed lag (ARDL) approach	Agricultural credit positively influences agricultural GDP in both the short-run and long-run. A unidirectional causal relationship running from credit to agricultural GDP was confirmed. The results also found the positive and significant effects of labour and rainfall on agricultural GDP in the long run.
Iqbal et al., (2003)	Pakistan over period	Cobb–Douglas Production	Found that institutional credit significantly and

	1971 – 2002	Function estimated by OLS	positively influences agricultural output.
Ahmad et al., (2018)	Pakistan using annual time series data from 1973 to 2014	Autoregressive Distributed Lag (ARDL) Bound testing approach	Results found a positive and significant relationship between agriculture credit and agricultural output. Labour participating in agriculture was found positive yet insignificant relation to agricultural output while trade openness had negative and significant impact on agricultural output.
Islam (2020)	Bangladesh over period 2000 to 2019	Autoregressive Distributed Lag (ARDL) Bound testing approach	Found short run and the long run relationships between the agricultural credit and agricultural productivity while the productivity of the agricultural sector also influenced by other dynamic variables like inflation, interest rate, and government expenditure on agriculture.
Bahşi & Çetin (2020)	Turkey over period 1998-2016	ordinary least squares (OLS) techniques	Agricultural credit has a positive and statistically significant effect on agricultural GDP.

Shuaibu and Nchake (2021)	Sub Saharan Africa	Two-Stage Least Square Instrumental Variable (IV-2SLS) and difference Generalized Method of Moments (GMM) dynamic panel model	Availability of credit, better infrastructure, and improved access to agricultural inputs are associated with increased productivity.
Chisasa and Makina, (2013)	South Africa over period 1970 – 2009	Cobb–Douglas Production Function estimated by OLS	Bank credit has a positive and significant impact on agricultural output in South Africa. Capital accumulation was also observed to have a positive and significant impact on agricultural output, albeit lower than that of credit. In terms the Cobb-Douglas elasticities, the combined effect of credit and capital accumulation gives constant returns to scale, meaning that doubling the two inputs will double agricultural output.
Anetor et al., (2016)	Nigeria over the sample	Vector autoregression (VAR) model	Commercial bank loans have a significant positive impact on

	period of 1981-2013		agricultural productivity, while the agriculture credit guarantee scheme by the government performed poorly in boosting agricultural sector performance.
Raifu and Aminu (2020)	Nigeria using annual data from 1981 to 2016	Autoregressive distributed lag (ARDL) model	Findings indicate that financial development exerts a positive impact on agriculture, but the impact is dampened by institutional weaknesses.
Akudugu (2016)	Ghana	mixed methods -quantitative and qualitative approach	Found a significant relationship between credit from formal and informal channels and agricultural productivity. The interaction of formal and informal credit with farm size also had a positive impact on agriculture output. The quadratic terms of formal and informal credit as well as farm size were found to significantly influence agricultural productivity.

Florence & Nathan, (2020)	Uganda over period 2008Q3 - 2018Q4	Autoregressive Distributed Lag (ARDL) Bound testing approach	In the long run, findings show credit has significant positive impact on agricultural output. Credit to production was found to have a much higher impact on agriculture output compared to credit to processing and marketing. And in the short run, it was found that bank credit has no instantaneous impact on agricultural output. Findings conclude commercial banks' agricultural credit has significant impact on Uganda's agricultural sector GDP.

9.3 Methodology: Data and Empirical Strategy

9.3.1 Data and Variable Measurements

The study used secondary annual time series data covering from 1990 to 2022. The data was collected from various sources including World Development Indicators (WDI), the World Bank Climate Change Knowledge Portal (CCKP), and the Bank of Tanzania (BOT). The sources for each variable and its measurements are as provided in Table 9.2.

Table 9.2: Variables used and their sources

Variables	Measurements	Sources	Expected sign
Agricultural Productivity	Agriculture, forestry, and fishing, value added (Constant LCU). It is used in the literature as a proxy for agricultural productivity.	WDI	NA
Credit to agriculture	The total amount of credit given to agriculture, forestry, and fishing expressed in Millions of TZS.	BOT	+
Lending rate	Lending interest rate (%)- bank rate that usually meets the short- and medium-term financing needs of the private sector.	BOT	
Employment	Employment in agriculture (% of total employment).	WDI	+
Capital	Physical capital is represented by the gross fixed capital formation (Constant LCU).	WDI	+
Inflation	Inflation rate (Annual % rate)	BOT	-
Rainfall	Annual rainfall/precipitation in millimetres.	CCKP	+

9.3.2 Empirical strategy

To estimate the effect of agricultural credit on agricultural productivity in Tanzania, we used three different measures of agricultural production as highlighted in the literature of previous studies: the agricultural component of GDP, Cereal yield (kg/ha) and agricultural labour productivity. The basic regression model is expressed as follows:

$$AGR = f(AGCR, X's) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where AGR, is agriculture productivity, while AGCR is the agricultural credit which is the key explanatory variable of interest. X represents control variables including the lending interest rates, inflation, agricultural labour, rainfall and fixed capital accumulation.

With regard that the production function is non-linear, we log-transform the Cobb-Douglas model to derive the following equation:

$$lnAGR_t = \beta_0 + \beta_1 lnAGCR_t + \beta_2 lnLIR_t + \beta_3 lnINF_t + \beta_4 lnL_t + \beta_5 lnRAIN_t + \beta_5 lnK_t + \varepsilon_t \ldots (2)$$

Where, the logarithm of agricultural productivity is represented by "ln (AGR)", the logarithm of agricultural credit is represented by "ln (AGCR)", and the logarithm of lending interest rate is represented by "ln (LIR)". Other variables such as the logarithm of the agricultural labour force, rainfall, and capital accumulation are represented by "ln(INF)", "ln(L)", "ln(RAIN)", and "ln(K)" respectively. The variable "t" represents the time dimension. ε_t is the error term. β_1 to β_5 are coefficients explaining the partial elasticities of explanatory variables. Our main parameter of interest is β1, which approximately describes the change in agricultural productivity measure in percentage terms in response to a one percent increase in agricultural credits.

This study applies the Autoregressive Distributed Lag (ARDL) technique, which was originally proposed by Pesaran and Shin in 1999. The ARDL model is a robust statistical tool that is specifically designed to produce accurate and unbiased estimates of long-run parameters, even when the integrated variables have different orders of integration (i.e. I (0) and I (1)). One of the key advantages of the ARDL model is its ability to handle endogenous explanatory variables, allowing for the simultaneous calculation of short-run and long-run estimates while correcting for endogeneity and residual correlation through the selection of optimal lag structures. In the context of this study, the ARDL model's relevance is highlighted by the fact that the data used is based on a small sample size. This is significant because the ARDL model is particularly effective in alleviating difficulties related to autocorrelation and omitted variable bias in such situations.

Therefore, by employing the ARDL technique, this study aims to generate precise and reliable findings that can offer valuable insights for policymakers and stakeholders. The goal is to equip decision-makers with the necessary information to make well-informed and evidence-based decisions.

Moreover, the specified ARDL for performing the bound test approach of eq (2) is as follows:

$$\begin{aligned} lnAGR_t = {} & \beta_0 + \beta_1 lnAGR_{t-1} + \beta_2 lnAGCR_{t-1} + \beta_2 lnLIR_{t-1} + \beta_3 lnINF_{t-1} \\ & + \beta_4 lnL_{t-1} + \beta_5 lnRAIN_{t-1} + \beta_5 lnK_{t-1} + \sum_{i1=1}^{m} \alpha_{1i} \Delta lnAGR_{t-i1} \\ & + \sum_{i1=2}^{n} \alpha_{2i} \Delta lnAGCR_{t-i2} + \sum_{i1=3}^{O} \alpha_{3i} \Delta lnLIR_{t-i3} \\ & + \sum_{i1=4}^{p} \alpha_{4i} \Delta lnINF_{t-i4} + \sum_{i1=5}^{q} \alpha_{5i} \Delta lnL_{t-i5} \\ & + \sum_{i1=6}^{r} \alpha_{6i} \Delta lnRAIN_{t-i6} + \sum_{i1=7}^{s} \alpha_{7i} \Delta lnK_{t-i7} + \varphi ECT_{t-1} \\ & + \varepsilon_t \quad \dots\dots\dots\dots..(3) \end{aligned}$$

Where Δ is the first difference operator and m, n, o, p, q, r and s are optimal lags in the model, β and α are coefficients of long-run and short-run dynamics, φ is the coefficient of the error correction term (ECT) estimating the speed of adjustment to equilibrium (φ should be negative and between 0 and -1), and ε_t represents the residual term, which is supposed to be well behaved (serially independent, homoscedastic and normally distributed).

We employed the Augmented Dickey-Fuller (ADF) test to ascertain the presence of a unit root in the series and to gauge the level of stationarity among the variables. It is recommended to meticulously assess the stationarity of the variables to ensure their suitability for application in the ARDL method (Kripfganz and Schneider, 2023).

Following the stationarity test, we proceeded with the implementation of the ARDL method, which entails a two-step process for estimating the long-run relationship (Pesaran et al., 2001). The initial step involves examining the existence of a long-run relationship among all variables used in the estimation. Subsequently, we calculated the F-statistic via the Wald test, with the null hypothesis suggesting no co-integration relationship between the modelled variables and the alternative hypothesis indicating a co-integration relationship among the variables of the estimated model. Upon establishing a long-run relationship in the first step, the next phase entailed computing the short-run and long-run coefficients of the variables under study alongside the error correction term of an ARDL model (Pesaran et al., 2001).

However, the chapter employed various tests to check for stability, serial correlation, normality, and heteroscedasticity of the residuals. Specifically, it used the Ramsey Regression Specification Error Test (RESET) by Ramsey (1969) to assess functional form, the Breusch-Godfrey test (Godfrey, 1978) for serial correlation, and the Jarque-Bera test to check for normality. Additionally, the study utilized the CUSUM and CUSUMSQ tests proposed by Brown et al. (1975) to evaluate the stability of the estimated coefficients.

Furthermore, we employed the Modified Wald test (MWALD), developed by Toda and Yamamoto (1995), to investigate the causal relationship between credit to the agricultural sector and agricultural production in Tanzania. The MWALD test is an improvement over the traditional Granger causality test as it considers the potential presence of non-stationarity or cointegration among the variables (Tuan et al., 2020). It can also be used to validate the results of the ARDL bounds test. Ageli (2022) suggested that if the null hypothesis of no cointegration in the ARDL bounds test is rejected, then there is at least one direction of Granger causality.

9.4 Empirical Results and Discussion

9.4.1 Descriptive Analysis

Tables 9.3 and 9.4 present the descriptive statistics and the correlation matrix for the variables used in the analysis, respectively. Table 9.3 reports the summary statistics that describe the nature of the distribution of each variable. Annual time series data from 1990 to 2022 is used for the explanatory and dependent variables. The average value for the natural logarithm of agriculture production (AGR in highest (30.1), with a range from 0.8 to 2.8. Furthermore, Table 9.3 indicates that the mean of the logarithm of public debt (lnPD) is 12.08, with a standard deviation of 1.86. This was followed closely by the mean of the logarithm of the investment (Inv) which has a mean value of 29.4 and a standard deviation of 1.8. Regarding, the normality test, Table 9.3 shows that the Jarque–Bera test for all variables included in the study is statistically insignificant at the 5% level, indicating that the selected variables follow a normal distribution.

Additionally, except rainfall, the Kurtosis values of other variables are below three, suggesting the absence of potential autocorrelation issues. Moreover, the coefficients of skewness for all variables used in the study fall within the range of -2 to +2, which is generally considered acceptable for normality.

Table 9.3: Descriptive Statistics

Variable	AGR	Credit	Inv	INF	LIR	L	Rain
Observation	33	33	33	33	33	33	33
Mean	30.49	12.08	29.37	2.17	2.95	4.32	6.86
Std. Deviation	0.39	1.86	1.84	0.73	0.29	0.10	0.11
Minimum	29.91	9.49	26.09	1.19	2.65	4.18	6.63
Maximum	31.14	14.55	31.94	3.58	3.58	4.44	7.12
Skewness	0.10	-0.17	-0.25	0.56	1.00	0.05	0.07
Kurtosis	1.73	1.37	1.76	2.02	2.61	1.32	3.18
JB- test	2.27	3.83	2.46	3.02	5.74	3.92	0.07
Probability	0.32	0.15	0.29	0.22	0.06	0.14	0.97

Note: Jarque-Bera (JB) test for Ho: normality; all variables are in logarithms form

Table 9.4 on the correlation matrix indicates that investment measured by gross fixed capital formation, credits to the agricultural sector and rainfall are positively correlated with agricultural production, while inflation rate, lending interest rate and agricultural labour are negatively correlated with agricultural production. All the pairwise correlation coefficients of the explanatory variables are below 0.8, indicating that multicollinearity is not an issue (Gujarati and Porter, 2009).

Table 9.4: Correlation Analysis

	logAGR	**logcredit**	**loginv**	**logINF**	**logLIR**	**logL**	**Lograin**
logAGR	1						
logcredit	0.97	1					
Loginv	0.99	0.77	1				
logINF	-0.76	-0.68	-0.79	1			
logLIR	-0.72	-0.77	-0.78	0.76	1		
logL	-0.98	-0.79	-0.77	0.68	0.74	1	
lograin	0.27	0.20	0.22	-0.21	-0.03	-0.23	1

9.4.2 Preliminary Analysis

9.4.2.1 Unit root test results

Table 9.5 shows the results of the Augmented Dickey-Fuller (ADF) test confirming that all variables become stationary after first difference implying that they are integrated into order I(1). Thus, the ARDL technique is suitable for this study.

Table 9.5: Augmented Dickey-Fuller (ADF) Unit Root Test

	Constant with no trend	**Constant with Trend**	**First difference**	**Order of Integration**
LogAGR	0.97	-3.50**	-3.89***	I(1)
Logcredit	-0.29	-1.68	-3.33**	I(1)
Loginv	-1.56	-1.46	-4.92***	I(1)

LogINF	-1.74	-2.02	-4.91***	I(1)
logLIR	-1.37	-1.59	-3.44**	I(1)
LogL	-0.99	-2.96	-4.09***	I(1)

9.4.2.2 Cointegration test results

The ARDL bounds test result is presented in Table 9.6. The computed F-statistic and t-statistic are larger than the upper bound values at a 5% significant level. Thus, the null hypothesis of no cointegration is rejected, i.e. the long-term relationship exists among agricultural credit, agricultural labour, rainfall, investment, inflation, lending rate and agricultural performance in Tanzania.

Table 9.6: ARDL Bounds Test Results

		Critical values					
		10%		5%		1%	
		L	U	L	U	L	U
F-Statistic	4.329	2.12	3.23	2.45	3.61	3.15	4.43
t-statistic	-4.716	-2.57	-4.04	-2.86	-4.38	-3.43	-4.99

***Note*:** L stands for Lower bound, U is Upper bound

9.4.2.3 An ARDL Estimated Results

With the existence of a cointegration relationship, this sub section examines the short-run and long-run dynamics among the variables by using the Error Correction Model. Moreover, the ARDL (1,2,2,2,2,2,0) model is selected through Akaike Information Criteria (AIC) and Schwarz Bayesian Information Criterion (SBIC). Table 9.7 shows the estimated short-run and long-run results. The coefficient of the error correction term (ECT) is negative and statistically significant, which implies the existence of co-integration among the variables included in the model. It indicates that 67% of the short-run disequilibrium is adjusted towards its long-run equilibrium annually.

The long-run results confirm that credits to agriculture boost agriculture production in Tanzania with an elasticity of 0.05. That is a one percent increase in credits to agriculture increases agriculture production by 0.05%. This finding is supported by Tuan, et. al. (2020), Seven and Tumen, (2020) and Gebeyehu and Bedemo (2024), whose studies revealed a positive effect of credit on the agricultural sector's productivity in the long-run. The argument for this positive relationship between credit to agriculture and its productivity is that credit could help farmers increase their productivity by allowing them to invest in new technologies and inputs, expand their operations and adopt new farming practices (Achumu et al., 2022). However, credits to agriculture could indirectly help farmers improve their access to markets and obtain better prices for their products (Gebeyehu and Bedemo, 2024).

Unsurprisingly, capital formation has a positive and significant effect on agricultural performance in the long-run. Specifically, the result reveals that a one percent increase in investment raises agriculture production by 0.11%. This result is consistent with that of Zakaria, et al., (2019) and Ngong, et al., (2023). The coefficient of capital accumulation surpassing that of credit extended to the agricultural sector, suggesting the differences in their impacts on agricultural productivity. Specifically, this phenomenon indicates that the resources allocated by the government towards infrastructure development, technological advancements, and research and development are yielding greater benefits for agricultural production than the financial support provided by banks to farmers. In contrast, while credit extended to the agricultural sector by banks is undoubtedly important, it often focuses on short-term financial needs rather than long-term structural improvements. Farmers may use loans for immediate expenses such as purchasing seeds, fertilizers, or equipment, but without the foundational support of infrastructure and technology, the impact of this financial assistance may be limited.

Meanwhile, we find that inflation negatively affect long-run agricultural productivity. Particularly, a one percent increase in inflation reduces agriculture production by 0.12%. This result is consistent with that of Mekonen (2020) and Gebeyehu and Bedemo (2024). This depicts that in Tanzania inflation increases input costs, such as labour, land, capital, fertilizer, and pesticides, which leads to uncertainty and restricts the growth of the agricultural sector.

Addionally, Table 9.7 shows that the lending rate is negative and significant in the long run, implying that an increase in lending rate exerts a negative impact on agricultural productivity in Tanzania. That is a one percent increase in lending rate is associated with a 0.96% decrease in agriculture production. This is consistent with the findings by Shuaibu and Nchake (2020) who found a negative and significant effect on lending rates in the South and West African sub-regions.

Another interesting observation is the negative and significant long-run effect of agricultural labour on agriculture productivity. However, this result is consistent with that of Ngong et al., (2023) and Shuaibu and Nchake (2020), who also found that agricultural employment has significant negative long-run impacts on agricultural productivity. This may be partly explained by the fact that better credit market conditions imply better access to finance, and this may induce substitution of capital for labour by farms and workers who migrate to other productive sectors.

However, in the case of Tanzania, the adverse impact of labour on agricultural productivity can be attributed to the inefficiency of the agricultural workforce. Research indicates that this sector is not only labour-intensive but also marked by a predominance of low-skilled labour, which significantly hampers the overall output and effectiveness of agricultural practices. The agricultural workforce in Tanzania largely consists of smallholder farmers who are mostly limited to advanced training and education. This deficiency in skills leads to suboptimal farming techniques, limited knowledge of modern agricultural practices, and inadequate use of technology (Tilumanywa, 2021). As a result, many farmers rely on traditional methods that may not be as productive or sustainable, leading to lower yields and inefficient resource use.

Furthermore, rainfall has a positive and significant effect on agriculture production in the long run in Tanzania. This is consistent with that of Shuaibu and Nchake (2020) who found a positive and statistically significant effect of rainfall on agricultural production in 35 SSA countries.

Likewise, Adabor and Essah (2024) showed that in the long run, rainfall exerts a positive effect on agricultural output in Ghana.

In the short run, the study's findings show that the coefficients of the lagged value of the credits to the agricultural sector are negative and significant in determining agriculture production. This could be attributed to the misuse of agricultural credits by farmers, who may use them for non-productive purposes such as household expenses (Gebeyehu and Bedemo, 2024). However, in the long run, farmers may have used it to invest in more productive farm businesses. Similarly, the coefficients of the lagged values of the lending rate are negative and significantly influence agriculture production in the short run.

However, the coefficient of the first lagged value of inflation is positive and statistically significant in determining agriculture production in Tanzania. This suggests that input costs change more slowly in the short term than in the long term and therefore have less of an impact on agricultural productivity. In the short term, agricultural productivity may increase due to the need to increase yield to respond to rising prices. Likewise, the coefficient of the first lagged value of investment is negative and statistically significant in determining agriculture production in the short run.

Moreover, the coefficient of the second-lagged value of agricultural labour is positive and statistically significant in terms of agriculture production in the short run. This finding is consistent with the fact that a rise in agricultural employment is associated with a rapid growth in agricultural productivity in the short run. This is consistent with the results obtained by Zhang and Diao (2020) in China and Gebeyehu and Bedemo (2024) in Ethiopia.

Table 9.7: An ARDL (1,2,2,2,2,2,0) Estimates Results

	Coefficient	**Standard errors**	**t**	**P>t**
ECT	-0.673	0.143	-4.72	0.000***
Long run estimates				
logcredit	0.054	0.023	2.39	0.033**
Loginv	0.110	0.016	6.83	0.000***
logINF	-0.116	0.013	-8.61	0.000***

logLIR	-0.965	0.169	-5.71	0.000***
logL	-0.936	0.482	-1.94	0.074*
Lograin	0.871	0.419	2.08	0.046**
Short run estimates				
logcredit				
D1.	-0.042	0.018	-2.27	0.041**
LD.	-0.022	0.012	-1.84	0.089*
Loginv				
D1.	-0.043	0.016	-2.72	0.018**
LD.	0.000	0.014	0	0.998
logINF				
D1.	0.046	0.013	3.58	0.003***
LD.	0.019	0.009	2.14	0.052*
logLIR				
D1.	-0.150	0.037	-4.01	0.001***
LD.	-0.068	0.032	-2.15	0.051*
logL				
D1.	-0.724	0.468	-1.55	0.146
LD.	2.119	0.773	2.74	0.017**
Constant	20.525	4.981	4.12	0.001***

***, ** and * denotes statistically significant at 1%, 5% and 10% level respectively.

9.4.2.4 Diagnostics and Stability Test Results

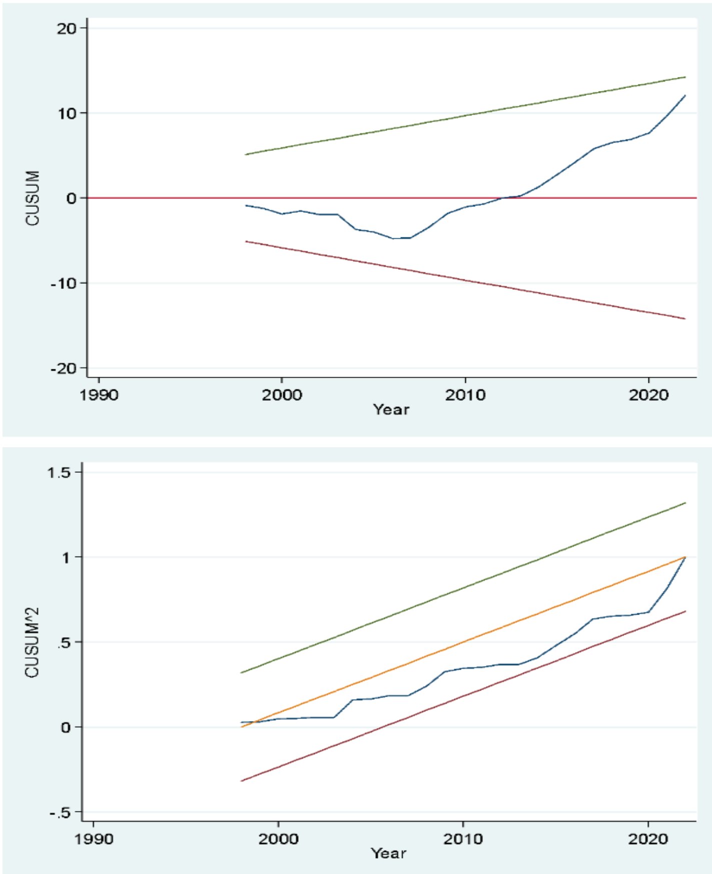
The diagnostics test results (see Table 9.8) confirm that the ARDL model does not suffer from autocorrelation, normality, heteroskedasticity and functional form specification issues.

Table 9.8: An ARDL (1,2,2,2,2,2,0) Model Diagnostic Test Results

Test	Value	Probability
Durbin-Watson d-statistic (18, 31)	2.46	
Ramsey RESET test	1.82	0.206
Breusch-Godfrey LM test for autocorrelation	4.22	0.040
White's test for homoscedasticity	31	0.415
LM test for autoregressive conditional heteroskedasticity (ARCH)	0.036	0.850
Durbin's alternative test for autocorrelation	1.891	0.169

Furthermore, to check the stability of the long-run coefficients along with the short-run dynamics, the figure of CUSUM was constructed. As shown in Figure 9.1, the CUSUM and CUSUMSQ of recursive residuals remains within the 5% critical bounds, which indicate that the model is stable.

Figure 9.1: Plots of CUSUM and CUSUMSQ



After estimating the ARDL model results, we proceeded to the causality test with the optimal lag order chosen based on the Akaike information criterion (AIC) and Schwartz Bayesian information criterion (SBIC). The optimal lag length used is 3. The results from the Toda Yamamoto Granger causality test are presented in Table 9.9. This result confirms the bidirectional causality between agricultural credit and agricultural production. The bidirectional causality is also observed among capital formation and agricultural production, inflation and agricultural production, agricultural employment and agricultural production. In addition, we observe a unidirectional causality running from lending rate to agricultural production and rainfall to agricultural production.

Table 9.9: Toda–Yamamoto (1995) Causality test results

	Null hypothesis	**chi2**	**Prob > chi2**
Agriculture credit vs Agricultural Production	logcredit does not Granger cause log AGR	13.47	0.001***
	logAGR does not Granger cause logcredit	8.71	0.013**
Capital formation vs Agricultural Production	loginv does not Granger cause log AGR	29.08	0.000***
	logAGR does not Granger cause loginv	6.95	0.031**
Inflation vs Agricultural Production	logINF does not Granger cause log AGR	13.72	0.001***
	logAGR does not Granger cause logINF	20.61	0.000***
Lending Rate vs Agricultural Production	logLIR does not Granger cause log AGR	14.82	0.001***
	logAGR does not Granger cause logLIR	0.14	0.932
Agricultural Labour vs Agricultural Production	logL does not Granger cause log AGR	4.92	0.085*
	logAGR does not Granger cause logL	20.43	0.000***
Rainfall vs Agricultural Production	lograin does not Granger cause log AGR	5.50	0.064*
	logAGR does not Granger cause lograin	3.50	0.174

***, ** and * denotes statistically significant at 1%, 5% and 10% level respectively.

9.5 Conclusion

Agricultural productivity in many African countries like Tanzania is still suboptimal. This chapter examined the macroeconomic impact of agricultural credit on agricultural productivity in Tanzania using time series data from 1990 to 2022. We specifically estimate the credit-agricultural performance nexus by employing the ARDL method and investigate the causality among variables based on the Toda–Yamamoto (1995) Granger causality approach. The results reveal that agricultural credit, rainfall, and capital formation have a positive significant impact on agricultural productivity in the long run. The low levels of productivity experienced by most smallholder farmers are partly attributed to credit constraints. This imply that credit constraints continue to hinder enhanced agricultural productivity in Tanzania.

However, the inflation rate, agricultural labour and prime lending rate exhibited a negative effect on agricultural productivity in the long run. Additionally, the Toda-Yamamoto Granger causality test demonstrated significant bidirectional causality between credit to agriculture and agricultural productivity in Tanzania. Moreover, in the short run, lagged credit and lagged lending rate were found to have a negative significant impact on agricultural productivity while lagged inflation and lagged labour were found to have positive effects.

Based on the findings, the paper recommends for collective efforts between the government and financial institutions to expand broader access of low-interest credit schemes especially to small-scale and resource-poor farmers by reducing collateral requirements and streamlining loan application processes.

Further, to ensure famers gain from agricultural credit, we suggest integrating credit supply with the provision of potential agricultural extension services; training on modern farming techniques, and climate-resilient practices; and access to high-quality inputs to leverage productivity gains - all aimed at reducing the costs and risks associated with lending to agricultural producers. Such efforts have the potential to stimulate banks' willingness to lend, helping to close the credit gap in the agricultural sector. It is also recommended to invest heavily in small-scale irrigation systems and water management technologies enhance rainfall reliability, which is likely to reduce associated risks for farmers and lenders.

More investment on Climate-Smart Agriculture is recommended through intensive research and distribution of drought -resistant crops and sustainable practices to mitigate rainfall variability, as well as build resilient farming systems. Lastly, subsidization of agricultural mechanization and infrastructure is recommended, to ensure farmers can tap in productivity-enhancing tools such as tractors. This can also be effective by emphasizing Private-Public Partnership in the delivery and supply of agricultural equipment at affordable prices.

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Chapter 10 Warehouse Receipt Systems and Agricultural Transformation in Tanzania: Unlocking Smallholder Prosperity through Policy Innovation

David Gongwe Mhando

10.1 Introduction

Tanzania's agricultural sector remains the backbone of the national economy, with smallholder farmers playing a vital role in ensuring food security and sustaining rural livelihoods. Despite their centrality, these farmers continue to face structural barriers—including limited access to markets, financial services, and modern agricultural technologies. In response, policy innovations have been central to agricultural reform efforts. Among these, the Warehouse Receipt System (WRS) stands out as a transformative mechanism, offering smallholder farmers both market stability and improved access to finance.

This chapter examines the interplay between broad policy frameworks and targeted innovations in the agricultural sector, with a specific focus on the WRS. The introductory section provides an analytical overview of agricultural policy innovations in Tanzania, evaluating their impacts on productivity and smallholder livelihoods. The second section explores the WRS in detail, highlighting its mechanisms, contributions to market efficiency, and the challenges that hinder its full potential. The chapter integrates these perspectives and offers a comprehensive understanding of how policy frameworks and interventions shape the dynamics of agricultural development in Tanzania.

The chapter situates the discussion within a broader context of agricultural transformation; thus, the chapter not only underscores the importance of the WRS as a standalone policy intervention but also evaluates its role in addressing systemic challenges that smallholder farmers face. The insights gained contribute to ongoing debates among academics and policymakers on the effectiveness of policy innovations in fostering sustainable agricultural development and improving rural livelihoods.

10.2 Contribution of Smallholder Producers in the Tanzania's Agricultural Framework

10.2.1 Smallholder farmers

Smallholder farmers in Tanzania are typically defined by the limited scale and subsistence nature of their operations, often cultivating plots of less than two hectares. While primarily focused on food production for household consumption, their engagement with markets remains limited. However, definitions of smallholders vary, emphasizing factors such as land size, income sources, and the proportion of produce sold (Fletcher et al., n.d.; Kawa and Kaitira, 2007). According to the 2019/20 National Sample Census of Agriculture, smallholders cultivate approximately 5.1 million hectares annually—accounting for 85% of the land used for food crops in Tanzania (NBS, 2021). These farms support the livelihoods of over 75% of the population (URT, 2016). Given their foundational role in the agricultural economy, it is essential to examine how innovative policies—such as the Warehouse Receipt System (WRS)—can enhance their productivity, market participation, and overall livelihoods.

Characteristically, Tanzanian smallholder farmers manage fragmented and diversified farms that integrate both crop production and livestock. Their farming techniques are primarily traditional and labour-intensive due to low access to modern agricultural technologies and limited financial resources. The economic profile of these households often includes a mix of agricultural and non-farm income, where agriculture does not always provide most of their income, especially in households that are transitioning or diversifying their economic activities (Fletcher, et. al., n.d.).

The categorization and segmentation of smallholder farmers in Tanzania is based on the proportion of crop production sold and the source of household income. These categories include subsistence, pre-commercial, specializing commercial, transitioning, and diversified, each reflecting a different level of market engagement and economic diversification (Fletcher, et. al., n.d.). Aimee Knight (2024) describes them as family farmers who predominantly rely on household labour, primarily producing to meet their household needs and retaining surplus for consumption. Similarly, the Food and Agriculture Organization (FAO) extends the definition to include smallholders in agriculture, pastoralism, agroforestry, and fishing, managing between one and ten hectares of land (FAO, 2014. In Tanzania, however, ten hectares might be too expansive for smallholders, where most operate on smaller plots of land less than two hectares, focusing primarily on subsistence farming with limited market engagement.

Overall, smallholder farming in Tanzania is marked by its critical role in rural livelihoods and food security. However, it faces significant challenges such as poor access to markets, inadequate agricultural inputs, and the impacts of policy and economic reforms that have shifted the agricultural landscape from a command-based system to a more market-oriented framework since the mid-1980s (Kawa and Kaitira, 2007). Smallholder farmers play a critical role in Tanzania's agricultural landscape, contributing significantly to food security and economic stability despite facing numerous challenges. These farmers are primarily engaged in subsistence farming, and their productivity is often hindered by factors such as limited access to markets, financial resources, and climate change impacts (Frontiers, 2023; MDPI, 2023).

Agricultural cooperatives have been recognized for their potential to improve smallholder farmers' market participation and livelihoods. By facilitating better access to markets, credit, and information, cooperatives can play a significant role in enhancing the economic well-being of their members (Coulter & Shepherd, 1995; Coulter & Onumah, 2002). To optimize the impact of smallholder farmers in Tanzania, it is essential for policy interventions to focus on enhancing access to financial resources, markets, and technology, while also supporting the adoption of sustainable agricultural practices through education and cooperative initiatives.

10.2.2 Smallholder Farmers and Innovative Policy Solutions

In post-independence Tanzania, efforts to address these structural inequalities focused on land reform and agricultural modernization policies. These initiatives aimed to redistribute land and increase smallholders' access to credit, technology, and infrastructure (Isinika, et. al., 2010). Despite these attempts, many of the structural challenges left behind by the colonialists such as poor infrastructure and bureaucratic inefficiencies persisted, limiting the impact of these reforms (Benjaminsen and Lund, 2003). One key innovation, however, has been the introduction of the WRS, which provides smallholders with secure storage options and access to credit using warehouse receipts as collateral (Mhando and Itani, 2011). The WRS has helped smallholder farmers, particularly in the coffee and cashew sectors, improve their market access and financial standing by allowing them to store crops and avoid distress sales during harvest periods when prices are typically low (Coulter and Shepherd, 1995). By stabilizing market prices and offering credit, the WRS has contributed to increased agricultural productivity and has enhanced smallholder prosperity (William and Kaserwa, 2015).

10.2.3 Policy Frameworks Supporting Agricultural Production and Smallholder Empowerment in Tanzania

Tanzania's agricultural policy frameworks are designed to support smallholder farmers and enhance agricultural productivity through a series of national strategies and international partnerships. The National Agriculture Policy (URT, 2013) focuses on transforming agriculture from subsistence farming to a more commercial and modern approach. It emphasizes crop intensification, technological advancement, and infrastructural development, with significant emphasis on private sector involvement as a growth engine. Efforts to support smallholder farmers in Tanzania are complemented by international funding and strategic initiatives. For example, the World Bank has approved financing to help smallholder farmers adopt resilience-enhancing technologies and practices, which are critical in boosting productivity and adapting to climate change (World Bank, 2023). Additionally, projects like the Tanzania Agricultural Inputs Support Project funded by the African

Development Bank (AfDB) aim to significantly increase food production through targeted financial and technical support (AfDB, 2022).

Barriers to trade and market access remain significant challenges for smallholder farmers in Tanzania. Policies such as the National Strategy for Economic Growth and Reduction of Poverty (MKUKUTA) focus on transforming agriculture from subsistence levels to commercial production, improving agricultural market systems, and enhancing producer empowerment and market linkages (FAO, 2013). Furthermore, the Gates Open Research briefing underscores the diverse structure of Tanzania's agricultural sector, where crop production is the dominant contributor to agricultural GDP, indicating significant scope for growth and improvements in smallholder livelihoods through targeted policies and investments (Derksen-Schrock, Anderson & Gugerty, 2019). Beyond national policy frameworks, strengthening cooperatives plays a pivotal role in ensuring that smallholder farmers can fully engage with market and financial systems such as the WRS.

10.3 Policy Innovations in Agriculture aimed at increasing productivity

Policy innovations in Tanzania's agricultural sector aim to address structural challenges and unlock the potential of smallholder farmers. These policies focus on improving productivity, enhancing market access, and fostering financial inclusion. This section highlights key policy innovations that have transformed Tanzania's agricultural sector, focusing on interventions that enhance productivity, market access, and resilience for smallholder farmers. It outlines examples such as improved seed distribution programs, input subsidies, extension services, cooperative revitalization, and infrastructure development, all of which contribute to sustainable agricultural growth and food security. These innovations serve as building blocks for systems like the Warehouse Receipt System (WRS), offering integrated solutions to the challenges faced by smallholders.

10.3.1 Examples of Policy Innovations

10.3.1.1 Improved Seed Distribution Programmes

The introduction of improved seed varieties through initiatives like the Agricultural Seed Agency (ASA) has significantly increased crop yields, particularly for maize, rice, and beans. These programmes enhance food security and resilience to climate change. Seed development has been one of the most significant agricultural innovations in Tanzania, playing a vital role in enhancing crop productivity, food security, and resilience to climate change. The introduction of improved seeds, supported by national and international policies, has helped farmers adopt higher-yielding and disease-resistant crop varieties. This is particularly critical for food crops such as maize, rice, and beans, which form the basis of food security in Tanzania.

The Agricultural Seed Agency (ASA), established in 2006, has been pivotal in distributing improved seeds to farmers, helping to close the yield gap caused by the reliance on traditional varieties. This innovation has led to an increase in food crop production, making Tanzania one of the largest producers of maize and rice in East Africa (URT, 2020). Seed development has helped address food security concerns, while the WRS complements these efforts by providing market access mechanisms that allow smallholder farmers to sell their surplus production under favourable market conditions.

10.3.1.2 Subsidized Inputs and Extension Services

Government-led input subsidy programmes and enhanced extension services play a crucial role in increasing agricultural productivity, particularly among smallholder farmers. In Tanzania, the government's efforts to subsidize inputs such as fertilizers and pesticides have led to significant reductions in the cost of these essential farming supplies, making them more accessible to farmers. This has encouraged the adoption of modern agricultural practices, thereby boosted crop yields and improved food security. Input subsidies, especially in the case of fertilizers, have been shown to increase productivity by enabling farmers to replenish soil nutrients, leading to more efficient farming systems (FAO, 2013). In tandem with input subsidies, the government has worked to strengthen extension services, which are vital in disseminating modern farming techniques and knowledge. These services provide farmers with information on the optimal use of subsidized inputs, pest control, and modern crop management strategies, which are essential for improving both the quality and quantity of agricultural outputs. Extension workers also help farmers adapt to challenges such as climate change by introducing more resilient farming methods and advising on the use of alternative inputs like organic fertilizers and integrated pest management (Mhando et al., 2018).

The combination of subsidized inputs and extension services creates a framework that enables smallholder farmers to increase their productivity while simultaneously improving their market access. For example, in the case of Tanzania's Warehouse Receipt System (WRS), smallholders can store their crops in certified warehouses and use the receipts as collateral for loans to purchase inputs. This financial flexibility, coupled with enhanced knowledge from extension services, helps farmers avoid distress sales, stabilize their incomes, and invest in productivity-enhancing technologies (Mhando and Itani, 2011).

These initiatives have demonstrated tangible impacts on agricultural productivity. Research indicates that farmers who participate in input subsidy programmes and benefit from extension services are more likely to adopt modern technologies and improve crop yields. However, challenges such as high transaction costs and limited farmer awareness still hinder the full potential of these programmes. To address these gaps, ongoing education and targeted policy reforms that include gender-sensitive interventions are critical for ensuring that all farmers, particularly women, can benefit from these innovations.

10.3.1.3 Promotion of Agricultural Cooperatives

Agricultural cooperatives have been revitalized to improve farmers' access to markets, credit, and technology. These cooperatives play a critical role in aggregating produce and negotiating better prices for their members. Cooperatives play a critical role in promoting agricultural productivity in Tanzania by providing smallholder farmers with access to essential resources, such as credit, technology, and markets. Policy innovations that focus on strengthening cooperative structures can significantly enhance their capacity to support farmers in adopting modern agricultural practices and increasing their productivity. One key strategy is the promotion of capacity-building programmes for cooperative leaders in areas such as financial management, market dynamics, and governance. Well-trained leaders are better equipped to manage cooperative resources efficiently and advocate for their members' interests, ensuring that farmers benefit from improved access to financial services and technology.

Furthermore, policies aimed at increasing the adoption of modern technologies, such as precision farming tools and climate-smart agricultural practices, can be integrated into cooperative activities. Cooperatives can serve as platforms for disseminating such technologies to farmers, who may otherwise face barriers to accessing them individually. Government support for technology adoption, combined with cooperative structures, can significantly reduce transaction costs, improve production efficiency, and enhance market linkages, ultimately boosting agricultural output.

Another essential policy innovation involves addressing infrastructure challenges, such as inadequate storage facilities, transportation networks, and market access. Investments in rural infrastructure can empower cooperatives to provide better services to their members, enabling farmers to reduce post-harvest losses, access markets more easily, and improve the quality of their produce. Additionally, infrastructure improvements can lower logistical costs, making it easier for cooperatives to connect farmers with buyers, thereby improving farmers' incomes.

Inclusive policies that promote the participation of marginalized groups, particularly women and youth, in cooperatives can also contribute to higher productivity. Tailored financial products and leadership development programmes targeted at these groups can ensure equitable access to the benefits of cooperative membership. Promoting inclusivity within cooperatives can strengthen social cohesion, increase labour participation, and enhance the overall productivity of the agricultural sector.

Overall, policy innovations that focus on strengthening cooperative structures, improving access to technology, enhancing infrastructure, and fostering inclusivity are essential for increasing agricultural productivity in Tanzania. These innovations empower cooperatives to serve as catalysts for agricultural transformation, supporting smallholder farmers in achieving higher productivity and improved livelihoods.

10.3.1.4 Infrastructure Development

Investments in rural infrastructure, including storage facilities, have enhanced market access and reduced post-harvest losses. Horticulture has emerged as a rapidly growing sector in Tanzania, driven by demand for fresh produce such as vegetables, fruits, and flowers, both locally and for export markets. To support this growth, policy innovations have focused on the establishment of pack houses and cold storage facilities, which provide critical infrastructure for preserving the quality of horticultural products and extending their shelf life. These facilities play a similar role to that of the WRS in reducing post-harvest losses but are specifically tailored to the unique needs of perishable products (United Nations Development Programme -UNDP, 2018).

The Tanzanian government, through partnerships with the private sector and international donors, has invested in pack houses in key horticultural regions such as Arusha and Kilimanjaro. These facilities provide smallholder farmers with access to international markets by ensuring their produce meets export quality standards. This infrastructure investment has not only enhanced market access but also improved the bargaining power of farmers, enabling them to secure better prices for their products (UNDP, 2018).

As it has been noted, infrastructure plays a critical role in enhancing agricultural productivity, with investments in certified warehouses, transportation networks, and digital technologies like electronic systems significantly improving the transparency, efficiency, and accessibility of agricultural markets (Jayne, et al., 2018; Reardon, et al., 2019). These investments reduce post-harvest losses and enable farmers to securely store their produce. Expanding certified warehouses, particularly in rural areas, and modernizing their operations through digital systems can streamline documentation and minimize administrative delays (Barrett, Reardon, Swinnen, & Zilberman, 2020).

Additionally, improved transportation networks ensure the timely movement of produce to storage facilities, reducing costs associated with long-distance travel and supporting policy innovations aimed at increasing agricultural productivity (Dorward & Chirwa, 2011).

10.3.2 Transition to the Warehouse Receipt System (WRS)

While these policy innovations create an enabling environment for agricultural development, the Warehouse Receipt System (WRS) stands out as a targeted solution addressing market and financial challenges faced by smallholder farmers. From a policy perspective, the WRS exemplifies an intervention that addresses several structural challenges faced by smallholders, including limited access to credit, markets, and storage facilities. Ellis (1993) and Hyden (1980) have both underscored the importance of such policy innovations in supporting smallholder agriculture, particularly in the context of market liberalization, which often leaves small producers vulnerable to price volatility.

The WRS provides a safety net by stabilizing income through secured storage and delayed sales, thus ensuring that farmers can participate in the economy with more equitable terms. Thus, the WRS in Tanzania has proven to be a vital tool for empowering smallholder producers, contributing to both their individual prosperity and the broader development of the agricultural sector and national economy. By allowing farmers to store their produce in certified warehouses and use receipts as collateral for loans, the WRS empowers smallholders to optimize their production outcomes. The next section focuses exclusively on the WRS, exploring its unique contribution to Tanzania’s agricultural sector.

10.4 Methodology

The study employed a mixed-methods approach to evaluate the impact and effectiveness of the WRS in Tanzania, emphasizing its role in supporting smallholder farmers. Data collection involved a combination of desk reviews, field-based case studies, surveys, and secondary data analysis. A comprehensive review of policy documents, government reports, and academic studies provided a theoretical foundation and contextual understanding of the WRS framework. Case studies were conducted in Tandahimba and Mbinga districts, which were selected for their reliance on cashew and coffee farming, respectively, and their adoption of the WRS. These case studies included interviews and focus group discussions with farmers, cooperative leaders, warehouse operators, and policymakers to gather detailed qualitative insights. Additionally, surveys were administered to smallholder farmers participating in the WRS, to quantify its impact on income, credit access, and market stability. The structured questionnaires captured demographic data, farming practices, and financial outcomes, while national statistics on agricultural production and market trends were analysed alongside warehouse records on crop storage volumes and credit issuance. The integration of these data sources allowed for a comprehensive assessment of the WRS's contributions and challenges.

The data were analysed using both qualitative and quantitative methods. Thematic analysis identified key issues, such as market access, financial inclusion, and gender disparities, while descriptive and inferential statistics applied to survey data to evaluate correlations between WRS participation and income stability. Regional trends in warehouse utilization and credit access highlighted systemic inefficiencies and areas for policy improvement. The study focused on the coffee and cashew sectors, which may limit its generalizability to other crops and regions. Additionally, limited availability of certain financial metrics necessitated reliance on self-reports and cooperative records. Despite these limitations, the methodology provided a framework for understanding the WRS’s transformative potential in the agricultural sector of Tanzania and offered actionable insights to guide policy enhancements and scale-up efforts.

10.5 The WRS: is a Policy Innovation

10.5.1 Policy innovation

The Warehouse Receipt System (WRS) is a policy innovation designed to address specific challenges in Tanzania’s agricultural sector, such as market instability, post-harvest losses, and limited access to credit. The WRS has emerged as a critical post-colonial policy innovation in Tanzania, designed to improve smallholder farmers' access to both credit and markets. Introduced in 2007, the WRS enables farmers to store their crops in certified warehouses, receiving warehouse receipts that serve as collateral for loans. This mechanism provides farmers with an opportunity to secure capital before selling their produce, enhancing their financial security, and reducing post-harvest losses. It also contributes to stabilizing market prices, offering flexibility for farmers to sell their crops when market conditions are most favourable (Mhando, 2011; William & Kasewa, 2015).

Particularly in sectors such as coffee and cashew nuts, the WRS has facilitated improved market access and price realization, helping smallholders avoid distress sales while investing in productivity-enhancing inputs (Mhando and Itani, 2011).

10.5.2 The Transformative Role of WRS) in Tanzania's Agricultural Sector

The WRS is a strategic intervention addressing multiple structural challenges in Tanzania’s agricultural sector, many of which have persisted since colonial times. These challenges include reliance on cash crops, inadequate agro-processing infrastructure, limited market access, and the inability of smallholder farmers to secure formal credit. By providing certified storage facilities and warehouse receipts as financial instruments, the WRS helps farmers overcome barriers to accessing markets and credit. The system enables farmers to deposit their crops in certified warehouses and receive warehouse receipts, which may use as collateral to secure loans. This mechanism not only enhances financial inclusion but also equips farmers with the resources needed to invest in modern agricultural technologies, improve productivity, and diversify production, mitigating the risks of monocropping (Mhando and Itani, 2011; William and Kaserwa, 2015).

The WRS represents a pivotal policy aimed at stabilizing market prices, reducing post-harvest losses, and improving farmer incomes. By enabling farmers to store their produce and sell when market prices are favourable, the WRS addresses the issue of rushed sales during harvest peaks, which typically result in low incomes for farmers. This flexibility reduces price volatility and empowers farmers to participate more effectively in agricultural markets. In regions like Ruvuma, coffee farmers utilizing the WRS reported significantly higher returns compared to those who sold their produce during peak harvest seasons (Mapunda, et.al, 2018). The integration of WRS with platforms like the Tanzania Mercantile Exchange (TMX) enhances these benefits by providing real-time price updates and market information, improving farmers' decision-making and bargaining power (Coulter and Shepherd, 1995).

10.5.3 Financial Inclusion and Credit Access for Smallholder Farmers

Historically, smallholder farmers in Tanzania faced significant challenges in accessing formal financial services due to high risks associated with agriculture, including price volatility, droughts, and floods. These challenges limited their ability to secure loans and invest in productivity-enhancing inputs. The introduction of the WRS marked a transformative shift by allowing farmers to use stored crops as collateral to secure loans on favourable terms. This development enhanced financial inclusion and provided farmers with the resources to purchase essential inputs such as seeds, fertilizers, and tools, fostering improved production and better livelihoods (Coulter and Shepherd, 1995). WRS-linked credit has been particularly impactful in districts like Mbinga and Namtumbo, where coffee and cashew farmers leveraged warehouse receipts to increase productivity and incomes (Mapunda et al., 2018; Mashalla, 2024). Research shows that the system has been instrumental in mitigating price risks and promoting a more transparent and efficient agricultural market. By certifying the quality and quantity of produce stored, the WRS fosters trust among farmers, financial institutions, and other stakeholders, further strengthening its acceptability as a financial tool (Coulter and Onumah, 2002).

Electronic Warehouse Receipt Systems (e-WRS), implemented in countries like Kenya and Uganda, offer valuable lessons for Tanzania. These digital platforms simplify credit access, reduce transaction costs, and enhance transparency by fostering direct linkages between farmers and buyers. For instance, Kenya's e-WRS in the maize and tea sectors and Uganda's digitized system for smallholder maize farmers demonstrate the potential of such innovations to improve market efficiency and financial inclusion (Farmers Review Africa, 2022; FAO, 2020).

10.5.4 Stabilizing Market Prices and Reducing Post-Harvest Losses

A core benefit of the WRS is its ability to stabilize market prices. By allowing farmers to store their produce and avoid selling during periods of oversupply, the system ensures better price realization and reduces income fluctuations. For example, coffee farmers in Ruvuma who used the WRS experienced higher incomes compared to those selling at peak harvest times when prices were lower (Mapunda, et al., 2018). The integration of market information systems, such as TMX, amplifies these benefits by providing real-time data, which helps farmers make informed decisions about when and where to sell their produce (Coulter and Shepherd, 1995).

The system also addresses significant post-harvest losses, a persistent challenge for Tanzanian farmers. Certified warehouses maintain optimal storage conditions, reducing spoilage and pest damage. According to the FAO (2021), effective storage facilities can decrease post-harvest losses by up to 30%, resulting in increased marketable produce and higher farmer incomes. Incorporating indigenous storage methods alongside modern facilities could further extend the WRS's impact, particularly in rural areas where access to certified warehouses may be limited (Ashraf & Mohi-udhin, 2018).

10.5.5 Promoting Gender Inclusion and Economic Resilience

The WRS also addresses the unique challenges faced by women in accessing credit and markets. Evidence from Uganda highlights the success of women-led cooperatives using e-WRS to gain financial independence and improve livelihoods. These findings underscore the importance of incorporating gender-sensitive policies and training within the WRS framework to maximize its impact on economic empowerment and poverty reduction (Katunze et al., 2017; Isaga, 2018).

Additionally, the system enhances smallholder farmers' economic resilience by stabilizing incomes and providing access to credit. This dual benefit enables farmers to invest in modern agricultural technologies, reduce financial vulnerability, and improve their overall livelihoods. Comparative studies in sub-Saharan Africa reveal that the WRS contributes significantly to poverty reduction and encourages smallholders to transition from subsistence to commercial agriculture (Mhando &Itani, 2011; Salami et al., 2011).

10.5.6 Lessons from International Experiences and Future Prospects

International experiences with WRS provide valuable insights for Tanzania. Kenya's e-WRS has demonstrated the benefits of reducing transaction costs and improving market efficiency, while Uganda's digitized system has enhanced access to markets for smallholder farmers. These innovations highlight the importance of robust institutional frameworks and the integration of digital technologies to optimize WRS operations. Tanzania could adopt similar approaches, such as mobile platforms, to expand the system's reach and accessibility, particularly for farmers in remote areas (FAO, 2020; Katunze et al., 2017).

While the WRS has achieved significant milestones in Tanzania, challenges remain, including delays in credit disbursement, high transaction costs, and limited farmer awareness. Addressing these issues will require targeted interventions, such as expanding certified warehouse networks, enhancing financial literacy programmes, and strengthening institutional support. Despite these challenges, the WRS continues to play a central role in creating a more equitable, efficient, and sustainable agricultural sector in Tanzania. By stabilizing market prices, reducing post-harvest losses, and improving financial inclusion, the WRS has the potential to further transform the livelihoods of smallholder farmers and advance the country's agricultural development agenda (Mhando and Itani, 2011; Coulter and Onumah, 2002; Mapunda et al., 2020).

10.6 Analysis of the Agricultural Sector in Tanzania and WRS: Improving Market Access and Financial Inclusion

Tanzania's agricultural sector, primarily dominated by smallholder farmers, has experienced significant transformations through innovative policy interventions, particularly the implementation of the WRS. These policies are aimed at enhancing the prosperity of smallholder producers by addressing key barriers to market access and finance. The WRS has emerged as a critical tool in enabling farmers to optimize their production outcomes, by allowing them to store produce and access finance using receipts as collateral. This system presents a departure from traditional agricultural practices, where immediate post-harvest sales often lead to lower profits due to market saturation and price volatility.

One of the most significant outcomes of the WRS is its role in expanding farmers' access to credit. As smallholder farmers frequently struggle to secure financial services, the WRS has introduced an innovative solution that uses stored crops as collateral for loans. Mhando and Itani (2014) report that coffee farmers in Mbinga District benefited substantially from this system, with increased access to credit enabling them to invest in improved farming inputs such as fertilizers. This, in turn, elevated their productivity and income. Isaga (2018) supports this by showing that smallholder farmers in Singida, involved in sunflower production, experienced similar benefits, as they were able to access loans through the WRS to modernize their farming techniques. Such innovations align with international findings by Salami, et. al. (2011), who argue that access to credit is pivotal for smallholder farmers to adopt technology and increase their productivity.

Beyond credit access, the WRS has facilitated better price realization for smallholder farmers. The ability to store produce and delay sales until market conditions improve has been a critical factor in enhancing farmers' profitability. For example, Mapunda et al., (2018) observed that farmers in Mbinga district, who participated in the WRS for coffee production, were able to avoid selling their products at low prices during peak harvest times. By holding their produce in certified warehouses, they gained the flexibility to sell when prices were more favourable. This reflects broader evidence from other agricultural sectors in Tanzania, such as the cashew nut industry, where Mapunda et al., (2018) found that WRS implementation helped farmers to secure higher prices by reducing their reliance on intermediaries. However, while the WRS has contributed to elevating the economic prospects of smallholder farmers, it has also faced challenges that limit its full impact.

Delays in credit disbursement and inefficiencies in the coordination of market activities have undermined its effectiveness. Mapunda et al. (2018) found that coffee farmers in Mbinga experienced liquidity challenges due to slow loan processing, which sometimes forced them to sell their crops at suboptimal prices. This challenge is not unique to Tanzania. Katunze, et al. (2017) found similar issues in Uganda, where smallholder farmers, particularly those in the maize sector, faced difficulties accessing credit through the WRS due to bureaucratic delays and high collateral requirements. These inefficiencies highlight the need for further policy innovations to streamline processes and ensure that smallholder farmers can fully benefit from the system.

Another key barrier to maximizing the potential of the WRS in Tanzania is the limited awareness and understanding of the system among farmers. Despite its benefits, many farmers are unfamiliar with how the WRS operates, which reduces their participation. Isaga (2018) highlights that smallholder farmers often lack the financial literacy needed to navigate formal market systems, contributing to low uptake of the WRS. Addressing this challenge require more robust training programmes as well as outreach efforts, aimed at educating farmers on the advantages of utilizing the WRS. Bee (2007) emphasizes the importance of comprehensive education campaigns to raise awareness about the system, noting that such interventions are critical for achieving broader participation and integration of smallholder farmers into formal financial markets.

Comparing Tanzania's experience with other countries further underscores the importance of institutional support for the success of the WRS. In Uganda, Katunze et al., (2017) found that while the WRS improved market access and price stability for smallholder maize farmers, access to credit remained a persistent challenge due to complex administrative procedures. This reflects similar issues in Tanzania, where smallholder farmers with low production volumes often struggle to meet the necessary collateral requirements to participate fully in the system (Isaga, 2018). These findings suggest that in both countries, policy innovations need to focus on simplifying credit access procedures and improving the overall efficiency of the WRS to serve smallholder farmers better.

In conclusion, Tanzania's Warehouse Receipt System has proven to be a transformative policy intervention aimed at elevating the prosperity of smallholder producers. By providing access to credit and facilitating better price realization, the WRS has empowered farmers to invest in productivity-enhancing technologies and improve their livelihoods. However, challenges such as delays in credit disbursement and limited farmer awareness continue to constrain its full potential. Addressing these issues through further policy innovations, including streamlined credit processes and targeted educational programmes, is essential for maximizing the benefits of the WRS and ensuring its long-term sustainability. The experience of other countries, such as Uganda, reinforces the need for institutional support and simplification of credit mechanisms to ensure that smallholder farmers can fully engage with and benefit from these market innovations.

10.7 Challenges and Policy Solutions for Strengthening the WRS in Tanzania

The WRS in Tanzania, while promising in theory, faces several challenges that hinder its effectiveness in fully supporting smallholder farmers. Despite the system's goal of enhancing access to finance and markets for smallholder producers, its implementation has encountered significant barriers. These challenges, however, present an opportunity for innovative policy interventions aimed at elevating the prosperity of smallholder farmers in Tanzania.

One of the primary challenges of WRS in Tanzania is inclusivity; it has not adequately addressed the needs of women farmers, who constitute a substantial portion of the agricultural labour force. Studies indicate that female-headed households have less access to financial services and resources, such as land and capital, compared to their male counterparts (Isaga, 2018). This gender disparity limits their participation in WRS, as access to credit and extension services are critical components for farmers to leverage the system effectively. Similar challenges are observed in other countries, such as Ghana, where female farmers also face hurdles in accessing agricultural credit (Obisesan, 2013). Addressing these gender-based inequalities through targeted interventions, such as women-focused financial products and capacity-building initiatives, could significantly enhance system's inclusivity.

Another critical issue is the low level of awareness and education among farmers about the benefits and functioning of the WRS. In a study conducted in the cashew-growing regions of Tandahimba, 76% of respondents indicated that they lacked a full understanding of the system's operations, particularly how it could improve their access to finance and enable better storage practices (Mashalla, 2024). This knowledge gap limits the adoption of WRS among smallholders, preventing them from accessing its full potential. Similar findings were reported in Uganda, where the lack of farmer education was identified as a key barrier to WRS adoption (Katunze et al., 2017). Increasing awareness through extension services and farmer cooperatives could bridge this gap and encourage wider use of WRS.

Operational inefficiencies further limit the system's effectiveness. Despite the regulatory framework established by the WRS Act of 2005, inadequate infrastructure and inconsistent quality control mechanisms undermine the credibility and reliability of WRS in Tanzania (Mapunda et al, 2018). Farmers, particularly those involved in cashew and coffee production, report challenges related to unreliable grading and quality assurance, leading to pricing that does not reflect the true value of their produce (Mashalla, 2024). This problem is not unique to Tanzania; other countries, such as Indonesia, have also struggled with similar operational inefficiencies in their WRS (Alderman and Shively, 1996). Strengthening regulatory oversight and improving infrastructure, including modern storage facilities and robust quality control systems, are critical steps toward ensuring that farmers benefit from higher prices for quality produce.

In addition to these operational challenges, high transaction costs deter many smallholder farmers from participating in the system. The costs of transporting produce to certified warehouses and the fees associated with storage can be prohibitive, particularly for farmers in remote areas. A study in Singida highlighted that logistical challenges and high warehouse fees were significant barriers to participation in WRS (William and Kaserwa, 2015). These findings are consistent with research from other African countries, such as Uganda, where smallholders cited similar concerns about the costliness of WRS participation (Katunze et al., 2017). To address this, policy interventions could focus on subsidizing transport and storage costs or offering incentives for farmers to use WRS facilities.

Finally, the issue of risk management remains a critical limitation of the current WRS framework. Smallholder farmers in Tanzania have expressed concerns about market price volatility and the inability of the system to provide adequate risk mitigation measures, such as price stabilization mechanisms. In regions where cashew and coffee are primary cash crops, price fluctuations pose significant risks, often resulting in farmers being unable to repay loans obtained through the WRS (Isaga, 2018). This situation is exacerbated by the lack of crop insurance schemes, which could protect farmers from the adverse effects of price volatility and crop failure. Comparatively, India’s WRS model includes a minimum support price scheme that guarantees farmers a fair price for their produce, offering them protection against market downturns (Katunze et al., 2017). Tanzania could adopt similar risk management strategies to safeguard smallholders against financial losses.

Thus, while the WRS holds enormous potential for improving smallholder farmers’ access to markets and financial services, several challenges, including gender disparities, low farmer education, high transaction costs, and inadequate risk management, limit its effectiveness.

Thus, to address these issues a multidisciplinary approach, integrating policy interventions focusing on inclusivity, capacity building, infrastructure development, and risk management. By tackling these barriers, Tanzania can enhance the prosperity of its smallholder farmers, elevating their participation in the agricultural value chain and ultimately contributing to national economic development. For example, Masali's study evaluates the operational and financial effectiveness of the WRS in the cashew nut sector, focusing on Tandahimba District. The research highlights key achievements in stabilizing market prices and improving access to credit for smallholder farmers. However, it also identifies challenges, including delays in credit disbursement, low farmer awareness, and logistical barriers that limit participation. The findings provide critical insights into region-specific dynamics, illustrating the necessity of tailoring WRS policies to address crop and location-specific challenges in Tanzania (Masali, 2013). On the other hand, Laizer investigates the sustainability of WRS in Kilimanjaro, analysing factors such as infrastructure adequacy, cooperative governance, and financial inclusion.

The research emphasizes the role of cooperatives in operationalizing WRS while identifying gaps in leadership training and financial literacy as barriers to long-term success. Laizer's work contributes to a nuanced understanding of how cooperative governance and localized strategies can enhance the sustainability of the WRS, offering valuable recommendations for improving system effectiveness in Tanzania’s coffee and horticulture sectors. Insights from Masali (2013) and Laizer (2022) reveal that, challenges such as inadequate infrastructure, delayed credit disbursement, weak cooperative governance, and low farmer awareness hinder the effectiveness of WRS in Tanzania. Key priorities for improvement include expanding certified warehouse networks, enhancing cooperative leadership through capacity building, and implementing targeted education programmes to boost farmer financial literacy. Consequently, through addressing these areas, the role of WRS in improving market access, stabilizing incomes, and fostering sustainable agricultural development in Tanzania will strengthen.

10.7.1 Training Initiatives to Improve Knowledge of Market trends and Financial Management Skills

Educational programmes designed to enhance the understanding of market dynamics and financial management are crucial in addressing the challenges faced by smallholder farmers in Tanzania, particularly in the context of the WRS. The WRS has the potential to improve farmers' access to markets and finance, but its success lies on effectiveness in educating farmers on this system for effective engagement. Studies conducted in Mbinga and Namtumbo districts in Ruvuma region have demonstrated the positive impact of WRS on smallholder farmers, especially in terms of increased access to credit and adoption of modern technologies (Mapunda et al., 2020). The study indicates however, that these benefits cannot be fully realized without comprehensive educational programmes that provide farmers with the knowledge to navigate market dynamics and manage their finances effectively.

Farmers who deposit their produce in certified warehouses can use the warehouse receipts as collateral for loans, which allows them to invest in modern farming techniques and improve productivity. Nevertheless, the success of WRS in Tanzania is contingent on farmers' understanding of market fluctuations and their ability to make informed decisions about when to sell their produce. Educational programmes that focus on teaching farmers about global commodity markets, price forecasting, and the benefits of delayed sales are vital for maximizing the system's potential (William and Kaserwa, 2015). These programmes should be tailored to address the specific challenges faced by smallholder farmers, including their limited access to market information and financial literacy.

Financial management is another critical area where smallholder farmers require support. Educational initiatives should include training on the proper use of credit, debt management, and long-term financial planning. Smallholder farmers often lack the skills necessary to effectively manage the loans they receive through WRS, leading to over-indebtedness and financial strain (Isaga, 2018). By providing training on financial management, these programmes can help farmers make better decisions regarding investment in agricultural inputs, savings, and loan repayment strategies. Furthermore, improving farmers' understanding of financial services and products, including credit options, will enable them to make more informed choices about their financial future.

Comparative studies from other countries, such as Uganda, offer valuable insights into the importance of educational programs in enhancing the effectiveness of WRS. In Uganda, the introduction of WRS was initially met with challenges due to a lack of awareness and understanding among smallholder farmers (Katunze, et. al., 2017). However, targeted educational efforts have helped improve farmers' engagement with the system, leading to better market access and more stable incomes. These findings highlight the need for similar educational interventions in Tanzania, where farmers face comparable challenges.

In conclusion, while the WRS has the potential to significantly improve the livelihoods of smallholder farmers in Tanzania, its success is heavily dependent on the implementation of educational programmes that enhance farmers' understanding of market dynamics and financial management. *Kenya's e-WRS*

Kenya has successfully implemented the e-WRS to enhance market efficiency and farmer participation in its agricultural sector. The e-WRS, especially for commodities such as maize and tea, has improved transparency and operational efficiency by allowing farmers to access real-time information on produce quality, storage conditions, and market prices. This system reduces the need for physical certificates, thereby lowering transaction costs and processing delays. For example, maize farmers who participate in Kenya's e-WRS have reduced post-harvest losses by approximately 30%, which has led to better price realization and easier access to credit. Additionally, the Kenyan e-WRS has streamlined credit disbursement processes, helping farmers avoid liquidity challenges associated with manual systems (FAO, 2021). Kenya's experience with the e-WRS offers valuable lessons for Tanzania. By adopting Kenya's digital model, Tanzania could address current inefficiencies in its WRS, particularly in credit disbursement and high transaction costs. Moreover, Kenya's successful integration of mobile platforms in rural areas shows that Tanzania could benefit from similar digital and mobile innovations to reach smallholders in remote locations who face logistical barriers (Farmers Review Africa, 2022).

Uganda's e-WRS

Uganda's adoption of the e-WRS in its maize sector has significantly improved access to both domestic and export markets. Much like Kenya, Uganda's e-WRS has reduced transaction costs and increased efficiency by allowing farmers to store their produce in certified warehouses and use electronic receipts as collateral for loans. Studies have shown that Ugandan farmers involved in the e-WRS have enjoyed better price stability and reduced market risks due to the ability to delay sales until more favourable market conditions emerged (Katunze, et. al., 2017).

However, Uganda has encountered challenges like Tanzania, particularly in terms of credit access. Smallholder farmers still struggle to meet the collateral requirements for loans, and credit disbursement delays persist. Despite these issues, Uganda's e-WRS experience demonstrates the importance of farmer education and financial literacy in the success of the system. Educational initiatives have been instrumental in improving farmers' understanding of how to use the system and manage credit effectively (Katunze et al., 2017).

Lessons for Tanzania

The experiences of Kenya and Uganda highlight key areas where Tanzania can improve its WRS:

a) **Digitization and Transparency**: Kenya's e-WRS model demonstrates that digitization can reduce delays and improve transparency in transactions. Implementing an e-WRS in Tanzania would streamline the process, allowing for better tracking of produce and faster access to credit (FAO, 2021).

b) **Farmer Education and Inclusion**: Both Kenya and Uganda emphasize the critical role of educational programmes for WRS success. Tanzania should invest in training programs on market dynamics, financial management, and the use of digital tools to enhance farmers' participation in the WRS (Katunze, et. al., 2017).

c) **Risk Management and Price Stability**: Uganda's success in stabilizing prices through delayed sales and better market timing is a model Tanzania can follow. Moreover, introducing crop insurance schemes or price stabilization mechanisms can mitigate the risks associated with fluctuating market conditions (FAO, 2021).

By learning from Kenya and Uganda, Tanzania can enhance its WRS to better serve smallholder farmers, improving their access to markets and financial services. These comparative insights show that an e-WRS could address the inefficiencies currently limiting Tanzania's WRS from reaching its full potential.

Integrating solutions into the Tanzanian Context

To address the delays in credit disbursement, Tanzania could adopt a digitized WRS similar to Kenya's e-WRS. This system would streamline loan processing by enabling real-time verification of warehouse receipts and direct communication between farmers, warehouses, and financial institutions. Furthermore, introducing mobile-based platforms could extend the reach of the WRS to remote areas, reducing the need for physical documentation and lowering administrative burdens.

High transaction costs can be mitigated through targeted subsidies for transportation and storage. By providing financial incentives for farmers to utilize certified warehouses, the government can reduce the economic barriers to participation. Additionally, investments in infrastructure, such as the construction of more certified warehouses in rural areas, would minimize the logistical challenges associated with long-distance transportation.

To address the issue of limited awareness, comprehensive educational programmes should be developed and delivered through farmer cooperatives and extension services. These programmes should focus on financial literacy, market dynamics, and the operational aspects of the WRS. Outreach efforts can be enhanced through partnerships with non-governmental organizations and the use of digital platforms to disseminate information. By improving farmers' understanding of the system, these initiatives can increase participation rates and ensure that more smallholders benefit from the WRS.

Finally, incorporating risk management mechanisms such as crop insurance and price stabilization funds would provide farmers with a safety net against market fluctuations. Drawing lessons from India's minimum support price scheme, Tanzania could implement policies that guarantee a baseline price for key crops, reducing the risks associated with delayed sales.

Thus, the challenges of the Warehouse Receipt System in Tanzania, delays in credit disbursement, high transaction costs, and limited farmer awareness, highlight the need for strategic interventions to enhance its effectiveness. By learning from international best practices, such as the digitization of WRS operations in Kenya and Uganda, the subsidization strategies in Ghana, and the risk management policies in India, Tanzania can transform its WRS into a more inclusive and efficient system. Implementing these solutions within the Tanzanian context requires a coordinated effort involving government agencies, financial institutions, and farmer cooperatives. Through targeted policy interventions and capacity-building initiatives, the WRS can fulfil its potential as a transformative tool for improving smallholder farmers' livelihoods and driving agricultural development.

10.8 Theoretical Implications for policy development in WRS

The theoretical implications of the findings on elevating smallholder producers' prosperity through innovative policy interventions in the WRS in Tanzania provide valuable insights for policy development, particularly within agricultural systems. These implications can be discussed from several theoretical angles:

Economic resilience and access to credit

The WRS has proven to enhance the economic resilience of smallholder farmers by providing them access to credit and the ability to store crops for better market conditions. Theoretically, this aligns with credit constraint theory, which posits that the lack of credit access limits smallholders' ability to invest in productivity-enhancing technologies. The WRS overcomes this barrier by using warehouse receipts as collateral, which is particularly valuable in markets where traditional collateral (like land) is hard to secure. This could theoretically suggest that policy interventions that reduce credit constraints can substantially improve agricultural productivity and income. Thus, policies should focus on expanding the accessibility of credit through innovative financial products linked to WRS and ensuring regulatory frameworks are inclusive of smallholder farmers.

Market Participation and Price Realization

The WRS allows farmers to delay selling their produce, thereby taking advantage of price fluctuations, which aligns with price stabilization theory, which states that mechanisms allowing farmers to hedge against price volatility lead to better income stability. This theoretical implication suggests that market timing is a critical factor for improving smallholders' profitability and reducing income vulnerability due to seasonal price crashes. Thus, policies should encourage the establishment of more certified warehouses and efficient logistical frameworks, ensuring farmers can store produce and wait for optimal market conditions.

Inclusivity and farmer education

One of the findings highlights a lack of inclusivity and financial literacy among smallholder farmers, which inhibits their full engagement with WRS. From a theoretical perspective, this is linked to human capital theory, which posits that education and training enhance productivity. The gap in financial literacy and market understanding means that smallholders often miss out on potential income gains from the WRS. Thus, developing targeted educational programmes on financial management and market dynamics is essential. Policies should emphasize inclusivity by addressing barriers faced by marginalized groups, such as women, to ensure broad participation in the WRS.

Institutional support and system efficiency

The findings also reveal operational inefficiencies in the WRS, such as delays in credit disbursement and high transaction costs. This resonates with institutional economics theory, which emphasizes the role of institutions in reducing transaction costs and coordinating economic activities. The lack of efficiency in credit processing and market coordination negatively affects the system's potential to maximize farmer benefits. Thus, strengthening institutional frameworks, including the streamlining of credit processes and the development of transparent pricing systems, is essential for improving WRS effectiveness. Policy should also aim to reduce transaction costs, particularly for smallholder farmers in remote areas.

Comparative Lessons from other regions

The findings suggest that Tanzania could benefit from comparative studies of WRS implementations in other countries like Uganda and Ghana, where electronic WRS (e-WRS) has been introduced to improve efficiency and accessibility. Theoretical insights from comparative institutional analysis show that learning from other systems can provide valuable lessons on best practices for improving institutional frameworks. Tanzania can draw from successful WRS implementations in other countries, particularly in adopting digital solutions like e-WRS to reduce administrative delays and increase system transparency.

The findings of this study highlight several theoretical implications for policy development in Tanzania’s agricultural sector. These implications underscore the need for more inclusive, efficient, and education-focused policy interventions to maximize the potential of WRS. By addressing credit access, market participation, inclusivity, and institutional efficiency, policies can contribute significantly to the economic resilience and prosperity of smallholder producers.

10.9 Conclusion and Policy Recommendations

The analysis presented in this chapter demonstrates that the Warehouse Receipt System (WRS) holds substantial potential to transform the livelihoods of smallholder producers and contribute meaningfully to Tanzania’s agricultural growth. By enabling farmers to access secure storage, obtain credit through warehouse receipts, and time their market participation more strategically, the WRS reduces distress sales, enhances income stability, and improves the overall quality and competitiveness of agricultural produce. These benefits position the WRS as a critical instrument for fostering rural economic resilience and advancing national development goals.

However, the system's transformative impact remains constrained by persistent operational, financial, and structural challenges. Delays in credit disbursement, weak market coordination, and limited farmer awareness continue to hinder effective participation. Gender disparities also significantly disadvantage female-headed households, while farmers in remote regions remain excluded due to high transportation and storage costs. Moreover, the absence of robust price stabilization mechanisms and crop-insurance schemes leaves farmers vulnerable to climate shocks and market volatility, undermining the very stability the WRS seeks to provide.

Addressing these gaps is essential for unlocking the full value of the system, and for ensuring that the system fully delivers on its potential as a driver of rural development and agricultural modernization. The following sub section distills and integrates the strategic insights articulated in the preceding chapters into a set of actionable policy recommendations aimed at strengthening the WRS ecosystem. The proposed interventions seek to create a more responsive, transparent, and equitable system that aligns with national agricultural priorities, supports private- sector engagement, and enhances the resilience of smallholder farmers. Ultimately, the goal is to build a balanced and sustainable WRS that promotes efficient markets, reduces systemic risks, and contributes to long-term agricultural growth in Tanzania.

10.9.1 Policy Recommendations for Enhancing WRS in Tanzania

Key recommendations include:

1) **Strengthen and Scale Up Farmer Education and Financial Literacy Initiatives**

Education is a crucial element in the success of WRS. Smallholder farmers often lack the necessary knowledge to fully utilize WRS. Comprehensive education programmes focusing on financial management, market dynamics, crop storage techniques, and cooperative governance should be developed. This includes:

- **Financial Management and Credit Use**: Programmes that enhance farmers' understanding of credit management, financial planning, and market timing are essential. These can help farmers delay selling their produce until market conditions improve, ultimately stabilizing their incomes.
- **Market Information and Pricing**: Training in analysing market trends and the benefits of delayed sales should be provided. Farmers need to know when it is advantageous to sell their produce to get the best prices.

2) Accelerate Investment in Modern Infrastructure and Advanced Technologies

Infrastructure plays a critical role in the efficiency of WRS. Investments in certified warehouses, transportation networks, and digital technologies like electronic warehouse receipt systems (e-WRS) can improve the transparency, efficiency, and accessibility of WRS. These investments reduce post-harvest losses and allow farmers to store their produce securely.

- **Certified Warehouses**: Increased storage facilities are needed, especially in rural areas. Modernizing warehouse operations by adopting e-WRS will streamline documentation and reduce administrative delays.
- **Logistics Networks**: Improved transportation networks can ensure timely movement of produce to warehouses and reduce costs associated with long-distance travel.

3) Improve Access to Credit

Access to credit is one of the most significant barriers for smallholder farmers in Tanzania. Policies should promote the establishment of financial institutions tailored specifically for smallholder farmers. These can include a **National Agricultural Bank** that provides low-interest loans and credit guarantee schemes to de-risk agricultural lending. In addition, programmes that offer subsidies on fertilizers, seeds, and other critical inputs, can enhance farmers' productivity allowing them to take full advantage of WRS.

4) Strengthen Cooperative Governance and Transform Leadership Capacity

Cooperatives are key to the success of WRS, but many suffer from poor governance. Strengthening cooperative leadership through training programmes on financial management, accountability, and strategic decision-making is essential. Cooperative Governance can be further enhanced by training Cooperative leaders to enable cooperatives to better advocate for their members, manage the WRS more efficiently, and ensure fair access to market opportunities.

5) Strengthen Participation of Women and Vulnerable Groups in WRS Governance and Markets

Despite their significant contributions to agriculture, women and marginalized groups often face systemic barriers to participation in WRS. Introducing gender-sensitive financial products, such as microfinance loans that do not require traditional collateral, can enhance women's access to WRS.

Further, providing leadership training to women within cooperatives will increase their participation in decision-making and management roles. Gender-inclusive policies are critical to ensuring that WRS benefits all farmers. Women make up a sizeable proportion of agricultural workers, yet they are often underrepresented in cooperative leadership and decision-making roles. Empowering women through leadership and financial management training will ensure that they have equitable access to the WRS (FAO, 2020). The Government should also encourage the development of financial products tailored to the needs of women farmers, such as microloans that require minimal collateral.

6) Enhance Market Stability with Integrated Crop Insurance and Price Protection Measures

Protecting smallholder farmers from price volatility and climate shocks is not only desirable—it is imperative for strengthening the Warehouse

Receipt System (WRS) and securing rural livelihoods. Establishing comprehensive crop insurance schemes and price stabilization mechanisms will provide the strong, reliable safety net farmers urgently need in a context of increasing market unpredictability and escalating climate risks. Without such protections, farmers face heightened vulnerability to sudden price crashes, droughts, floods, and other shocks that can erase an entire season's effort and undermine trust in the WRS.

Because price volatility remains a major barrier to effective WRS participation, Government leadership is essential in introducing well-designed price stabilization funds and affordable crop insurance products (World Bank, 2020). These mechanisms would cushion farmers from abrupt market downturns and climate-induced losses, ensuring they can store their produce with confidence rather than being forced into distress sales.

By reducing risk and uncertainty, these interventions will encourage wider adoption of the WRS, strengthen farmer resilience, and support more predictable and secure incomes. Ultimately, implementing crop insurance and price stabilization mechanisms will not only protect farmers, but it will also stabilize the agricultural sector, contributing to national food security and rural economic transformation.

7) Optimise System Functionality by Tightening Regulatory Oversight

Operational bottlenecks, such as delays in credit disbursement and inconsistent grading of produce, hinder the full potential of WRS. A dedicated regulatory body should be established to oversee the operations of WRS, ensuring that these inefficiencies are addressed promptly. Effective regulatory frameworks will ensure the smooth functioning of the WRS. A dedicated regulatory body should oversee warehouse operations, ensuring standardized grading and quality control of stored produce (FAO, 2021). Additionally, transparent mechanisms should be put in place to monitor the use of e-WRS systems, ensuring consistency and reliability across regions.

8) Leverage PPPs to Drive Investment, Technology Adoption, and Market Efficiency

The government must foster stronger collaborations with the private sector through public-private partnerships (PPPs) that prioritize the development of WRS infrastructure. Tax incentives, low-interest loans, and subsidies should be offered to private investors interested in building and upgrading warehouse facilities, particularly in rural regions (Nguyen and Shepherd, 2021). Private sector entities should lead the implementation of modern technologies such as electronic Warehouse Receipt Systems (e-WRS), which streamline operations and ensure transparency.

9) Scale Up Digital Transformation by Mainstreaming the e-WRS System

Digital transformation through the adoption of e-WRS can drastically improve the efficiency and accountability of the WRS. An e-WRS allows farmers to track inventory digitally, access real-time market information, and connect seamlessly with buyers and financial institutions (FAO, 2020). To ensure widespread adoption, both government and private sector stakeholders should launch capacity-building initiatives aimed at familiarizing farmers and cooperatives with the benefits and usage of e-WRS platforms.

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Chapter 11 Trends in Budget Allocation and Credit Facilities in Support of Agricultural Development in Tanzania

Ahmed A. Ndyeshobola and Donald E. Mmari

11.1 Introduction

11.1.1 Significance of Agriculture in Developing Countries

Of the three-quarters of the world's poor that live in rural areas, 80% directly or indirectly depend on agriculture as their main source of income and employment (IFC, 2011). These smallholders also play a key role in increasing food supplies. Despite their socioeconomic importance, smallholders tend to have little or no access to formal credit, which limits their capacity to invest in the technologies and inputs they need to increase their yields and incomes and reduce hunger and poverty, both their own and that of others (IFC, 2014).

In developing countries, agriculture is considered to be the most important source of pro-poor economic growth and poverty reduction. Agriculture growth is more effective in raising incomes of the poor than other sectors, almost by two to four times. Moreover, it is estimated that three out of every four poor people in developing countries live in rural areas, most of them depending on agriculture, either directly or indirectly. In Sub-Saharan Africa, for instance, agriculture accounts for nearly one-third of GDP and two-thirds of employment.

These statistics also apply for	➢ Over two-thirds of the working population derives their livelihood from agriculture;
	➢ Smallholder farmers constitute an important segment of the agricultural value chain, but often in upstream nodes.

The significance of the agriculture sector in Tanzania's economy and the lives of the country's population:

- Not only does agriculture remain the largest contributor to the national economy, in terms of food for domestic consumption and raw materials for the domestic industries and export earnings, but also the largest employer.
- Agriculture employs over 65% of the labour force and sustains the majority of the population through both cash income as well as food.
- The welfare improvement of most of Tanzanians and agricultural advancement are highly interlinked.
- Agriculture contributes about 30% of export earnings and about 25 percent of the Nation's Gross Domestic Product, if looked in real terms.
- The sector provides backward and forward sectoral linkages, and is important in controlling inflation, since food contributes about 44% of consumer's expenditure. (BOT, 2017).

Among the major challenges facing agriculture, include low productivity and difficulties in reaching profitable markets. Tanzanian agriculture is also very much constrained by its dependence on climatic conditions. This is notwithstanding the fact that Tanzania is home to huge expanses of water resources and irrigation potential. A related key challenge is ensuring sustainable agriculture, meaning that as production expands and productivity rise, the key sources of water must be well protected and deforestation better managed (BOT, 2017).

In addition, there has been a very low access to government and bank financing by the agricultural sector, particularly, the small-scale farmer as compared to other sectors such as manufacturing, trade and services. A major and immediate policy response to promote pro-poor growth would require addressing problems facing agriculture, including raising agricultural productivity, easing constraints of access to finance, reducing and market barriers—including infrastructure, storage and quality management—and enhancing capacity for irrigation. Value addition through processing of agricultural products is also critical, as it must remain high in the industrialization agenda (BOT, 2017).

11.1.2 Importance of Financing Agriculture

Agriculture development encompasses a broad range of activities from small-scale farming to finance, marketing, infrastructure projects to research and innovation. With reference to agriculture finance, the financial markets are clustered into four groups correspond to different approaches to addressing the needs of the sector: (1) the needs of farmers and entrepreneurs, (2) the transactions between the actors along the value chain, (3) infrastructure needs and (4) generating knowledge to support the sector (Ruete, 2015).

1. Farmers and small agricultural	➢ Farmers and small entrepreneurs, like small supply companies, need finance to allow them to expand production and/ or diversify products.
	➢ This can include finance for inputs (such as seeds and fertilizers), production (such as machinery and equipment) and marketing (such as processing, packaging and transport).

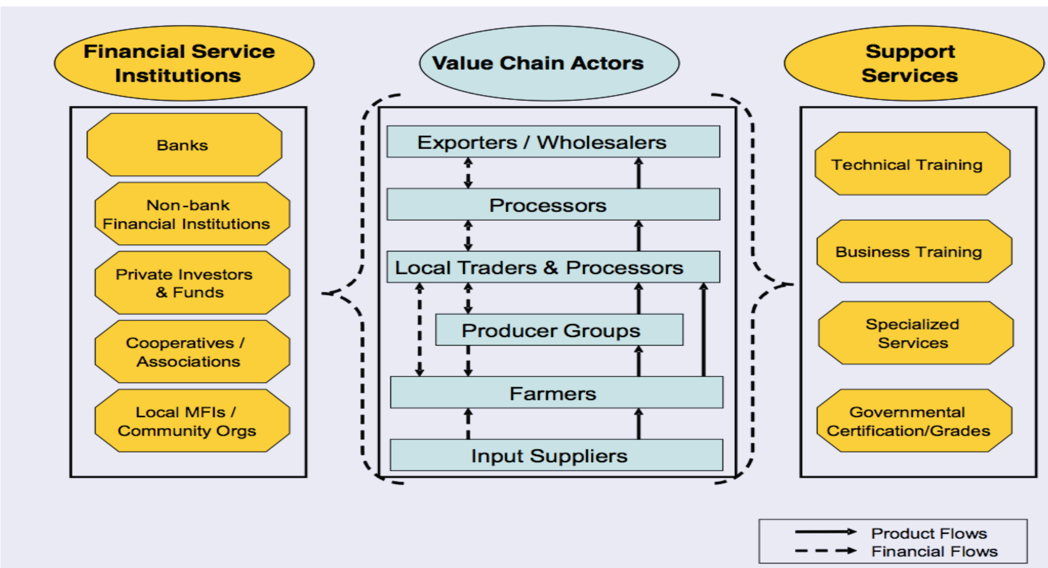
2. Actors along the Value Chain	➢ Agriculture entails a sequence of interlinked activities and transactions in a chain that starts from the supply of seeds and fertilizers and finishes in the mouth of the consumers.
	➢ There are financial instruments specifically designed to strengthen these links between the actors along the value chain.

3. Rural Infrastructure	➢ The sector depends heavily on infrastructure such as rural transport systems, irrigation systems, and water supply, sanitation, electricity, storage and telecommunication facilities.
	➢ Financing can be also concentrated on the infrastructure needed to carry out agricultural activities. These projects are costly and require large amounts of financing.

4. Research and Development (R&D)	➢ Financially supporting knowledge generation for the sector—this includes the generation of agricultural technology and new technical knowledge about products, processes and services for the sector.
	➢ R&D also provides valuable knowledge to help producers prepare business plans for banks or other financial institutions, to support financial planning and credit assessment by financial institutions, and government planning and financing in general.

In sub-Saharan Africa as well as South and Southeast Asia, where demand for financing is high, value chain actors are the main sources of short-term agricultural financing, while informal financial institutions are the main providers of non-agricultural financing. Figure 11.1 below shows a variety of financial relations and linkages between various actors in the value chain.

Figure 11.1: A variety of financial relations and linkages from inside and outside the value chain

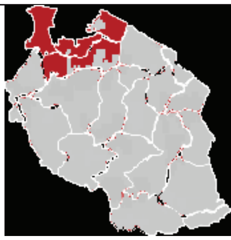
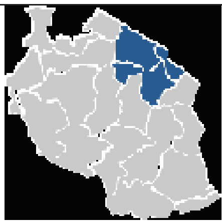


***Source*:** Using the Value Chain in Financing Agriculture, ISSD, 2015

Agriculture is the backbone of Tanzania's economy and could become its growth engine. The sector currently employs more than three-fifths of the labour force and provides livelihoods for three-quarters of the poor (URT, 2024). Agriculture is growing, albeit slowly, and creates jobs with strong backward and forward linkages to the rural economy. Since 2016, agricultural GDP increased by about 4.2% per year, although slower than national GDP (5.2%) (World Bank, 2022). This upward trend is partly driven by intensification, with the growth of agricultural total factor productivity increasing from 0.5% per year over 2001-2010 to 1.8% over 2011-2019. Despite this productivity increase, the growth also arises from agricultural area expansion by deforestation, combined with natural resources depletion (soil, water) (World Bank, 2022). Tanzania produces a variety of agricultural commodities that are used for food, industrial raw materials, animal feeds and other uses in six agro-ecological zones as summarized in Table 11.1.

Table 11.1: Priority Commodity Value Chains in Agro-Ecological Zones/ Clusters in Tanzania

Agro-Ecological Zone	**Regions**	**Targeted Households**	**Priority commodities**	
			Food Crops	***Cash Crops***
Central		715,000 (8%)	Maize Tobacco Sorghum & Millet	Oil crops Horticulture
Coastal		2,300,000 (25%)	Rice Maize Cassava Beans	Cashew Sugar cane Oil crops Horticulture

Lake		2,100,000 (23%)	Rice Maize Cassava	Cotton Coffee Sugar cane Horticulture & Banana
Northern Highlands		1,035,000 (11%)	Maize Legumes & Pulses—Beans Banana	Coffee Horticulture
South		570,000 (6%)	Cassava Oil crops Maize	Cashew
Southern Highlands		2,395,000 (26%)	Maize Potatoes (Irish % Sweet) Rice	Tea/Coffee Horticulture Sugar cane

***Source*:** National Sample Census of Agriculture, 2019/20.

11.1.3 The Structure of Agricultural Finance in Tanzania

The diverse system of agricultural finance enables identification of a wide variety of actors as financers of the sector (Figure 11.2). These actors bear different risks and cover various instruments. Farmers and small entrepreneurs play the most important role and are the first level actors in the upstream nodes of the value chain, acting mainly within the informal sector (such as community savings and credit systems) but also in more complex organizations, such as saving and credit cooperatives and unions or mutual credit guarantee schemes (IFC, 2014).

Most private sector finance traditionally comes from local commercial banks, branches of foreign banks and insurance companies. However, infrastructure financing can include a combination of actors, such as private partners, financial institutions, national and local governments, development banks, and donors.

Figure 11.2: Types of Financing Institutions

1. COOPERATIVES AND CREDIT UNIONS

- Cooperatives and credit unions play an important role in agriculture as self-help member institutions.
- Unlike banks, they have a non-profit status.
- Smaller cooperatives are well positioned to offer its members better access to financial institutions and investments.

2. COMMERCIAL BANKS

- These institutions finance small farmers and entrepreneurs directly, facilitate microfinance schemes and finance large rural infrastructure projects.
- The most successful ones have in-house expertise in the agriculture sector and the capacity to diversify across geographic regions, economic sectors and agriculture sub-sectors.

3. DEVELOPMENT BANKS

- Development banks play an important role in agriculture finance by filling financial gaps in developing countries.
- They finance specific programmes in the public sector, directly with local companies or through local banks acting as intermediates because of their better access to the domestic market.

4. GOVERNMENT BUDGET

- Development / Capital expenditure financing.
- Recurrent expenditure financing.

5. DONOR FINANCIAL SUPPORT & SERVICES

- Bilateral donors.
- Multilateral donors.
- Private donors.

The estimated annual demand for credit from smallholder farmers in low- and middle-income countries (LMICs) is USD 238 billion, equivalent to between four and eight per cent of the agriculture sector's contribution to GDP. However, actors meet less than a third of this demand with the Sub-Saharan Africa having the widest financing gaps. South and Southeast Asia have the smallest gap in agricultural financing, mainly because value chain actors and informal financial institutions often provide financing to farmers. In Latin America, formal financial institutions play a key role, covering 46% of smallholders' agricultural financing (Ruete, 2015).

This persistent financing gap is driven by a perception among Financial Service Providers (FSPs) that financing agriculture is high risk, expensive and has low returns. Most FSPs have little incentive to invest in gathering intelligence on agricultural production and expanding into rural areas. The agriculture sector is also increasingly vulnerable to climate change and environmental risks, including irregular rainfall patterns and increased incidence of pests and diseases. It is also vulnerable to market risks, such as price volatility and poor infrastructure. A lack of data on smallholder incomes and credit histories limits the ability of FSPs to accurately predict future cash flows and assess farmers' creditworthiness. Farmers usually live in remote areas, making collecting and verifying this information costly, especially when the reward is unclear. All this has contributed to the underfunding of the agriculture sector (Ruete, 2015).

11.2 The Essence and Importance of Financing Agricultural Production and Productivity

11.2.1 Financing Agriculture and Agribusiness in Tanzania

Financing agriculture and agribusiness is a very important catalyst to Tanzania's prosperity and poverty reduction. Besides its importance to the economy and poverty reduction, agriculture and agribusiness in Tanzania face various challenges, with limited access to finance being one of them. Limited access to finance is one of the significant impediments to the farmers in adopting better technologies to improve efficiency in production (Shamte, 2017).

Finance is needed to elevate Tanzania agricultural production and farm inputs to world average.	
Comparative statistics show that:	• Only 16.8% of rural households in Tanzania use improved seeds.
	• Tanzania farmers realize less than 40% of the world average yields.
	• Fertilizer application rate for Tanzania is very low at 19.3kg/ha compared to world average of 150 kg/ha.
	• Low farm mechanization – 64% of farmers in Tanzania still use hand hoes; on small land areas of 0.5 – 5 acres.
	• Only 6.5% of rural households have access to credit resulting to lack of working capital to buy inputs, farm preparations and other farm costs.
	• Only 24% of rural households have access to reliable all-season roads – hence high costs of transportation averaging 83% of market costs.
	• About 35% – 40% post-harvest losses due to little or no storage infrastructure.

Motivating opportunities in Tanzania include the following:

First	• The vast arable land, which is estimated at 44 million hectares, with only a quarter of it being cultivated.
Second	• The rising global food demand, driven by demographic trends, especially in emerging market economies, such as India and China, which have close trade links with Tanzania.
Third	• Supportive government policies and initiatives.

In the context of these immense opportunities in agriculture and agribusiness, lending institutions need to be innovative. They need to design financing products that match with demands of the small holder agriculture, agribusiness, as well as agro-processing and reduce the cost of delivering credit to those in dire need. The increased use of ICT presents an important transformational opportunity in that direction (Shamte, 2017).

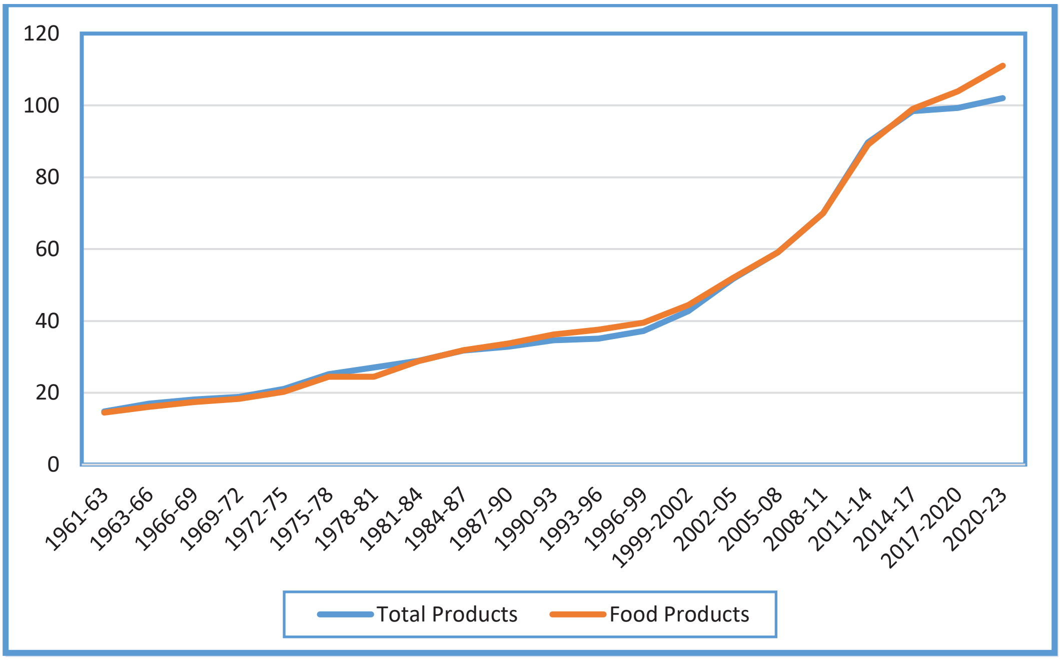
11.2.2 Strategic System "Drivers" for Inclusive Agricultural Growth and Reduced Rural Poverty

Increasing sustainable productivity of crop and export commodities would improve household nutrition and food security but also raise marketable surplus.

Increased competitiveness and farmer profitability will be enabled by:	Sustainable productivity-enhancing technologies (including climate smart), facilitated through strengthened research–extension linkages;
	Effective extension models using ICT;
	Expanded and inclusive private sector role;
	Sustainable access to rural financing; and
	Stronger and more effective farmer cooperatives and organizations which also would support and incentivize expanded marketed production, and value chain development.

As evident from Figure 11.3 below, Tanzania's growth dynamics have shifted, with public investments increasingly driving growth. The growth in total agricultural growth rose rapidly from 2000, led by food production whose growth has risen faster than aggregate growth in recent years. Structural transformation, however, remains crucial for sustainable development and private sector-led growth (SEP, 2024).

Figure 11.3: Growth of Agricultural and Food Products from 1961to 2023 (Index 2014-2016=100)



Source: FAOSTAT 2025

From 2001 to 2010, economic growth was driven by public/private investments and total factor productivity. Between 2011 and 2023, and as it will be evident in the next section, public investments increasingly fuelled growth as compared to private investments. The Government of Tanzania (GoT) is thus focused on enabling the private sector to contribute more on economic growth. Consequently, the Government requested financing support from the World Bank to address enterprise-level constraints, legal and regulatory barriers, and limitations in accessing and utilizing formal financial products and services. These goals align with the Government's mission under the national development plans to spur private sector led economic growth (SEP, 2024).

Nonetheless, the following financing challenges have been found to hinder the development of the agricultural sector:

- Low financing of agriculture, whereby the proportion of total domestic lending by banks to agriculture over the period 2009 t0 2014 was only 10.32 percent. About 91 percent of banks' domestic lending to agriculture was allocated to trading, whereas only 9 percent was allocated to agricultural production.
- High interest rates charged for loans applied equally to the agriculture sector, without any exception.
- The loan repayment period was short relative to the crop cycle.
- Lack of collateral for farmers seeking loans to finance agricultural activities.

11.3 Trends in Government Budget Allocation to the Key Sub-Sectors of Agriculture, Forestry, Fisheries and Research from 1980 to 2023

Aside from private sources of finance, governments are also important sources of finance for developing country agriculture. Public financing can focus on actors, such as small farmers or enterprises; on issues, such as environmental protection and organic agriculture; or on particular geographic locations. Other promising government initiatives include the creation of financial institutions in agriculture, whose regulations are usually defined by the central banks.

Governmental intervention in agriculture finance is often directed towards managing risks in the sector. This includes:

i. Support to farmers in the form of payment of indemnities, reductions in social security contributions and exemption of taxes during periods of crisis in the sector or subsidizing private insurance schemes. (OECD, 2011).

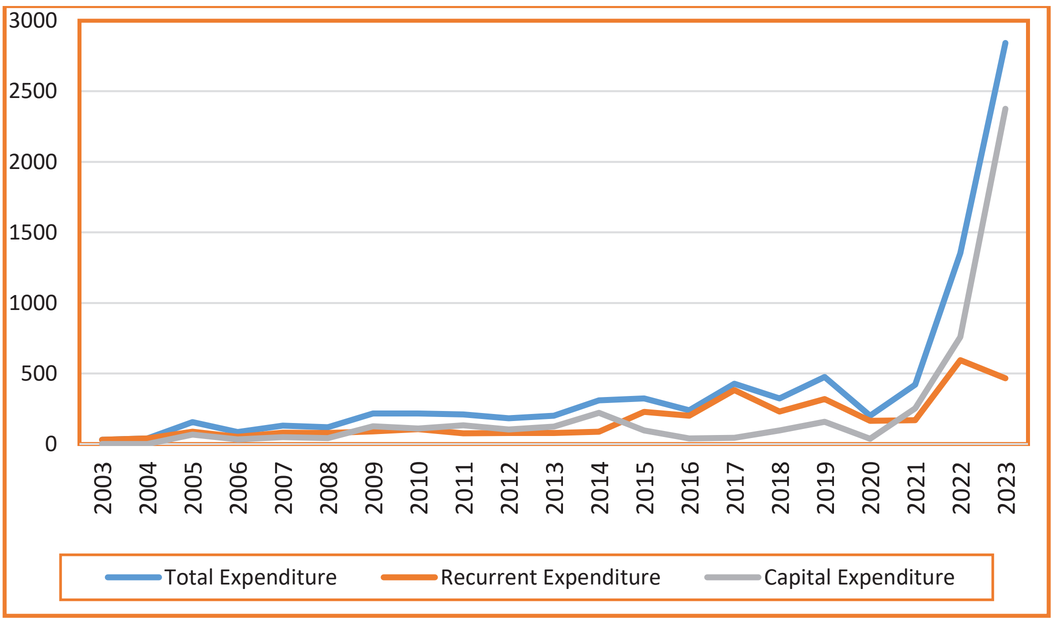
ii. Creating credit guarantee funds or supporting credit guarantee schemes offered by private institutions through counter guarantees.

iii. In the case where risk management is left to the farmer, governments can still support by providing information to the sector on potential risks and mitigation options.

Finally, the government can function as a facilitator without disbursing public funds itself. This role is especially significant in value chain finance, where the government can develop a business model to link the different actors that would benefit from financing one another (IFAD, 2012).

One key component of Tanzania's government budget allocation to agriculture has been the agricultural spending, which have increased substantially in recent years (post-2021) as shown in Figure 11.4 below. However, this can be primarily attributed to the growth in input subsidies and grants to the National Food Reserve Agency (NFRA). The country's strategic turn both for the total and development expenditure budgets are indicated in Figure 11.4 below.

Figure 11.4: Central Government Finance for Agriculture, Forestry, and Fishing (TZS billion)



Source: FAOSTAT, 2025

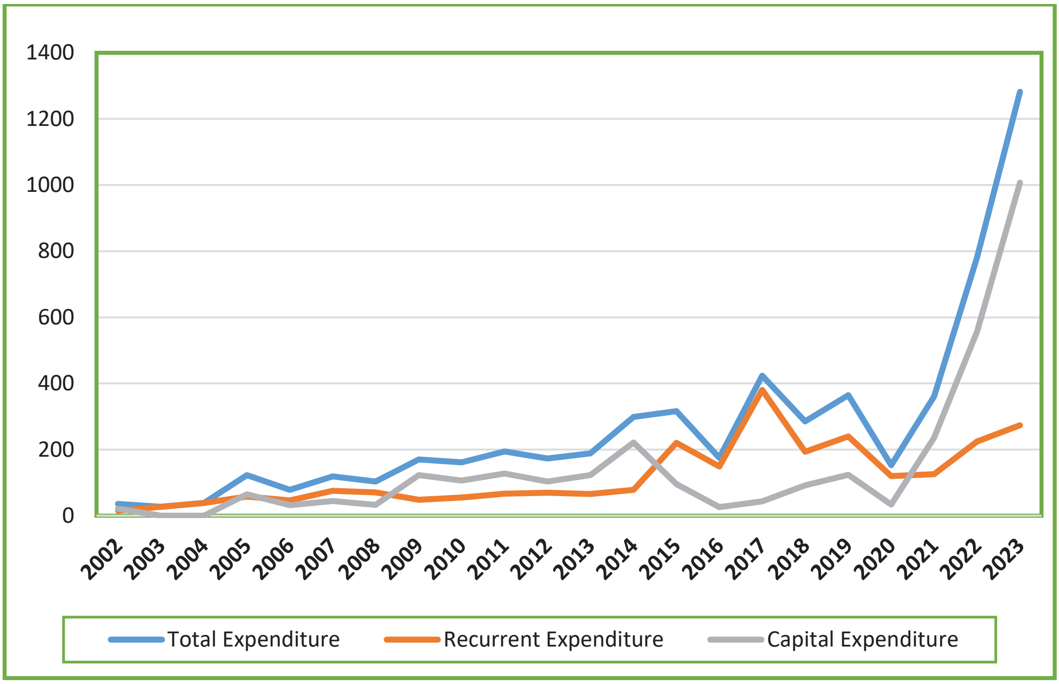
11.3.1 Budget Allocation to Agriculture sub-sector

While the overall level of public expenditures is low, budgetary spending mostly targets public goods that supports the sector's growth. Tanzania moved away from general agriculture input subsidies, and according to the World Bank, only five percent of budgetary transfers directly support producers, mostly through input subsides for agrochemicals, seeds, and seedlings. By importance of the budget allocation, other main key functions are administration (30%), forestry management (17%), extension services (18%), marketing and storage (14%), research (5.2%), and irrigation (4.3%). Regrettably, climate smart agriculture funding was anecdotal (about 0.05%), despite its critical importance in sustaining productivity and resilience (World Bank, 2022).

The World Bank observes that Tanzania's constrained agricultural budget has significantly limited the fiscal space available for development spending, resulting in inadequate support for the critical public services required to drive agricultural transformation. Although the budget formally prioritizes public goods, allocations remain far below the threshold needed for meaningful impact. Notably, nearly two-thirds of actual central-level agricultural expenditures have been recurrent in nature—funding operational costs rather than investments that stimulate long-term sector growth.

It is encouraging, however, that development expenditures within the Ministry of Agriculture (MoA) have shown an upward trajectory over the review period (Figure 11.5), with expectations of further increases in the years ahead (World Bank, 2022). This shift signals a positive move toward more growth-enhancing public investment, though sustained and strategic scaling will be essential to achieve transformative outcomes.

Figure 11.5: Central Government Budget Allocation to Agriculture sub-sector (TZS billion)



Source: FAOSTAT 2025

As earlier noted, and as per Figure 11.5 above, government budget expenditure for agriculture remained very low, until the upturn of capital (development) spending of post-2021. A similar trend also observed for government expenditure for the forest and fisheries subsectors as indicated in Figures 11.6 and 11.7 below.

Figure 11.6: Central Government Budget Allocation to Forestry sub-sector (TZS billion)

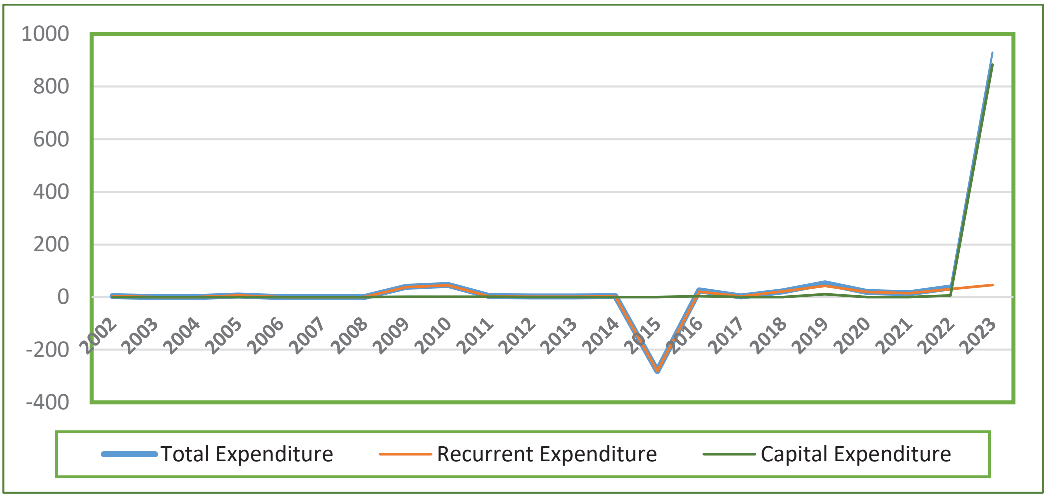
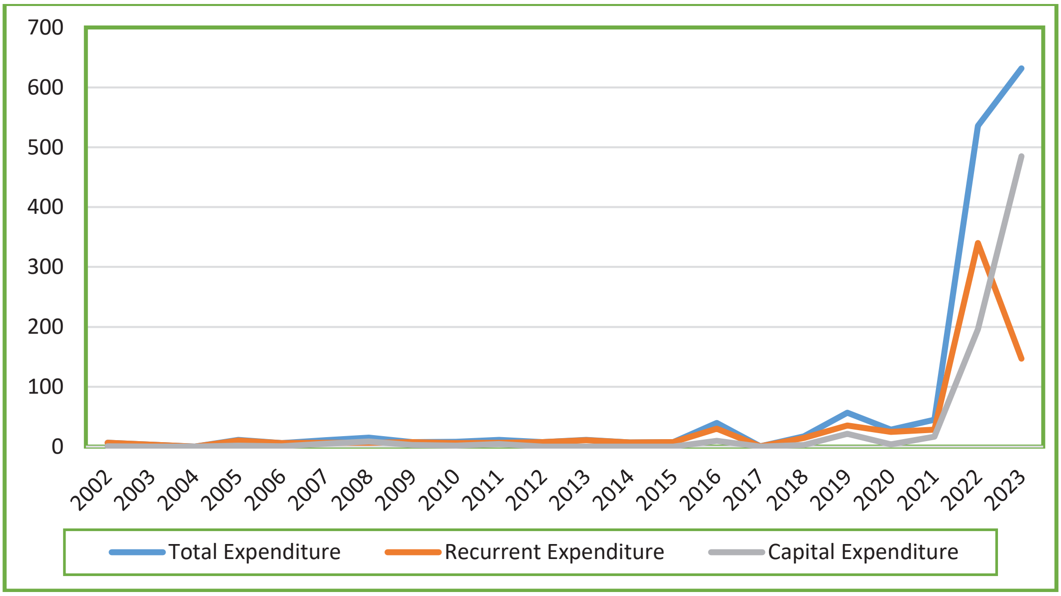


Figure 11.7: Central Government Budget Allocation to Fishing Sub-sector (TZS billion)

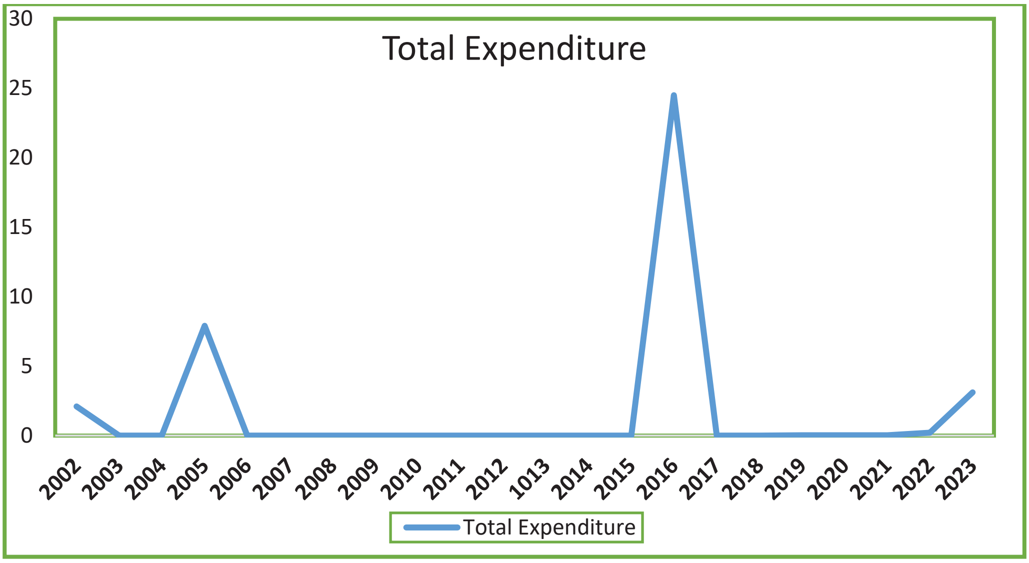


Source: FAOSTAT 2025

11.3.2Budget Allocation for R&D in agriculture, forestry and fisheries

Technology-enhancing expenditure is a significant component of the MAFF budget with expenditure on research, plant breeding, mechanization and irrigation services absorbing between 40% and 50% of the total expenditure on research. Nevertheless, and as per Figures 11.8 and 11.9 below, technology-enhancing and environmental protection (overall research) expenditure is still very low and almost negligible (0.3%) in relation to the crops sector's contribution to GDP.

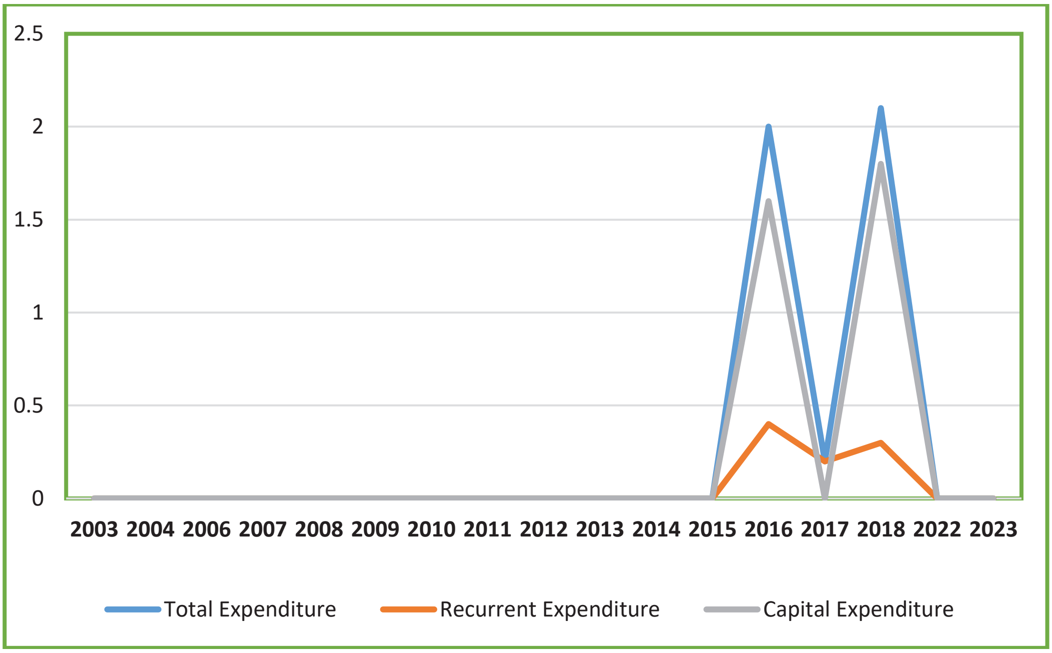
Figure 11.8: Government Expenditure for R&D in Agriculture, Forestry & Fisheries (TZS billion)



Source: FAOSTAT 2025

Public expenditure on agriculture in Tanzania is therefore very low and, even if NFRA grants and input subsidies are included, agricultural spending as a proportion of total government budget is well below the target 10% envisaged in the 2003 Maputo Declaration. In addition, as a signatory of CAADP, Tanzania is expected to change both its investment pattern and meet some of the key principles of the programme, namely "pursuing an average of 6% annual agricultural sector growth at country level, and allocating 10% of the national budget to agricultural development". To achieve these goals, a substantial increase in investments in sustainable agricultural development is therefore required, and it is anticipated that programmes such as ASDP II will provide a framework to facilitate rapid expansion of agricultural investment.

Figure 11.9: Government Budget Allocation for R&D in Environmental Protection (TZS billion)



Source: FAOSTAT 2025

11.4 Trends in Credit Facilities for Agriculture, Forestry and Fisheries, and Other Sources of Development Funding

Financial institutions in the formal sector that deals with agricultural loans include the Bank of Tanzania (Boot), the National Bank of Commerce (NBC), the CRDB Bank Plc, the Tanzania Agriculture Development Bank (TADB), and other commercial banks. The Bank of Tanzania (Boot) which is the nation's central bank is involved in agricultural credit through its control of bank lending rates, levels of lending and borrowing and the administration of loans and grants from external sources.

The NBC Bank, established as a state-owned bank in 1967, prior to its restructuring, agriculture accounted for about 55% of NBC's total loan portfolio. Until the late 1980s, NBC was not actively involved with smallholder production credit but dealt mainly with loans or overdrafts for crop purchase to crop parastatals and cooperatives, and issuing of farm credit for large scale projects (about 90% of NBC's agricultural lending). In December 1997, NBC was restructured into two banks under the NBC holding corporation. The banks are 1) NBC (1997) Limited, and 2) NMB Bank Plc (formerly National Microfinance Bank).

The Tanzania Agriculture Development Bank (TADB), a state-owned development finance institution (DFI) established in 2015 which aims to catalyse access to finance to smallholder farmers and Small and Medium-sized Enterprises (SMEs) in the agriculture sector, plays a leading role in agriculture transformation. It supports the sector through value chain financing, financing for infrastructure development and by enhancing financial inclusion to the subsistence and smallholder farmers. It also aims to develop specific financial and non-financial interventions needed to increase access to finance among women and youth in agribusiness, with a reference to global best practices.

TADB and other Banks can potentially support agricultural transformation journey towards economic growth, food security and poverty reduction through:

Infrastructure development--To improve productivity in the agriculture sector by supporting infrastructure development projects

Financial Catalyst--Play a leading role to catalyse other banks and financial institutions to participate actively in financing of agriculture value chains.

Financial Inclusion--Mobilize financial resources for affordable agricultural financing and enhancing financial inclusion to subsistence and smallholder farmers.

Other notable functions and targets include:

ASSET FINANCING	Financing purchase of assets for facilitating agriculture mechanization.
PROJECT FINANCING	This is the long-term financing of infrastructure and industrial projects.
SEASONAL FINANCING	This is a monetary loan to serve as a working capital.

SMALL HOLDER FARMERS CREDIT GUARANTEE SCHEME	Enabling small holder farmers to access financial support from commercial & community banks

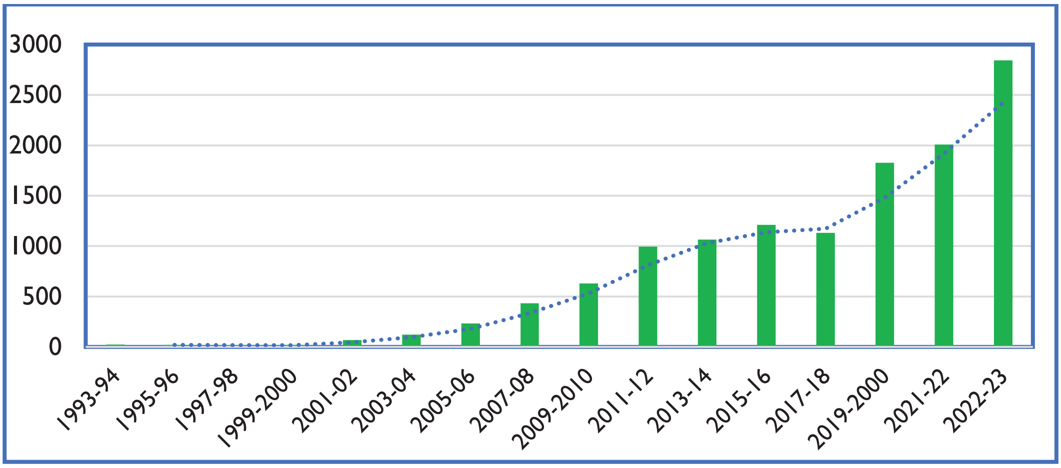
Loans offered to SMEs and corporates involved in agriculture sector (primary producers, aggregators, off-takers, processors, and input suppliers) including those in fishery, animal husbandry and forestry for the purpose of enhancing working capital, capital expenditure and post-harvest items have the following requirements and features:

- Farm documents and verification from local government authorities.
- Applicants may be in Farming Cooperatives or individual farmer.
- Introduction letters from local government authority verifying the farmers' activities in area.
- Should be in farming operations for at least two seasons.
- Registration documents and permits for activities requiring special permits.
- All documents related to registered companies.
- Flexible loan repayment depending on harvest season and cash flow regimes.
- Maximum loan tenure depends on harvest cycle, maximum 12 months for primary producers and maximum of five years for capital expenditure.

11.4.1 Trends in Credit Facilities for Agriculture, Forestry and Fisheries

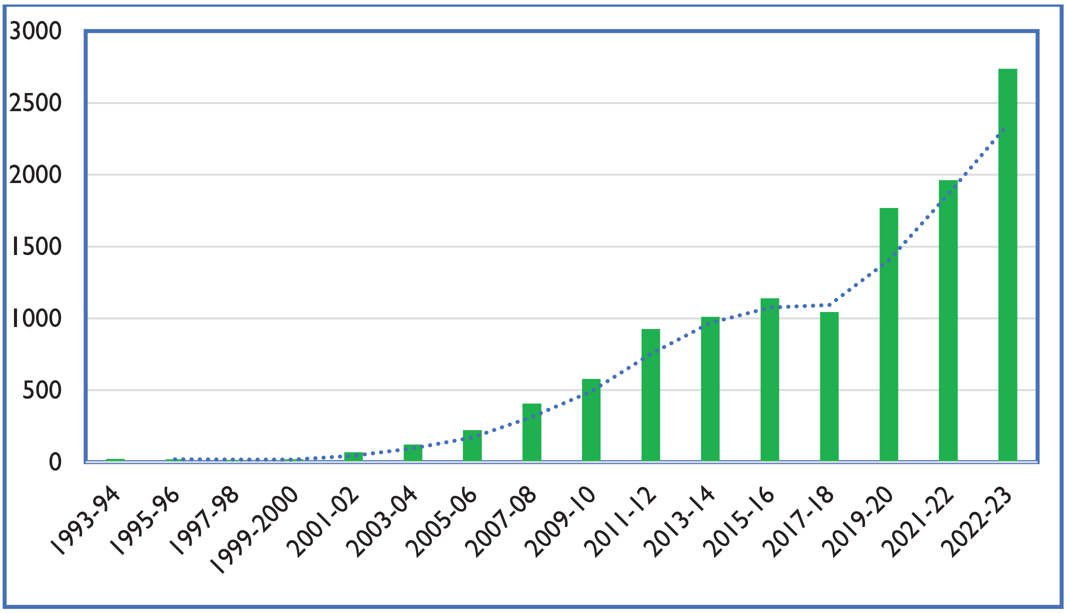
Despite the importance of agriculture in Tanzania, the agricultural sector attracts less financing (9%) from the formal sector than other areas such as industry (26%) and services (14%), especially to youth. Figures 11.10 and 11.11 show the rapid growth of credit to agriculture; although the absolute levels are relatively low compared to non-agricultural sectors.

Figure 11.10: Bank Credit to Agriculture, Forestry and Fisheries (TZS billion)



Source: FAOSTAT, 2025

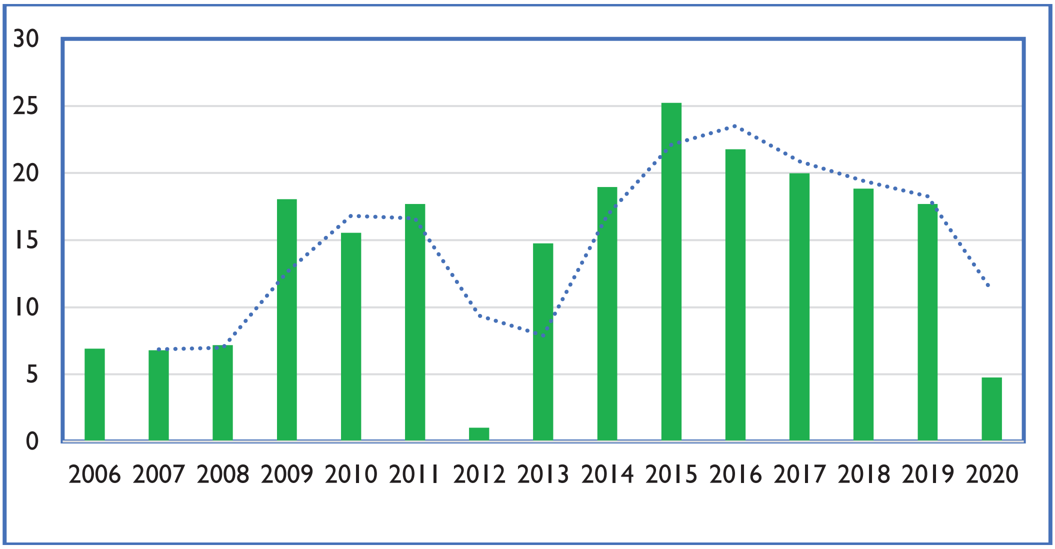
Figure 11.11: Total Bank Credit to Agriculture (TZS billion)



Source: FAOSTAT 2025

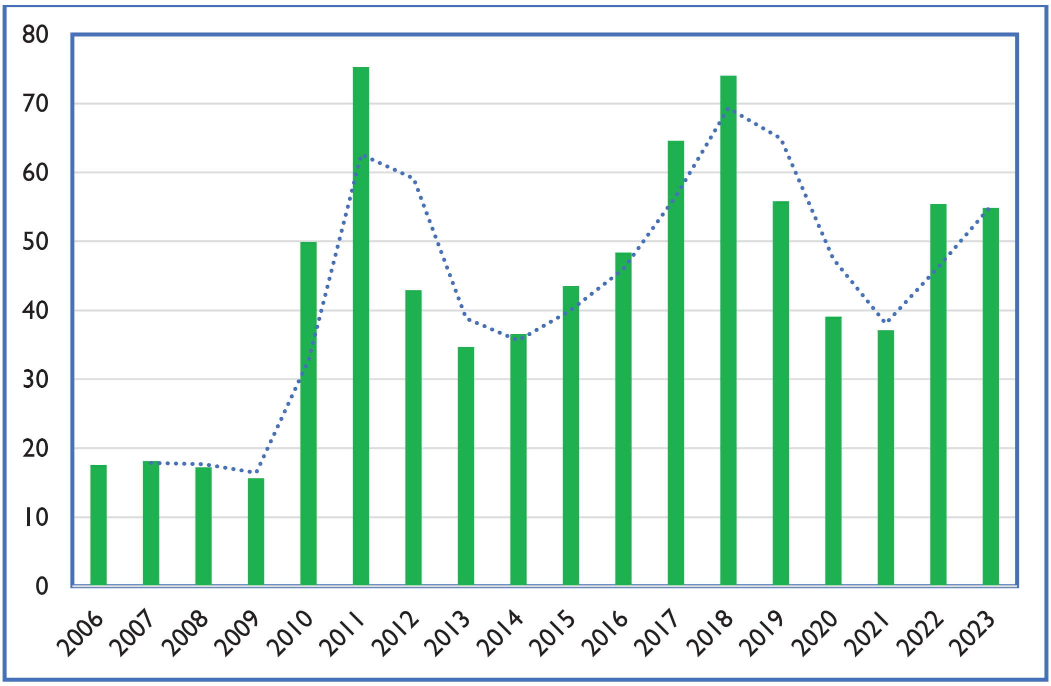
Figures 11.2 and 11.3 below show that credit facilities for the forestry and fisheries sub-sectors have remained low and declined in recent years, although there was an upward trend for fisheries since 2022.

Figure 11.12: Total Bank Credit to Forestry (TZS billion)



Source: FAOSTAT 2025

Figure 11.13: Total Bank Credit to Fisheries (TZS billion)



Source: FAOSTAT 2025

The following are some of barriers to the use of financial services:

On the Supply side	
Lack of Infrastructure	The financial sector is constrained by inadequate infrastructure and the challenging geography, which makes reaching customers both difficult and costly;
	Developing products tailored to the needs of the agricultural businesses is also problematic: cash flow is generally erratic and dependant on the level of harvests;
	As a result, lending to the agricultural sector remains high risk.
Product development	Banks and MFIs lack the willingness to expand into the sector;
	The need for insurance to afford lenders protection against the particular risks in agriculture has been identified, and pilot schemes are being undertaken in this area.
MFIs and SACCOS: regulation	The regulatory regime for both deposit-taking institutions and SACCOS needs to be reviewed.
	The MFIs argue that their regulation would be too close to that required of a bank if they were to become Microfinance Companies. This not only imposes high financial costs, but places obligations beyond those needed for them to be a deposit-taking institution.
	Regarding SACCOS, the law is both unclear and difficult to administer.
On the Demand side	
Banking services	Significant barriers are related to access and affordability: banks are too far away, banking hours are inconvenient, and costs are too high.
Insurance services	A combination of lack of information and understanding about insurance, together with the absence of agriculture related risks products means that the insurance industry has virtually no impact on most agri-businesses.

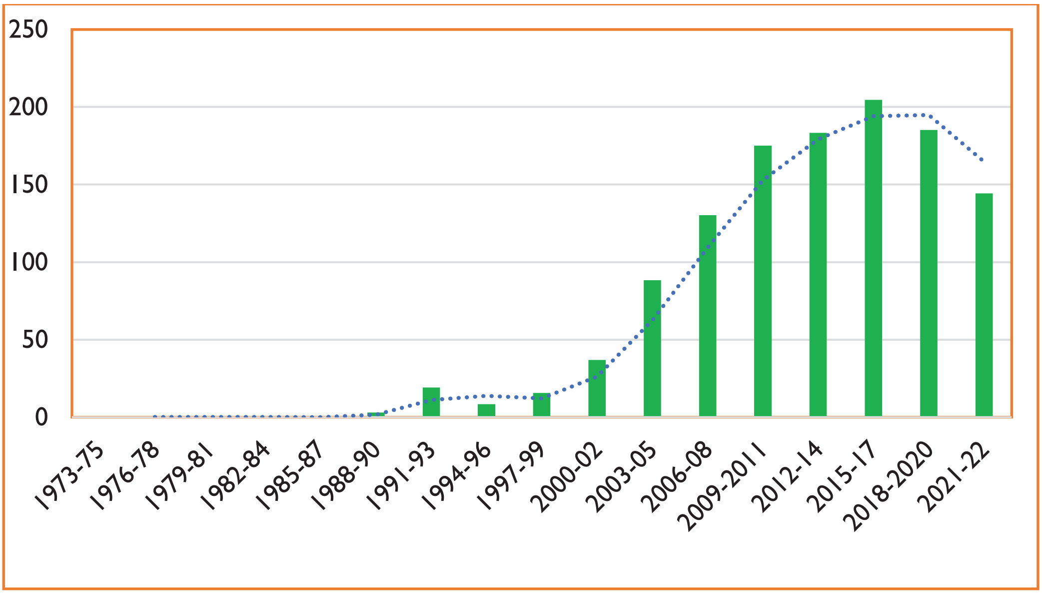
Credit	Business owners who do not borrow money for their business do not know where to borrow from; the perception is that financial institutions are not prepared to lend to agri-businesses, and that this type of borrowing is in any case not affordable as interest rates are too high.
Perceived obstacles to growth	For producers, processors and service providers alike, the lack of access to markets and transport, insufficient infrastructure and limited credit facilities are the main inhibitors to growth.

11.4.2 Donor Disbursements for Agriculture, Forestry and Fisheries

Financial sustainability increased over the period, but agriculture funding remains dependent on donors. According to the World Bank, development partners supported about one-fifth of agricultural budget. Their "off-budget" expenditures over 2017/18-2019/20 accounts for about half of the public agricultural funding. Thirty percent of the MoA budget depended on foreign funding, as was 26% 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 Programme (ASDP I) basket in 2014/15 winded down without being replaced by new engagements. As a result, 73% 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, and Irrigation Master Plan—had counted in part on donor funding that did not materialize, to the detriment of implementation of some planned activities (World Bank, 2022).

Overall, the coverage of development aid in the government budgets remains poor. Development Partners contribute substantial funds through development projects, but a significant proportion of expenditure is not recorded in government budgets as off-budget spending; and non-governmental organization (NGO) expenditure is also not captured. The budget book lists agricultural projects and their respective donors; although the list is not exhaustive and does not show annual expenditures. Thus, the analysis is based on available data on development budget spending by various international donors, as presented in Figure 11.14 below.

Figure 11.14: Development Finance–Disbursements from All Donors for Agriculture, Fisheries and Forestry (in Million USD)



Source: FAOSTAT 2025

11.5 Policy Frameworks to Overcome Financing Challenges

While financial inclusion in Tanzania has increased considerably over the last five years, the people who remain behind are more likely to live in rural areas (77% of the excluded) and depend on farming and fishing as their key sources of income (26% of the excluded), according to the recently published FinScope Tanzania 2023 report (FSDT, 2023).

The reasons for this continued exclusion include the fact that very few people in Tanzania have title deeds to their land and therefore cannot meet banks' requirements to use land as collateral for loans. This is even worse for women farmers, who traditionally have not been able to own land until recently. Another obstacle is that many youths under the age of 18 do not have national identification numbers and are therefore failing to meet banks' "Know-Your-Customer" (KYC) requirements.

The Government should work with financial service providers (FSPs) to find ways to overcome these obstacles to loan financing for farmers and help develop products that can serve millions of Tanzanians. This would contribute significantly to the goals of the Financial Sector Development Master Plan 2020/21 – 2029/30, that aims to develop a more resilient, competitive, and dynamic financial system in Tanzania; and the effective implementation of the ASDP II.

It is not only quality inputs that are crucial for farmers to grow better harvests, but also financial support throughout the farming process – from ploughing land and sowing seeds, to harvesting and selling crops, sometimes in markets long distances away.

Lack of access to affordable credit prevents these farmers from hiring the needed additional labour or leasing tractors and other machinery to help in crop planting, cultivation, harvesting and transport. Having access to capital would also enable them, to add value to their crops so that they are able to increase the amount they receive for their efforts.

Access to financial services by MSMEs engaged in the sectors like horticultural sector from financial institutions remains a challenge. Although financial institutions have products tailor made for MSMEs, the demand for collateral, higher interest rates and lack of information on available financial products impede MSMEs from accessing such financial services and products (NORAD-Farm Africa, 20).

The financial sector has recently focused on improving interest rates and tailoring products that are more accessible and affordable for MSMEs. For example, NMB announced in October 2021 that they were cutting interest rates to customers from the agriculture, fisheries and livestock value-chains, and new rates will not exceed 10%. The Bank of Tanzania has also announced strategies to reduce higher interest rates.

While it is acknowledged the improvements in developing products and services for farmers, more needs to be done to gather data and information on exactly what farmers in different crop value chains require and what they could achieve with more considerately tailored loans.

As a market facilitator, the Financial Sector Deepening Tanzania *(FSDT)* advocates for the development of evidence-based financial solutions to address the challenges highlighted above. To do so, FSDT supports FSPs by conducting research such as FinScope Tanzania 2023, which still undergo customization to focus on specific industries in the financial sector to provide FSPs with a better understanding of farmers and their specific needs. Financial services and products are not a one-size-fits all.

11.5.1 Pursuit for successful agricultural lending

While lending to agriculture is characterized with the challenges and the unfavourable trends, especially for smallholders, successful lending to agriculture is possible if the following actions can be proactively pursued:

i. **Knowledge of the client—**While this is important for any lending operation, it is particularly critical for MFIs interested in entering the smallholder lending market to understand the differences between their traditional urban and rural clientele on one hand, and smallholder farmers on the other.

ii. **Flexible product—**Smallholder lending is not one size fits all. Loan tenure, disbursement, and payment terms need to be adaptable to the diverse profiles of smallholder borrowers.

iii. **Cash flow analysis of the household production unit—** Analysing the household production unit both allows for matching payment terms to cash flow and provides a more accurate analysis of the payment capacity and true risk of lending to the smallholder.

iv. **Diversified risk management tactics—**Agricultural lending risks are diverse and need to be mitigated in a variety of ways. Close, field-based client monitoring; portfolio diversification; conservative cash flow analysis; and credit bureaus and credit scoring are all tools MFIs can use in risk management. In addition, an MFI's collateral should be commensurate with loan sizes and other risk factors the MFI considers, such as client repayment history, crop diversification, and non-agricultural sources of revenue.

v. **Use of specialized credit officers—**Hiring credit officers with a background in agriculture is generally considered critical. Introduction of additional, specialized staff positions to support portfolio quality may also be necessary.

vi. **High-level buy-in—** Successful smallholder lending requires products, approaches, and systems that are distinct from those for microcredit, which in turn, require different mind-sets and investment in new tools and systems. In short, it requires a strong institutional commitment and support by the most senior level management.

vii. **A strong customer service orientation—**By providing rapid loan processing and disbursement, personal attention to clients, and customization of products, terms and services to match client needs, as well as providing non-financial services, MFIs can compete effectively with subsidized credit from agricultural development banks and differentiate their offerings among themselves.

viii. **Exploring opportunities to introduce or expand value chain finance—**Value chain finance could be used both to serve the "missing middle farmers"—commercial smallholders in existing value chains—and to reach larger groups of smaller farmers more efficiently (IFC-WB, 2014).

11.5.2 Implications for Involvement of Development Partners

The chapter underscore areas of technical assistance and other forms of donor support that may affect MFIs' effectiveness in reaching smallholders. Development partners also highlight areas in which further research may be warranted.

Technical assistance and training

Development partners and agencies need to provide technical support and training in the following areas:

i. Design and implementation of market research (demand and supply analyses) to help MFIs understand different smallholder segments and their needs
ii. Product design and piloting to reduce the costs and risks of new market entry and innovation.
iii. Systems improvements to adapt MIS/core banking systems and use technology solutions, such as automation of data capture and analysis to accommodate tailored credit assessment, portfolio monitoring requirements, and loan repayment schedules.
iv. Design of staff incentive plans to promote agricultural lending.
v. Introduction of product-costing practices to inform product and programme design and to help to make the business case for new market entrants.
vi. Design and piloting of new delivery channels to reduce the costs and risk of lending.
vii. Support for non-financial services, such as financial education and/or technical assistance programmes for smallholders, to complement credit services.

Potential areas for further research

Research topics that focus on the viability of long-term lending to smallholders, exploring value chain financing, alternative delivery channels, and the role of government and donor guarantee plans are areas that require further research.

Policy coherence, analysed through the lens of ASDP II, need scaled up. The livestock sector is an overlooked priority with large potential to contribute to agricultural growth, rural poverty reduction, and food security. Factors such as 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, all affect realizing the objective of attaining higher agriculture productivity.

Several other factors impede achievement of country objectives to increase commercialization and rural income and decrease rural poverty, including trade policies, marketing interventions, commodity taxation and 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 (World Bank, 2022).

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Chapter 12 Smallholder farmers' access and use of information and knowledge to enhance agricultural productivity in rural Tanzania

Constantine George Simba, Amani Sanga and Lilian Sylvester

12.1 Introduction

It is widely acknowledged that in today's global community, information and knowledge serve as essential drivers of growth across various production sectors. In particular, access to timely, reliable, and relevant agricultural information and knowledge is crucial for substantial development in the agricultural sector and improved livelihoods, particularly in rural areas, notably within African nations (Mkenda et al., 2017; Kaske et al., 2017; Lwoga et al., 2011).

Enhanced information and knowledge exchange within the agricultural sector plays a vital role in enhancing small-scale agricultural productivity and connecting it to lucrative markets (Asaba et al., 2006). This, in turn, leads to enhanced rural livelihoods, improved quality and yield, food security, and strengthened national economies. This arises from the fact that a farmer equipped with relevant information is better positioned to make informed decisions regarding what crops to cultivate, where and when to plant them, and how to optimise cultivation methods, thereby yielding positive outcomes (Ndimbwa et al., 2019). Studies indicate that agricultural information comprises innovations, advice, techniques, skills, agricultural technologies, weather information, soil-moisture conditions, crops and cattle diseases, fertilisers, best practices, storage facilities, information about transportation, markets, and price trends and consumer preferences (Ndimbwa et al., 2019; Levi, 2015; Gakuru et al., 2009).

This signifies that in a country like Tanzania, which is dominated by smallholder farmers, the prosperity and growth of the agricultural sector will rely on smallholder farmers' ability to acquire, access, and use relevant agricultural information and knowledge (Ndimbwa et al., 2019). In

Tanzania, the 2022 Population and Housing Census shows that about 65.55% of the population live in rural areas (URT, 2025), where agriculture is the main activity (accounting 64.9%) of employment, 26.2% of GDP, 30% of export earnings, and 65% of industrial raw materials (URT, 2022; 2023). Furthermore, the 2019/20 National Sample Census of Agriculture results show that, of the 12,007,839 households in Tanzania, agricultural activities engaged 7,837,405 households, constituting 65.3 percent (URT, 2021). The sector plays a crucial role in ensuring food security, supporting rural livelihoods, and driving export earnings. Smallholder farmers are the backbone of Tanzania's agricultural sector, cultivating approximately 5.1 million hectares annually. About 85% is dedicated to food crops and contributes over 75% of the nation's total agricultural output. These farms typically range in size from 0.9 to 3 hectares, with an average of around 2.4 hectares, reflecting the subsistence-oriented nature of Tanzanian agriculture[17].

In that regard, Kaske et al. (2017) argue that to bring substantial development to the agricultural sector, access to timely, reliable, and relevant agricultural information is critical to making informed decisions for farmers (Mwantimwa, 2019; Mkenda et al., 2017; Nicholas-Ere, 2017; Mtega et al., 2016; Silayo, 2016). They added that the success and expansion of the agricultural sector hinge upon smallholder farmers' capacity to obtain, access, and effectively utilise relevant agricultural information and knowledge (Kaske et al., 2017).

Since gaining independence, the Tanzanian government has instituted a range of initiatives aimed at disseminating agricultural information and knowledge to smallholder farmers and boosting productivity, spanning from traditional face-to-face outreach by extension officers to the adoption of modern ICTs. Historically, governmental initiatives have entailed training extension officers, who then allocated nationwide. This strategy guarantees that smallholder farmers have access to dependable and timely agricultural guidance, which is vital for fostering agricultural progress. Moreover, the introduction of the National ICT Policy in 2013, followed by its amendment in 2016, stands out, as it aimed to transition the agricultural sector from a subsistence to a more commercialised

[17]https://www.tanzaniainvest.com/smallholders?utm_source=chatgpt.com

model (URT, 2016). Furthermore, community telecentres have been established in various locations, such as Lugoba, Mpwapwa, Ngara, Dakawa, Kilosa, Mtwara, and Kasulu. Telecentres play a vital role in expanding access to agricultural information and knowledge, particularly for smallholder farmers with limited access to conventional telecommunication services. In this context, it is important to explore the main sources, preferred channels, and accessibility of agricultural information—including the use of modern information and communication technologies (ICTs)—as well as the barriers that hinder effective access and utilization among rural smallholder farmers in Tanzania.

i. What are the primary sources of information and knowledge about agricultural practices accessible to smallholder farmers in rural Tanzania?
ii. What kind of information is mostly preferred by smallholder farmers?
iii. What barriers hinder smallholder farmers in rural Tanzania from effectively accessing and utilising agricultural information and knowledge?

This chapter aims to summarise the existing evidence of access and use of information and knowledge by smallholder farmers in Tanzania to enhance agricultural productivity. It also identifies gaps in current research and highlights areas that require further investigation.

12.2 Literature review

12.2.1 Agriculture information and knowledge

Agriculture information and knowledge encompass the skills, data, and insights necessary for effective farming and agricultural practices. This includes traditional knowledge passed down through generations, as well as modern scientific and technological advancements. Agricultural knowledge covers various perspectives and sectors. Farmers view it as their accumulated experience, including indigenous wisdom and implied knowledge. Extension and research organisations, on the other hand, acknowledge it as established best practices that optimise crop yield while also promoting environmental conservation (Jahanshiri and Walker, 2015). Alternatively, agricultural information serves as the fuel to empower farmers to make informed decisions (De-Silva et al., 2013). Farmers need a variety of information, such as marketing needs, weather conditions, agricultural loans/credit, new seeds, storage methods, disease and pest control, and pesticide availability and its application. The effective dissemination and application of this knowledge are critical for improving productivity, ensuring food security, and fostering sustainable agricultural practices.

For example, in today's rapidly changing world, the significance of accurate weather forecasts cannot be overstated. Farmers rely on weather forecasts to make informed decisions about when to plant, irrigate, and harvest their crops (Calanca et al., 2011). For example, a farmer may consult weather forecasts to determine whether it will rain in the upcoming days and adjust their irrigation schedule accordingly. In addition, weather forecasts can also help farmers plan for and mitigate the impact of extreme weather events such as droughts or hurricanes. Furthermore, weather forecasts are crucial for livestock farmers who need to ensure the well-being of their animals. For example, they may use weather forecasts to anticipate heatwaves and take measures to provide shade and water for their animals (Calanca, 2014).

12.2.2 ICT in agriculture information and knowledge

Information and Communication Technology (ICT) is vital in achieving all sustainable development goals by 2030 (UN ESCAP 2020). It facilitates the realisation of SDGs by streamlining the dissemination of information, reducing costs, and fostering competitiveness and productivity, thereby enhancing overall efficiency (International Telecommunication Union, ITU, 2017).

The dynamic evolution of ICT in Tanzania has emerged as a catalyst for the country's economic advancement. With the progress in ICT, the expansion of internet connectivity, the proliferation of mobile devices, and the growing demand for digital services, the communication sector has assumed a pivotal role, contributing around 1.5% to the national GDP

(URT, 2024). Demonstrating the government's firm commitment, the Government announced in the fiscal year 2021/2022 that TZS 170 billion will be allocated to deploy 4,244 km of National ICT Broadband Backbone (NICTBB) infrastructure, thereby extending the existing optical fibre backbone from 8,319 km to 12,563 km, with a targeted expansion to 15,000 km by 2024/2025. This ambitious initiative aims to decrease communication service expenses, enhance internet accessibility, and improve access to other services, benefiting citizens and service providers across public and private sectors.

The Tanzania National ICT Policy 2023 serves as a foundational pillar in the development of the emerging digital economy and the ongoing process of digital transformation. Aligned with the Digital Economy Strategic Framework 2023-2033, the policy sets forth a vision for a nationally competitive economy that is digitally empowered, fostering a culture of digital innovation and entrepreneurship.

The advancement of any nation relies significantly on the effectiveness and modernisation of key productive sectors, notably agriculture, tourism, natural resources (such as minerals, oil, and gas), energy, manufacturing, and financial services. ICT has emerged as a pivotal factor in bolstering the performance of these sectors. The impact of ICTs on boosting productivity in key economic sectors is significant. The ICT Policy 2023 highlights the government's commitment to integrating ICTs into development strategies and expanding nationwide ICT infrastructure to support rural and agricultural growth. To strengthen these sectors, the government has introduced several initiatives, including the Agriculture Sector Stakeholders Database, Farmers Registration System (FRS), Agricultural Routine Data System (ARDS), Agriculture Trade Management Information System (ATMS), and M-Kilimo. In the livestock sector, the Mifugo Integrated Information System (MIMIS) has also been established.

Within the agricultural sector, ICT services have facilitated farmers' access to vital information and knowledge concerning weather patterns, the timing of rainy seasons, pricing information on agricultural equipment from manufacturing facilities, and the prices of agricultural commodities in various markets. For many years in Tanzania, farmers have traditionally obtained agricultural information through interpersonal communication with extension workers. However, this method appears increasingly inefficient due to the rising ratio of farmers to extension staff. For instance, the 2019/20 National Sample Census of Agriculture reveals that in Mainland Tanzania, only 6.9% of the 7.5 million crop-growing households and 9.1% of livestock-rearing households received extension services (URT, 2021). Additionally, factors such as inadequate infrastructure exacerbate this inefficiency. For instance, many roads in remote rural areas become impassable during the wet season, hindering communication between farmers and extension staff.

The adoption of ICTs, notably radio, television, and mobile phones, holds the potential to accelerate agricultural development by enhancing access to information and knowledge services. These technologies can furnish valuable and pertinent information to address the challenges faced by individual farmers and farming communities, enabling them to acquire new skills, technologies, and innovations. This facilitates the dissemination of knowledge for sustainable and inclusive agricultural development, contributing to enhanced productivity in agricultural activities and improved livelihoods for farmers. Fereres (2007) further reinforces this notion, asserting that the utilisation of ICTs yields additional benefits in economic aspects, such as increased earnings and production.

Through the lens of Agricultural Knowledge and Information Systems (AKIS), ICT emerges as a valuable asset in strengthening connections among research institutions, farmers, and agricultural extension systems (Rivera et al., 2005). ICT facilitates seamless linkages by enhancing the exchange of information, particularly technological advancements, among these domains, effectively integrating them into a cohesive institution. Within research institutes, ICT fosters the establishment of small extension sections and research-extension committees, leveraging tools like mobile phones to streamline communication processes. Through the utilisation of ICT, Agricultural Extension Services disseminate information and novel technologies to farming communities, empowering them to enhance their productivity, incomes, and overall standards of living.

12.2.3 Challenges facing smallholder farmers in access and use of agricultural information

Various studies have addressed challenges faced by smallholder farmers in accessing and using agricultural information. Phiri, Chipeta and Chawinga (2019) pointed out some obstacles that hinder the efficient access and utilisation of information in Africa, such as illiteracy, lack of awareness regarding information sources, inadequately trained extension agents, and digital disparities. Muhanguzi and Ngubiri (2022) also highlighted additional challenges, such as low levels of education, inadequate information quality, poorly designed information networks, and the high cost of accessing information. Furthermore, other sources have highlighted significant hurdles such as limited mobility, financial constraints, inadequate rural information centres, and infrequent visits from extension officers (Phiri et al., 2019). Additionally, Misaki, Apiola et al. (2018) study delves into challenges encountered by sub-Saharan small-scale farmers in accessing agricultural information via mobile phones. These challenges encompass their limited involvement in the inception stages of technological development, diminished levels of trust and transparency, incongruous utilisation of foreign languages (particularly English) within local cultural frameworks, bureaucratic hurdles, and incidents of mobile phone theft.

These challenges are similar in developing countries. For instance, Megerssa et al. (2020) report that, in Ethiopia smallholder farmers face challenges like illiteracy, the remote location of market centres, farmers' limited information-seeking behaviour, poor connectivity between farmers and extension services, insufficient operational skills among support personnel, language barriers, and inadequate training opportunities. Additionally, absence of rural electrification, scarcity of development agents, lack of rural networks, insufficient reading materials, and inappropriate timing of information dissemination. Likewise, in Uganda, Asingwire (2011) f found several hurdles, including limited or subpar access to ICT tools, deficient ICT infrastructure, insufficient resources, pervasive poverty and low literacy rates as well as unsuitable methods of information dissemination, socio-cultural complexities, and sustainability concerns. According to Odongo (2014), the adoption levels of technologies that facilitate information access in Kenya are low due to a lack of information about the existence of such technologies among smallholder farmers.

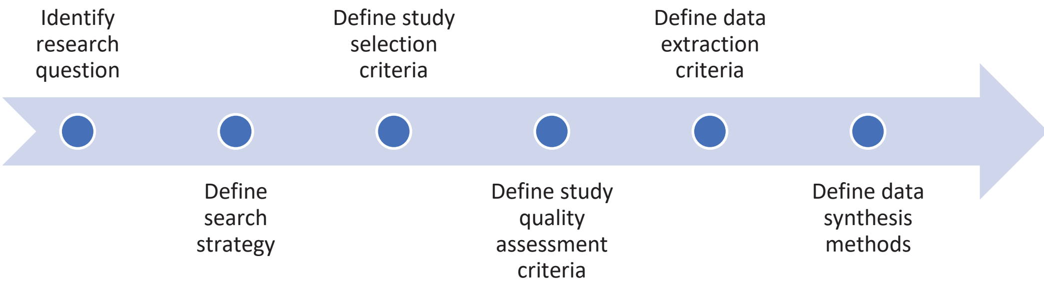
Tanzania also faces similar challenges regarding smallholder farmers' access to and utilisation of information. They include poor access to market information due to inadequate infrastructure, a lack of priority, and language barriers. Additionally, unfavourable broadcasting schedules for radio and television programs make it harder for farmers to access agricultural information. Furthermore, the absence of training in Information and Communication Technology (ICT) limits farmers' ability to utilise digital tools for farming practices, while poor network connectivity exacerbates the issue. Moreover, lower levels of literacy among farmers hinder their ability to access and comprehend written agricultural information (Benard et al., 2020; Elly and Silayo, 2013; Isaya et al., 2018; Magesa et al., 2014).

12.3 Methodology

This study adopted a systematic literature review, a secondary study that uses a well-defined methodology to identify, analyse and interpret available evidence related to a specific research question unbiasedly. The study selected primarily published journal articles that are relevant to answering the study's research questions.

The study borrows the review protocol proposed by Kitchenham and Charters (2007) (see Figure 12.1) to answer the research questions. The search strategy is outlined by explaining the search scope, method, and query. The search scope encompasses the publication year and publication venue. Specifically, regarding the publication year, the search targeted primary papers published between 2010 and December 2024. Furthermore, concerning the publication venue, the search for the targeted research papers utilised the following renowned databases: Research4Life, Emerald, Google Search, and Google Scholar. These databases were chosen because they are easily accessible, thanks to subscription by the REPOA's resource centre.

Figure 12.1: Review Protocol



***Source*:** Kitchenham and Charters (2007)

The search string was developed using keywords derived from the research questions and their corresponding synonyms. Subsequently, a pilot search was performed to refine the search string. The resultant search string includes: smallholder farmers or small-scale farmers or farmers, agricultural knowledge and or agricultural information, information technology and Rural Tanzania or Tanzania. In addition, we used a snowball method to search the papers referenced by the primary studies identified.

We further employed study selection criteria to streamline the process and ensure the inclusion of relevant studies. A predefined set of exclusion criteria was then employed to filter out papers that did not align with the study's objectives. The following were used as exclusion criteria: papers published before 2010, the full text of the paper is not available, the paper does not relate information and or knowledge in the agriculture domain, the paper focuses outside Tanzania and duplicate publication from multiple sources. The exclusion criteria were applied to the 115 papers obtained from our searches. This process involved an initial review of titles and abstracts, followed by a comprehensive examination of the full text. Following the application of the criteria, 95 papers were chosen for additional evaluation. Although the agricultural sector includes crop cultivation, livestock, and forestry, this study specifically focuses on crop cultivation.

Using the quality assessment criteria outlined by Kitchenham and Charters (2007), the 95 selected studies were evaluated to determine their eligibility for further inclusion or exclusion. The criteria were categorised into four primary domains focusing on factors that could potentially influence the results: reporting, relevance, rigour, and credibility. First, the assessment evaluated the reporting quality based on the studies' objectives, clarity, and coherence. Subsequently, the rigour of the studies was appraised regarding their contribution to research and practice. Additionally, the relevance of the studies was gauged based on the thoroughness and completeness of addressing all the said aspects. Finally, credibility was evaluated concerning the meaningfulness and logical coherence of the findings and conclusions. Following the application of quality assessment criteria to the 95 papers, 30 papers were extracted based on their good quality and relevance.

A data extraction template was created to capture data precisely from the primary studies. A pilot data extraction was conducted, and consensus was reached on all fields essential for addressing research inquiries. The data extraction template comprises details such as authors, title, publication year, and data repository. Additionally, it incorporates elements necessary for addressing research questions.

Finally, data synthesis was conducted to integrate and summarise findings from primary studies to address the research questions. Ultimately, data synthesis transforms individual study results into a coherent and comprehensive understanding of the topic under investigation.

12.4 Limitations of the study

This study focused only on crop cultivation and not agriculture in general. Consequently, it relied primarily on peer-reviewed journal articles available in the identified electronic databases, excluding projects not documented in these sources or those published in languages other than English, such as Arabic, French, or Portuguese. This language restriction introduces potential language bias, as excluding non-English studies can lead to an incomplete understanding of the topic and may skew results towards English-language publications. Additionally, the study did not consider relevant projects reported in grey literature or other non-indexed sources, further limiting the comprehensiveness of the review. As a result, the findings may not fully capture the diversity, particularly those documented in non-English contexts or outside mainstream academic publications.

12.5 Results and discussion

This section presents the results of the study by research question. It is divided into two subsections: primary sources of information and knowledge about agricultural practices accessible to smallholder farmers, the kind of information that is mostly preferred by smallholder farmers and barriers that hinder smallholder farmers from effectively accessing and utilising agricultural information and knowledge.

12.5.1 The primary sources of knowledge and information accessible to smallholder farmers

Overall, the results in Tables 12.1 and 12.2 show that Tanzania's smallholder farmers depend on various agricultural information and knowledge sources, which are crucial for enhancing productivity, ensuring food security, and improving livelihoods. The sources include radios, television, mobile phones, extension offices, person-to-person interaction, newspapers, farmers' associations, village meetings, brochures, leaflets, flyers, posters, demonstration farms, training and seminars, input supplies/agro-dealers, NGOs, libraries and information centres, books/journal articles, internet, and social media. The study findings specifically reveal that the majority (92%) of the reviewed studies reported using mass media (radio and television) to share agricultural information and knowledge with smallholder farmers. Following mass media, the next most common sources included agricultural extension officers (77%), mobile phones (69%), and person-to-person interactions (family, parents, friends, and neighbours) (62%). Similarly, Mtega (2021) noted that all 10 reviewed studies identified radio as the most commonly used communication channel for farmers to access agricultural information. Only four out of the ten studies reported that the majority of farmers used interpersonal communication channels.

In rural Tanzania, smallholder farmers rely on various sources to access agricultural information and knowledge. Despite the growing presence of mass media, oral communication remains a dominant method through which farmers obtain and share agricultural knowledge. Studies (Elly and

Silayo, 2013; Opara, 2008; Ugboma, 2010; Lwoga et al., 2011) suggest that farmers often turn to trusted individuals such as friends, neighbours, family members, and extension officers for advice. Mkenda et al. (2017) further indicate that over 60% of smallholder farmers primarily depend on interpersonal communication channels due to their accessibility and trustworthiness. According to Mtega and Ngoepe (2018), oral communication is preferred because it allows for easy consultation, is cost-free, and perceived as being rich in knowledge. Additionally, farmers often rely on lead farmers, those who have adopted innovative agricultural practices and technologies, as their main sources of agricultural information (Misaki et al., 2016).

However, while interpersonal communication is highly accessible and fosters trust among farmers, it has notable limitations. Farmers can only engage in face-to-face knowledge exchange when they are physically present in the same location. This geographic limitation restricts the timely dissemination of agricultural knowledge, particularly in cases of dispersed farmers across different regions. Furthermore, access to agricultural extension officers remains limited in rural areas (Msoffe and Ngulube, 2017), and not all farmers are equally reliable sources of information (Mtega et al., 2016). This variation in the quality and accuracy of information can hinder the adoption of best agricultural practices.

Table 12.1: The primary sources of information and knowledge accessible to smallholder farmers

Location District/Region	**Sources of Information and Knowledge**									**Reference**
	Radio	**Mobile phone**	**Newspapers**	**Television**	**Village meeting**	**Person-to-person interactions (neighbour, friend,**	**Agric extension officers**	**Farmers' association**	**Brochure, leaflet, fliers**	
Hai, Mvomero and Kilosa	√	√	√	√	√					Magesa *et al.* (2014)
Iringa rural district	√			√	√	√	√	√		Sawe (2022)
Chamwino	√	√	√	√	√	√	√	√		Mwalukasa (2011)

Iringa rural district	√	√	√	√		√	√	√	√	Elly and Silayo (2013)
Tarime, Butiama	√	√	√			√	√			Bonephace *et al.* (2022)
Kilombero district	√		√	√	√	√	√	√	√	Benard *et al.* (2014)
Gairo, Kilombero, Kilosa, Ulanga, Malinyi, Morogoro Municipal, Morogoro Rural and Mvomero.	√	√		√			√			Mtega (2018)
Mvomero, Kilolo	√	√		√		√			√	Siyao and Sanga (2023)
Mpwapwa, Karagwe, Moshi Rural, Kilosa, Songea Rural Kasulu	√	√		√						Lwoga (2010)
Kilosa	√			√			√	√		Chipungahelo (2014)
Kilosa, Hai	√			√		√	√			Isaya et al (2016)
Moshi rural		√	√	√	√		√	√		Mkenda *et al.* (2020)
Kilombero	√	√	√	√	√	√	√	√	√	Mtega et al (2016)

Table 12.2: Sources of agricultural information and knowledge in Tanzania

Sources of information and knowledge	Frequency	Percent	Rank
Radio	12	92	1
Television	12	92	1
Agric extension officers	10	77	2
Mobile phone	9	69	3
Person-to-person interactions (e.g., neighbour, friend, family, parents	8	62	4
Newspapers	7	54	5
Farmers' association	7	54	5
Village meeting	6	46	6
Brochure, leaflet, fliers	4	31	7

Source: Fieldwork

On the other hand, mass media, particularly radio and television, serve as alternative sources of agricultural information. The findings of this study suggest that television plays an important role in disseminating agricultural knowledge, a position that contrasts with earlier research (e.g., Silayo, 2016; Mwantimwa, 2012), which argues that television is largely inaccessible to many rural residents. Even where television and radio are available, their effectiveness is limited by several factors. For instance, agricultural programmes on radio and television are often scarce (Mkenda et al., 2017; Opara, 2008), and the few that exist tend to be aired at times that are inconvenient for farmers (Siyao and Sanga, 2023a; Sawe, 2022; Ndimbwa et al., 2019; Magesa et al., 2014; Mwalukasa, 2012; Siyao, 2012; Mwakaje, 2010). Additionally, limited access to electricity and financial constraints prevent many rural farmers from using radio and television effectively (Siyao and Sanga, 2023a; Ndimbwa et al., 2022; Ndimbwa et al., 2019; Mubofu and Elia, 2017; Bernard and Dulle 2014; Magesa et al., 2014; Mwalukasa, 2012; Lwoga, 2010; Mwakaje, 2010). Unlike television, which is more common in urban areas due to better signal coverage and affordability, radio is more widely used in both urban and rural areas (Mkenda et al., 2017).

Moreover, mobile phones have become a powerful tool for improving information access among rural farmers in Tanzania. With the rapid growth of mobile telephony, mobile phones have surpassed other ICTs like radio, television, and newspapers in terms of reach and usage (Isaya et al., 2018). As of 2022, over 60% of smallholder farmers in Tanzania own mobile phones, highlighting a significant adoption of mobile technology within the agricultural sector. This widespread usage positions Tanzania among the African countries with the highest number of mobile phone users in agriculture (Mwageni et al., 2022). The proliferation of mobile phones among farmers has facilitated access to vital agricultural information, including market prices, weather forecasts, and farming techniques. Platforms like M-KULIMA, developed through collaborations involving the Ministry of Agriculture and Vodacom, have digitally profiled over 1.3 million farmers, providing services such as market linkages, insurance, and financial tools (Mwakifwamba et al., 2024; Mwageni et al., 2022). This digital integration not only enhances productivity but also contributes to improved livelihoods and resilience among rural farming communities in Tanzania. Despite this progress, challenges remain, including limited network coverage and affordability issues in rural areas, as well as concerns around cybersecurity and data privacy (Mwakifwamba et al., 2024). However, the expectation is that ongoing investments in infrastructure and innovation will continue driving the growth of mobile phone usage in Tanzania.

While mass media have the potential to reach a broader audience, they do not provide the same level of interaction and trust that interpersonal communication offers. Farmers who obtain information from television or radio cannot easily ask follow-up questions or clarify uncertainties, as they would, when consulting a fellow farmer or an extension officer. This lack of direct engagement limits the depth of knowledge transfer and may slow the adoption of new agricultural practices. However, mobile phone usage among farmers is growing fast and has significantly reduce the costs and efforts associated with agricultural information search, while offering the convenience of private, anytime-anywhere access through a personal device. This discussion presents a balanced view of both communication methods and suggests a hybrid approach as the most effective solution.

12.5.2 Type of information mostly preferred by smallholder farmers

This part is about the type of agricultural information smallholder farmers prefer during the production process. Information is important for any production to take place as a main factor in production. Smallholder farmers need information about the availability of suitable and fertile land, extension officers, seeds, fertilisers, pesticides, weeding mechanisms, farming techniques, harvesting methods, product storage, product transportation, marketing and sources of funding to produce a good quantity and quality of agricultural products.

The results indicate that smallholder farmers prefer a variety of information types, including market information, farming techniques, natural resource management, agricultural inputs, access to credit, product quality and quantity, pest and disease control, rice-related information, weather updates, soil characteristics, irrigation methods, training opportunities, and climate change.

Table 12.3 illustrates the distribution of these preferences. Approximately 15.3% of the farmers preferred market information, 13.1% prioritised information on agricultural inputs, 12% were interested in soil-related information, 10.9% preferred farming techniques, 9.8% sought information on pest and disease control, 8.7% valued access to funding sources, and 6.5% were interested in weather information.

Most of the existing literature supports the finding that market information is the most sought-after type, followed closely by information on agricultural inputs such as seeds and fertilisers. Access to market information helps farmers increase production and align the quality of their products with market demands, ultimately boosting their income. The same was stated by Magesa et al. (2014), that agricultural producers' access to market increase agricultural production, general economic growth, and reduce hunger and poverty. Moreover, access to agricultural market information is an important aspect for agricultural development as accurate and timely agricultural market information enhances market performance through making better agricultural production plan to meet the demand of the market.

A study by Lwoga (2010) revealed that the most disseminated information via Fadeco Radio included agricultural product market prices and daily exchange rates. These findings are consistent with the results of this study. Additionally, Lwoga noted that internet usage among farmers for acquiring knowledge remained low.

However, Bonephace et al. (2022) found that smallholder farmers preferred information on pesticides and disease control, followed by market information. In their study, the market information was the second preferred information type, as this makes sense, as farmers to win the market need agricultural products, which are of good quality. The products which are free from diseases and not affected by pests are the ones needed in the market and can be sold at higher prices. Elly and Silayo (2013) present similar findings, that the preferred information type was disease outbreak, followed by agricultural input and market information, the third preferred information type. Having good seeds and fertilisers for agricultural production results in having a good quantity and quality of agricultural products, which will meet the needs of the market, making farmers win the market and earn more income. In this study, the agricultural input information type was the second preferred information by smallholder farmers. This shows that information on agricultural input is important because farmers need to know information about suitable land for production, suitable seeds, and good fertilisers for agricultural production. Having good information on agricultural inputs enables farmers to produce large quantities and high-quality produce.

Table 12.3: Typology of information preferred by smallholder farmers

Information type	Frequency	Percentage
Market information	14	15.3%
Farming techniques	10	10.9%
Natural resource management	1	1%
Agricultural input	12	13.1%
Sources of Credit	8	8.7%
Quality of product	1	1%
Quantity of product	1	1%
Pests and disease control	9	9.8%
Weather	6	6.5%
Soil characteristics	11	12%
Irrigation techniques	2	2.1%
Crop varieties	4	4.3%
Storage methods	5	5.4%
Agricultural product processing	3	3.2%
Training	1	1%
Climate change	3	3.2%
Rice information	1	1%
	91	

***Source*:** Fieldwork

12.5.3 Barriers hindering smallholder farmers in rural Tanzania from effectively accessing and utilising agricultural information and knowledge

Smallholder farmers in rural Tanzania are facing various barriers that significantly hinder their ability to effectively access and utilise agricultural information and knowledge, ultimately hindering productivity enhancements. These impediments are not isolated but rather form a systemic challenge, encompassing infrastructural, economic, human capital, and institutional dimensions (see Table 12.4).

Table 12.4: Barriers hindering smallholder farmers from accessing and utilising agricultural information and knowledge

Barrier category	frequency	Percentage
Infrastructural Deficiencies	17	57
Limitations in Extension Services and Weak Linkages	15	50
Economic Constraints	14	47
Knowledge, Skills, and Awareness Gaps	11	37
Quality and Timeliness of Information	11	37
Socio-cultural and Gender Aspects	8	27
Policy and Systemic Gaps	7	23
Market and Produce-Related Barriers	6	20

Source: Fieldwork

One of the most persistent categories of barriers relates to inadequate infrastructure. Poor road infrastructure, particularly during rainy seasons, renders many rural areas impassable, limiting farmers' physical access to markets and information centres (Magesa et al., 2014). This geographical isolation also restricts their exposure to agricultural innovations and broader market opportunities (Silvestri et al., 2021). Compounding this, the widespread lack of reliable electricity supply in rural Tanzania severely constrains the use of modern communication technologies, including televisions, computers, and even the ability to consistently charge mobile devices, thereby reducing the utility of electronic information sources (Churi et al., 2012; Magesa et al., 2014; Mubofu and Elia, 2017; Mwalukasa, 2012; Mtega, 2018). Furthermore, the communication infrastructure itself is often weak, characterised by poor network coverage for mobile phones and limited internet access, which directly impacts the reach of conventional extension services and the effective utilisation of digital tools (Churi et al., 2012; Mtega and Msungu, 2013; Muhanguzi and Ngubiri, 2022; Siyao and Sanga, 2023a). The physical absence or scarcity of dedicated information centres, libraries, and facilities for accessing agricultural materials in rural communities necessitates long, costly, and time-consuming travel for farmers seeking vital information, a challenge highlighted by numerous studies (Mtega et al., 2016; Mubofu and Elia, 2017; Mwalukasa, 2013; Ronald et al., 2014; Siyao, 2012; Siyao and Sanga, 2023b)

Economic constraints represent another difficult barrier to low-income smallholder farmers. With many earning less than a dollar per day, directly translate into an inability to afford essential communication tools such as mobile phones, radios, or televisions, which are critical for accessing information (Churi et al., 2012; Magesa et al., 2014; Mubofu and Elia, 2017; Mwakaje, 2010; Nyamba and Mlozi, 2012; Siyao and Sanga, 2023a). Beyond device acquisition, the high costs associated with accessing information, including travel expenses to attend agricultural demonstrations or markets, purchasing printed materials, and the tariffs for ICT services further limit access. Although, there has been a decreasing trends in usage costs (Churi et al., 2012; Lwoga, 2010; Mtega et al., 2016; Mtega and Msungu, 2013; Muhanguzi and Ngubiri, 2022; Mwakaje, 2010; Mwalukasa, 2013; Siyao, 2012). Inadequate financial resources also prevent farmers from attending crucial workshops, agricultural exhibitions, or investing in recommended agricultural inputs and technologies, thereby limiting their practical application of knowledge (Churi et al., 2012; Mubofu and Elia, 2017; Silvestri et al., 2021; Siyao and Sanga, 2023a).

Gaps in knowledge, skills, and awareness significantly hinder effective information utilisation. High illiteracy rates, particularly among female farmers, pose a fundamental challenge to comprehending written agricultural information, including print media and technical terms (Lwoga, 2010; Nyamba and Mlozi, 2012; Siyao and Sanga, 2023a). This is compounded by low digital literacy, where a substantial portion of farmers lack the necessary computer knowledge and skills to effectively use mobile phones and the internet for agricultural information (Lwoga, 2010; Magesa et al., 2014; Mtega and Msungu, 2013; Muhanguzi and Ngubiri, 2022). Many farmers also exhibit a general lack of awareness regarding available information sources, agricultural information services, and the potential benefits of information centres or training opportunities (Benard et al., 2020; Nyamba and Mlozi, 2012; Siyao and Sanga, 2023a). Furthermore, agricultural information, especially on climate change adaptation, is often not clearly understood due to the use of complex technical language, jargon, or presentation in non-native languages, making it inaccessible to smallholder farmers (Magesa et al., 2014; Mwalukasa, 2013; Mtega, 2018; Silvestri et al., 2021). Farmers also often lack a fundamental understanding of modern farming techniques and may exhibit resistance to adopting new practices, preferring traditional methods.

The quality and timeliness of information also present considerable challenges. Information available to farmers is frequently outdated, inconsistent, vague, or perceived as unreliable, particularly concerning critical seasonal weather forecasts, which diminishes its relevance and effectiveness for current agricultural needs and long-term planning (Churi et al., 2012; Elly and Silayo, 2013; Mtega et al., 2016; Muhanguzi and Ngubiri, 2022; Mwalukasa, 2013; Ronald et al., 2014). The untimely delivery of information, including extension services, further hinders effective and timely decision-making (Mtega et al., 2016; Mtega and Msungu, 2013; Mubofu and Elia, 2017; Siyao, 2012). Moreover, conventional communication content, such as agricultural programmes on TV and radio, is often too generalised and lacks the specific tailoring required for local farming contexts, rendering it less relevant to farmers' immediate needs (Churi et al., 2012; Elly and Silayo, 2013).

Limitations in extension services and weak linkages are critical systemic barriers. The extremely high ratio of farmers to extension workers is 1:1500 or even 1:10,000-20,000. This ratio falls short of the World Bank recommended standard ratio of 1:200-500, as well as below the Tanzania Ministry of Agriculture’s standard of two extension officers per village.

This leads to the insufficient and untimely provision of agricultural advice and limited face-to-face communication, which is crucial for transferring complex knowledge (Krone et al., 2014; Mtega, 2018). There are also weak connections between research institutions, extension services, non-profit organisations, libraries, and farmers, which prevent the effective dissemination and adoption of technologies and knowledge (Lwoga et al., 2011; Mtega et al., 2016; Mtega and Msungu, 2013). The prevailing top-down approaches in public agricultural extension services often neglect participatory methods, failing to incorporate farmers' valuable indigenous knowledge and lacking the skills for participatory problem-solving (Lwoga, et. al., 2011). This is compounded by limited farmer participation in training, seminars, and workshops, often due to a lack of awareness or time constraints (Siyao and Sanga, 2023a)

Market and produce related barriers further exacerbate the information challenge. Fragmented rural markets, often dominated by traders and intermediaries, result in uncompetitive market structures that limit farmers' bargaining power and price negotiation, leading to sales at farm gates or informal markets with low returns (Ismail et al., 2024; Magesa et al., 2014). Farmers' dependence on these intermediaries is often a direct consequence of their limited access to real-time market information on prices, demand, and potential buyers, which hinders informed decision-making (Ismail et al., 2024; Mwakaje, 2010). Additionally, the practice of selling small volumes of produce, often driven by immediate financial needs or a lack of adequate storage facilities, further restricts farmers' access to more competitive formal markets (Magesa et al., 2014).

Socio-cultural and gender aspects also play a significant role in limiting information access. Gender imbalances remain pronounced, with female farmers frequently having less access to education, resources, and communication tools. Studies indicate that male farmers are more likely to access agricultural market information, partly due to cultural norms where men, as household heads, dominate farming activities, thereby limiting women’s engagement with mobile platforms (Mwageni et al., 2022). There is also a noted preference among female farmers for female extension agents, who are often in insufficient numbers, creating an additional barrier (Lwoga et al., 2011). Cultural differences and gender-specific roles can limit knowledge sharing, and indigenous knowledge, primarily transferred orally, can be inconsistent, with unequal sharing influenced by social dimensions such as age, gender, status, and wealth (Mtega and Msungu, 2013; Chipungahelo, 2015). A concerning trend is the declining appreciation of traditional knowledge, with younger generations sometimes undervaluing indigenous practices and traditional crops in favour of exotic varieties (Chipungahelo, 2015).

Finally, policy and systemic gaps contribute to the overall challenge. Many ICT-based solutions developed for agriculture are not adopted by farmers because they were created without using participatory approaches, indicating a fundamental disconnect between technology developers and end-users (Barakabitze et al., 2017). The absence of specific indigenous knowledge policies and weak intellectual property rights frameworks fails to adequately protect traditional knowledge, thereby limiting its formal integration into agricultural practices (Lwoga, 2010). Furthermore, the distribution of knowledge can be fragmented due to social dynamics, politics, power, culture, conflicts, and religious beliefs, leading to uneven access within communities (Lwoga, 2011).

These multifaceted barriers collectively create a significant impediment to smallholder farmers in rural Tanzania, underscoring the need for integrated and context-specific interventions to improve their access to and utilisation of agricultural information and knowledge.

12.6 Conclusion and recommendations

This study reveals that smallholder farmers in rural Tanzania access agricultural information through a mix of mass media, interpersonal communication, and mobile technology. Radio and television remain the most widely used sources (92%), supplemented by extension services (77%), mobile phones (69%), and trusted individuals such as family, neighbours, and lead farmers (62%). Farmers express a strong preference for practical, output-oriented information, especially regarding market trends (15%), agricultural inputs (13%), soil health (12%), and cultivation techniques (11%). However, the ability to effectively access and use this information is constrained by several interrelated barriers. Infrastructural shortcomings, such as poor roads, unreliable electricity, and weak network coverage, limit both physical and digital information flow. Economic hardship further restricts farmers' ability to invest in communication devices, pay for ICT services, or attend training events. Additionally, low literacy and digital skills hinder comprehension and utilisation of technical content, while socio-cultural factors, gender disparities, and institutional gaps in extension services exacerbate these challenges.

12.6.1 Recommendations

To address challenges involved, the following recommendations are made to the Government of Tanzania and its development partners:

One, enhance ICT infrastructure and affordability: Expansion of rural network coverage and investments in off-grid power solutions (e.g., solar charging stations) are crucial. Encourage policies and partnerships to reduce the cost of smartphones and data services for smallholder farmers.

Two, strengthen and diversify extension services: Recruit and train additional extension officers with mobile capability and agro-advisory access. Support lead farmer programmes to expand peer-based learning networks, which are trusted and cost-effective.

Three, tailor content to literacy and local language needs: Develop audio-visual materials in local dialects, using storytelling, drama, and pictorial guides. Integrate traditional knowledge alongside modern methods to enhance relevance and trust.

Four, promote hybrid, interactive communication models: Integrate mass-media outreach with SMS alerts and interactive voice response (IVR) platforms to bridge reach gaps. Regularly schedule two-way radio or phone programs where farmers can ask experts questions in real-time.

Finally, reduce economic and institutional barriers: Subsidise agricultural equipment, inputs, and training events. Establish local "information hubs" at agro-dealer outlets or community centres offering free or low-cost advisory services. Introduce participatory planning to ensure solutions meet farmers' real-world needs and address gendered access constraints.

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Chapter 13 Lessons from China's Policies on Rural Poverty Reduction

Donald E. Mmari and Paschal B. Mihyo

13.1 The context of Africa- China cooperation

Africa's trade relations with China have a very long history. Archaeological excavations in Mogadishu, Somalia and Kilwa in Tanzania, have uncovered Chinese coins dating as far back as the Chinese Song Dynasty (960-1279) and some belong to the Ming Dynasty (1368-1644) as well as the Qing Dynasty which covered the period 1636 to 1912 (Pankhurst, 1961; Nkrumah and Kipo-Sunyehzi, 2024). However, political and diplomatic links with Tanzania began on the day it became independent from British colonial rule on the 9th December 1961. Since then, there has been a period of unbroken trade and development cooperation. The cooperation has entailed processes of learning both by Chinese, Tanzanian and other African participants in various activities.

Recent research indicates that with increased investments and other forms of cooperation by Chinese firms, learning and the acquisition and transfer of knowledge have increased substantially. Benefits include exposing local producers and service providers to global value chains and providing them with opportunities for acquiring new knowledge and technology thereby increasing employment, production, productivity and incomes (Amendolagine, 2021). In addition, loans used for investment in big infrastructure projects related to transport and energy have eased transport and energy shortages that constitute major constraints on enterprise growth and foreign direct investments in Africa (Johnston 2024).

Evidence also shows that where well-planned projects were completed, there was an increase in investments, production, employment and incomes (Muneno, 2021). Learning and acquisition of technology and skills has been faster and more effective in countries such as Ethiopia which have established mechanisms for Chinese firms to train locals in the implementation of these big projects including infrastructure and electronics (Chen 2022). Furthermore, in such countries, the spill overs have included stimulating demand for local products and equipment, especially in the construction of railway systems. Also, in training local staff to operate and maintain technological systems and fabricating some spare parts for systems and facilities repairs as well as imparting skills for managing infrastructure and maintaining the established systems and assets (W. Chen 2021; Park and Tang, 2021).

In countries where governments have put an emphasis on technology acquisition through the training of local staff and providing the necessary conditions for such learning, Chinese cooperation has entailed on the job training and provision of further studies for eligible students in Chinese universities. For example, according to W. Chen (2021), Ethiopia sent more than 300 students to railway universities in China to acquire hard and soft skills on how to run railway systems. However, the level of success in the transfer of knowledge has not been as high in Tanzania as compared to Ethiopia. It is evident that the level of success in technology and skills learning is determined by the level of strategic preparedness of the host country in creating catchment conditions for the knowledge and skills (Y. Chen 2020; W. Chen 2021).

When conditions are conducive, even Chinese firms find it easy and gainful to train local experts and equip them with new, hands-on skills (W. Chen 2021; Park and Tang 2021). Huawei, for example has established training centres in Angola, Kenya, DRC, Egypt, Morocco and South Africa and in these countries, the youth are very eager to use IT to develop digital products, some of which increase customers for Huawei products and create capability for self-employment among those trained (Tugendhat, 2020). In what some have termed the Digital Silk Road, Huawei and ZTE have contributed to domestic firms in Algeria and Morocco being enabled to technologically upgrade their ICT capabilities, diffuse new hardware, software, process and standards technology (El-Kadi 2024).

While this has led these countries out of the 'technological lock-out' under the hegemony of western technology companies, it also has the potential for a 'new technological lock-in' of these firms by the Chinese technology giants. The long-term solution lies in developing capability for local content on key software and processes. This necessitates purposive technology learning aimed at the acquisition and development of such capabilities.

In the case of Tanzania, investments by Chinese firms and nationals vary from trade to manufacturing and internal commerce. Firms involved in steel and plastics production, garment manufacturing and agro business have started to create linkages with local markets, establishing local supply networks and even facilitating transfer of skills to local producers (Jung and Xiayang 2021). Xia has studied some firms and noted that some of them such as Twyford Ceramics, Tooku Garments, JOC and Ocean Kiss which are in manufacturing, have established links with local vocational training institutes and offer classroom and video-based courses to staff. Tooku Garments works closely with the Ministry of Industry and Trade to support vocational training institutes, but the major limitation is that these institutes do not have qualified trainers and instructors capable of operating imported machines and equipment (Xia 2019).

Apart from learning experiences by firms in Africa, China continues to support capacity building through scholarships for training African students in China. China has become a leading destination for students in search of higher education opportunities from Tanzania and lower income countries (ICEF Monitor 2021). On the ground the Chinese government's 20+20 project announced at the FOCAC IV in November 2009 establishes links between African and Chinese universities, providing room for transfer of knowledge through joint research and training. In his study of the Chinese international office, Professor Kenneth King was told by staff that, '....there is learning on both sides. We have learnt on the research side. So, we see it as equal'. There is an old Chinese saying, "Qu Chang Bu Duan" meaning to enhance each other, we learn from each other. We have weaknesses and advantages and vice versa for our partners in Africa. We compensate for and take advantage of each other (King, 2014).

Chinese firms undertake many initiatives in Tanzania. However, the involvement of Tanzanian entrepreneurs to forge links with and learn has been lower than it has been in Ethiopia and Nigeria. Part of the problem is lack of confidence on the part of Chinese investors about the confidentiality of local staff when it comes to trade information. Additionally, differences in cultures and values related to work ethics (Xia, 2019b). The main problem is that in both private and public investment policy, there is a mistaken assumption that, acquisition of foreign is merely through association or participation in transactions with foreign high-tech firms. On the contrary as has been observed by some researchers, to benefit from these firms needs a conscious policy geared towards 'acquisition' rather than 'transfer' of knowledge and skills (Kweka and Sooi 2023; Salam et al., 2019).

13.2 Key strategies used by China on rural poverty reduction

This chapter focuses on what Tanzania can learn from the Chinese experience to inform its poverty reduction drive. China's poverty alleviation strategy was predicated upon a holistic approach from, which Tanzania can learn. First, it adopted a policy of Township and Village Enterprises (TVEs) through which rural enterprises had direct links with surrounding villages for employment, labour supply, and markets. These village enterprises helped to create linkages between agricultural production and cottage industrial enterprises. Second, they adopted policies, which link human development (health, education, employment, and other social services) on the one hand and income generation (employment, enterprise development, taxes, incentives, prices and subsidies) on the other.

Third, while in most African countries including Tanzania, market reforms have focused more on price deregulation and rolling back the frontiers of the state in economic activity, the Chinese rural poverty alleviation strategy combined market and non-market mechanisms which encouraged state involvement in stimulating growth and regulating production and procurement to increase incomes for rural producers. Fourth, the role of the state was strengthened, especially in areas needing coordination, supervision and resource mobilization for transformation.

An example is the formation of institutions such as the Leading Group for the Economic Development in Poor Areas whose parallel in Tanzania is the Tanzania Social Action Fund (TASAF), but which goes beyond what TASAF does. Fifth, the strategy of resource mobilization for poverty alleviation, drawing mainly from local resources. The Chinese strategies involved mobilization of financial and human resources between better resource-endowed provinces supporting less resource-endowed ones and conscious policies to promote labour mobility and absorption across provinces.

The sixth strategy from which Africa in general and Tanzania in particular can learn is partnerships between government and social movements such as women groups, education NGOs and similar institutions getting involved in building education, health, and other social infrastructure. This goes beyond normal citizen participation in development which is practiced through decentralization by devolution in Tanzania and other African countries (Mmari and Wangwe, 2017; Massoi and Norman 2009; Kisimbe, Sanga and Kasubi 2014). In some districts in Tanzania, decentralization by devolution seems to have undermined effective coordination and service delivery (Kessy, 2023; Shayo 2022). In China, decentralization backed by popular participation through civil society organizations led to effective service delivery and accountability for rural development funds.

13.3 Chinese experience on fast tracking rural poverty reduction

In this section, we dig deeper into rural poverty alleviation strategies in China focusing on a selected number of strategies used by the Government of China to fast-track rural poverty reduction and raise many people out of poverty in a very short time. Most Sub-Saharan countries have similar conditions that were facing China before its great transformation in terms of the pre-dominance of primary sector's dependency and high levels of poverty. The transformation began with the ascendancy of Mr. Deng Xiaoping in 1977 with his theory of 'four modernizations'- agriculture, industry, defence, and science and technology. Although some fundamental pillars of tacit knowledge and governance were different, China had and still has a big rural population.

It had vast rural areas with poor people aggravated by regional disparities and inequalities, land disputes, and high rates of peasant unrest just as there are in many African countries including Tanzania (TECH Tefra ARD, 2012). But it managed to change and create factors that have increased space for inclusive and peaceful development.

Zafar (2010) has opined that, what differentiates China from most of SSA is the capital accumulation coupled with more factor usage. Thus, Africa can learn from China by adopting policies that lead to equitable sharing of gains; using Diaspora knowledge and networks to market their products and countries; embarking on rural reforms that improve property rights and using decentralization to promote growth. Kaplan has also identified ten characteristics of the Chinese development model from which African countries can learn for rural poverty reduction. They include starting small with small farmers and rural areas; investing heavily in knowledge infrastructure; ensuring social cohesion; building competent government bodies committed to inclusive development; 'paving the road to riches literally'; testing before rollout; using financial markets to promote development and stability and using policy to scale up competitiveness and self-reliance (Kaplan, 2014). In the next few sections, we highlight some specific strategies which Tanzania can consider learning from.

13.3.1 Ensuring a balance between social and economic policies

In October 2005 Tanzania elected a new leadership under the aegis of the ruling Chama cha Mapinduzi (CCM). Most of the far-reaching policies we discussed in the previous section were passed and implemented during this period. Moreover, for agriculture, this may have been the golden period after many years. It was the year which signalled a lot of changes and the launching of MKUKUTA I among other growth and poverty reduction blueprints. In October 2006, the Communist Party of China (CPC) held its 16th Congress, which was a landmark Congress as regards policy changes since the post 1984 reforms. The 11th Congress of the CPC resolved to establish a harmonious society in China by the year 2020. According to Wang Thye Woo (2007), the resolve was to build a harmonious socialist society whose objectives were to establish a democratic society under the rule of law; a society based on equality and justice; an honest and caring society; a stable, vigorous and orderly society in which humans live in harmony with nature.

These five objectives were to lay the foundations for policies aimed at economic transformation and poverty reduction. The Congress went further and identified challenges to attaining a society based on these principles. These included a serious imbalance between rural and urban areas; and environmental decline and increasing population problems. Additionally, the need to improve public managementt; institutionalization of democracy and rule of law; limited leadership and management capacity to work with the new situation; corruption in some areas; and social challenges in the areas of employment, income distribution, education, medical care, housing, occupational safety and public order.

The emphasis on social harmony as a crosscutting issue to guide policy choices and interventions is something that has escaped focus in many African countries during the economic reforms in the eighties and nineties with leaders putting more faith on markets and economic transformation in the hope that these would automatically bring growth and prosperity. In contrast, in the 2006 approach the Chinese leadership sought to combine economic construction and social harmony as inseparable elements of growth and development. Woo has attributed this position to a realization that peoples' expectations had changed so much that without harmony, economic transformation was not going to be broadly appreciated by the masses. This possibility has yet to be taken into consideration by many leaders in Africa. Woo has further pointed out that the CPC was aware that without social harmony, by 2020 the economic gains would be threatened by social instability and leadership would not be sustainable (Woo, 2007).

At the time the structural adjustment programmes and public sector reforms began to have a negative impact, there was a lot of disquiet in Tanzania and the same was the situation in China. There were several disturbances especially in the rural areas and the Chinese leadership was convinced that economic growth alone was not going to reduce unrest.

Therefore, China was determined to reinvent itself and the long-term solution was to ensure local democracy, rule of law and stable incomes to put the economy on a high growth path to enable it to catch up with the US. Tanzania was in a similar situation in 2005. It had recorded phenomenal growth, embarked on a new industrialization trajectory in the backdrop of increasing inequality, concerns on the rule of law, threats to the union between Tanzania Mainland and Zanzibar and a rise in land-based conflicts especially those between pastoralists and farmers in Morogoro, Manyara and Arusha. Most of them were driven by poor governance (54%); conservation policies (22%); and land grabbing by the elite (14%) (Care International, 2016). Lack of a holistic approach to reform in Africa in general and Tanzania in particular left some sectors such as education, health and other social services more disadvantaged than others leading to more growth than social development (Forster et.al, 2020; Ndhlovu, 2025; Utoh and Kitole, 2025)

Therefore, in 2005 Tanzania put itself on a higher level of policy reforms and designed policies and strategies that aimed at lifting the rural and urban people out of poverty. In 2006, China stepped back and took stock of the rapid growth that had characterized its phenomenal growth since 1984. Tanzania focused more on growth while China saw social unrest arising out of unequal growth as a potential threat to continued reconstruction and decided to ensure growth with equity. There was convergence on the need for reforms to propel growth and poverty reduction. However, there was divergence on how to protect growth from creating fetters to its own sustainability. Therefore, of the lessons we learn from China is that poverty reduction efforts should aim at shared growth and link sustainable poverty reduction strategies with broader issues of social harmony, equity and political stability.

13.3.2 Harmonious local development

More often than not, in many African countries democracy and good governance are achieved more effectively in urban than in rural areas. Therefore, out of the thirty indicators of good governance many of them are rarely effectively delivered at local level. Examples include rights related to freedom of assembly, speech and participation (the socializing indicators); and aggregation indicators relating to representation and participation in legislative processes. As well executive dimensions relating to freedom from fear, want and the right to choice; the managerial dimensions such as policy advice, accountability by officials, transparency or the regulatory dimensions related to security of property; equal treatment and access to justice and many other indicators or dimensions of governance (see Goran Hyden and Julius Court, 2002). More emphasis is placed on political organization and the mobilization of rural people for production, political rallies and elections. While all these are important and inseparable, mobilization without emancipation cannot bring the development outcomes that rural people expect from the systems of power, production, distribution and governance. Most of the reforms in Africa have concentrated on strengthening political systems and increasing the socialization indicators while leaving very little on the ground in terms of the executive and managerial dimensions at local level.

On the contrary, the Chinese government has found it particularly important to strengthen governance and democracy at the local and grassroots level. According to Sanders and Chen (2007), the reform process in China which was labelled 'Reform and Open to the Outside World' (in Chinese shortened as '*gaige kaifang')* started with the abolition of communes which were replaced by the 'household responsibility' system just the same way Tanzania abolished or abandoned the policy of collective farms (Ujamaa villages). The changes led to exponential growth in China. When China launched the second wave of reform post 2005, economic growth remained high on the agenda, however, did not emphasized as the prime mover of change. Instead, the Communist Party of China began pushing for growth with considerations for equity, equality, honesty, democracy, caring and harmony.

The guiding theory was that the leadership had to realize that people had different expectations and power lies with them. In addition, the richer and more educated citizens had higher expectations from government performance and therefore there was a consensus within the leadership that harmony was necessary to ensure stability in production and services and given the previous period in which there had been disturbances in rural areas, it was important to strengthen good governance especially at the local level. What we learn from China is that deep-rooted inequality and its resultant disharmony are dangerous to national stability and that while political indicators of good governance such as freedoms of assembly and speech are important, what strengthens economies is harmony and the institutionalization of executive, managerial and regulatory indicators of governance. Table 13.1 summarizes some of these indicators.

Table 13.1: Critical governance indicators that create harmony and stability in China

Dimension of Indicator	Components	Essential elements
Executive Dimension	• Ensuring freedom from fear	• Fear from hunger • Fear of the environment • Fear of leaders and the state • Personal insecurity
	• Ensuring freedom from want	• Access to social services • Access to a clean environment • Accessible infrastructure
	• Ensuring peace	• Peaceful households • Peaceful communities • Freedom from harassment • Peaceful relations with law enforcement
	• Willingness to make hard choices / tough decisions	• Long term planning • Avoidance of populist decisions • Making decisions that matter for the majority
Managerial dimension	• Participation in decisions	• Involvement in planning activities • Involvement in policy decisions

		• Engagement in implementations and evaluation • Emancipation - beyond participation
	• Meritocracy	• Merit in the choice of leaders • Merit in the choice of representatives • Merit in access to inputs and subsidies • Merit in local employment • Merit in procurement and market access
	• Accountability of officials	• For local resources • For delegated functions and representation • For performance at local and national level
	• Transparency	• Procedures used in choosing leaders • In allocation of land • In accounting for collective assets • In the systems of justice • In grievance handling
	• Equal access to public services for all	• In all social services • In the courts • In access to opportunities
Regulatory Dimension	• Security of property	• Recognition of private or family property • Proper management of commons • Respect for community intellectual property rights

	• Equal treatment	• At the household and community levels • Equal gender rights
	• Removing obstacles to business	• Equal access to productive assets • Equal entitlement to licenses and • Equal access to permits • start-up support

Source: *A modification of three of the six clusters of governance indicators by Goran Hyden and Julius Court, 2002, 'Comparing Governance across Countries and Over Time: Conceptual Challenges'*, in Dele Olowu and Soumana Sako, *Better Governance and Public Policy. Capacity Building and Democratic Renewal in Africa,* Kumarian Press Inc. and African Capacity Building Foundation

These dimensions are very important for local development. The socializing dimension, mainly freedom of speech, association and expression and non-discrimination are very crucial. As a result, without these three dimensions as adapted in China, many African countries have experienced short-lived political reforms and the democratization of anarchy as was the case in Sierra Leone, and the endless political bargaining between political elite groups as has been the case in Kenya (Salih, 2001). What the Chinese government has done from which we can learn is to ensure that the dimensions of governance that strengthen equity, equality, social justice and national harmony form the basic foundations for the broader good governance and democratization agenda because they help in the delivery of better poverty reduction outcomes.

Other measures China put in place to improve governance in the rural areas include provision of more resources to support links between villages and county governments; linking heads of department in charge of village affairs with village leadership systems; and establishing one stop handling through a unified management service platform. In addition, strengthening self-management, self-service, self-education and self-supervision at local level in order to improve the democratic system at the grassroots.

13.3.3 Cushioning farmers from shocks and strengthening social services

China's accession to the World Trade Organization (WTO) in December 2001—and its rapid subsequent rise in global trade—fundamentally reshaped national competitive dynamics, forcing the reassessment of agricultural policies that had long depended on public subsidies and state-controlled trading systems. Similar imperatives were imposed on other countries whose agricultural sectors were dependent on the state. In the first years of the introduction of free market mechanisms, it had severely impacted the incomes of Chinese farmers. However, the government took radical WTO-compatible measures to cushion Chinese farmers and businesses from decline. The measures taken included phasing out agricultural taxes; reducing electricity charges for rural residents; support to internal migrant workers to secure payment of their wages which had not been paid for some time; assistance for the education of migrant workers; and support to rural families which were implementing the government family planning programmes.

Other measures include increased funding for improved seeds and providing subsidies for the purchase of equipment by farmers. Input subsidies increased every year to offset costs of fuel, fertilizers and seed. Essentially, these subsidies meant to increase the competitiveness of Chinese cereals on local and international markets (Daryll and Schaffer 2013).

Because of these measures, rural incomes stabilized and even grew but not at the same rate as urban incomes and the rural-urban divide began to widen. In a study released by the United States Department of Agriculture (USDA) titled, 'China's 2020 Agricultural Policy Stays the Course', it is indicated that the leadership of the Communist Party of China (CPC) made fundamental decisions which were aimed at strengthening the sector and systems of food security. The party increased programmes to support farmers' incomes while growing the sector. Grain production, for instance, was given a very high priority and guidelines given on the minimum grain planted area and volumes of production per province. In addition, a minimum support price was set for wheat and rice. The Government also committed to purchase a total minimum volume of the produce. It launched pilot programmes on cost-based insurance for rice, wheat and corn production. More guidelines for construction of standard farmland irrigation and water harvesting infrastructure also provided. Moreover, they introduced biosafety certification for soya, corn and other products to minimize the spread of animal and plant diseases.

What distinguishes the CPC from most of the African governing political parties is that once the latter release an election manifesto, it takes another five or so years before another pronouncement of policy by the party in power. This silence in between elections deprives policy implementers of regular monitoring to check and ensure the policy guidelines are adhered and sanctions for non-compliance imposed appropriately. The CPC has a system of passing long and short-term policies and following them up with evaluations and innovations if necessary. It has a *culture of renewal of commitments*.

An example is the Central Committee of the CPC document of January 2, 2020 on 'Increasing Efforts on Major Work Concerning Agriculture, Rural Areas and Rural People to Ensure the Goal of Building a Moderately Prosperous Society in All Respects is Achieved on Time' released by Xinhua News Agency on February 6, 2020. After assessing its earlier policies, the CPC renewed its commitments and stated from the outset that, 'The whole party must be aware of the special importance of the work on agriculture, rural areas and rural people in 2020, with unrelenting efforts to achieve overall victory of the first centennial goal'. It reiterated the key objective as being 'winning the battle against poverty and strengthening weak links in the work on agriculture, rural areas and rural people, maintaining agriculture in stable production and sufficient supply, increasing farmers' incomes and promoting high quality agricultural development'.

This statement of objective is indicative of a holistic approach that combines production, income generation and poverty reduction. The guidelines included:

i. Taking strong measures to ensure harmony in rural areas to ensure successful completion of the battle against poverty and building a modern and prosperous society.

ii. To remove worries about food and clothing and ensure compulsory education and guarantee basic medical care and housing safety.

iii. Undertaking surveys and keeping records at local government level of the number of people lifted out of poverty.

iv. Linking agricultural and industrial production as well as consumption with poverty alleviation.

v. Returning farmlands to forests and grasslands in poor areas.

vi. Tapping and using the knowledge of the poor populations.

vii. Following standards set for accounting for poverty alleviation and using M&E which is based on regular supervision; timely identification of problems; immediate rectification of problems; publication of vivid accounts and identification of magnificent practices and factors behind success stories.

viii. Ensuring poverty reduction policies are stable and keeping poverty reduction institutions active.

On research for poverty alleviation, it was emphasized that research results should be properly utilized in the implementation of policy and research institutions should establish long term mechanisms to promote steady transformation of poverty alleviation strategies and research results should be geared towards revitalization of rural areas and rural people. On infrastructure, it was directed that projects should be speeded up for building a moderately prosperous society in all aspects in accordance with relevant standards. Further directed that reforms of rules and regulations relating to rural roads and traffic be accelerated and the power grid for villages should be upgraded.

The policy statement also covered rural education. It was directed that:

i. Boarding schools should be built in townships, and the quality of education should be improved for rural schools.
ii. Leaders should ensure average salaries of primary and secondary school teachers are not lower or higher than those of other local civil servants.
iii. The appraisal and appointment of teachers' professional titles and qualifications should include rural school teachers.
iv. Promote pre-school development, popularize compulsory education and address issues of drop-outs in rural areas.
v. Improve general national language abilities for rural teachers.
vi. Expand enrolment in vocational schools in rural areas and improve the quality of vocational education.

Guidelines on health and social security emphasized the improvement of rural medical provisions and facilities. Directed that new medical graduates working in poor areas should be compensated for their tuition fees and student loans. In addition, primary disease prevention and control teams should be strengthened. Likewise, directed increase in fiscal subsidies and individual contributions for basic medical insurance and medical assistance services. Other directives include local authorities to establish one stop service, one window handling and one system settlement at prefecture level; to supervise carefully the allowances paid in rural areas; and to establish care centres for children and the elderly and improve nursery services for the elderly and disabled in rural areas.

13.3.4 Revitalizing rural areas

The 2020 guidelines covered seven areas in relation to revitalizing rural areas. The first was about rehabilitation of rural ecological environment. The emphasis was on promoting the use of poultry and livestock manure thereby reducing the use and negative impact of fertilizers and pesticides, promoting the use of mulching (straw). These were aimed at reducing soil erosion and pollution and promoting erosion control and conservation tillage.

The second area relates to the guidelines on the construction of modern agricultural infrastructure, mainly large-scale irrigation projects; water saving schemes and water conservation programmes. The third relates to the development of rural industries. The government was directed to embark on integrated industrial development in rural areas; establish industrial parks at national, provincial and county levels; establish demonstration parks for integrated rural industrial development and the improvement of industrialization of agriculture which should include small farmers in the agricultural value chain through 'order-based agricultural equity dividends, trusteeship services, and other methods.

Rural governance featured again in the guidelines as the fourth area. It was directed that the rural grassroots party organizations should adhere to party regulations on how to work with inter-party committees and masses should be heavily involved in decision making to enhance their sense of ownership of development agendas. Harmony, discipline, order, transparency and accountability were emphasized as critical for good governance at the local level.

Fifth was improved land use. Provincial and county governments were directed to: protect farmlands; classify and clarify types of land use and land supply; strictly implement land classification management; and improve infrastructure related to agricultural cultivation and breeding. Also, improve fresh packing and cold storage; agricultural machinery and warehousing; sorting and treatment of produce; waste treatment and management; and strengthening county-level national land space planning with at least 10% of the land guaranteed for rural industrialization. The sixth area was accelerating land reforms by strengthening the management and supervision of township approvals for homesteads to prevent land occupation getting out of control; reforming cooperatives to increase their ability to serve people and strengthening law enforcement capabilities.

13.3.5. Promoting technological change in rural areas

Pronouncements on transfers of technology appear in many policies on economic transformation in Tanzania and other African countries. However, how to really institutionalize it and secure the desired outcomes, technology transfers require learning from other economies as well as a successful industries and sectors. Evidence from China suggests that technology transfer policies are most effective when tailored to specific sectors. In the agricultural domain, Wang Dong-Yang (2017) highlights several distinctive features of China's approach—such as localized project selection, multi-tiered extension networks, and strong integration between research, training, and policy—which offer valuable lessons for Tanzania's own agricultural transformation. The first element he points out is that, in the national science and technology development strategy, the objectives of transfer of technology must be embedded for each sector. This means there must be a comprehensive national science, technology and innovation strategy in which transfer, or acquisition of technology is embedded with sector specific characteristics.

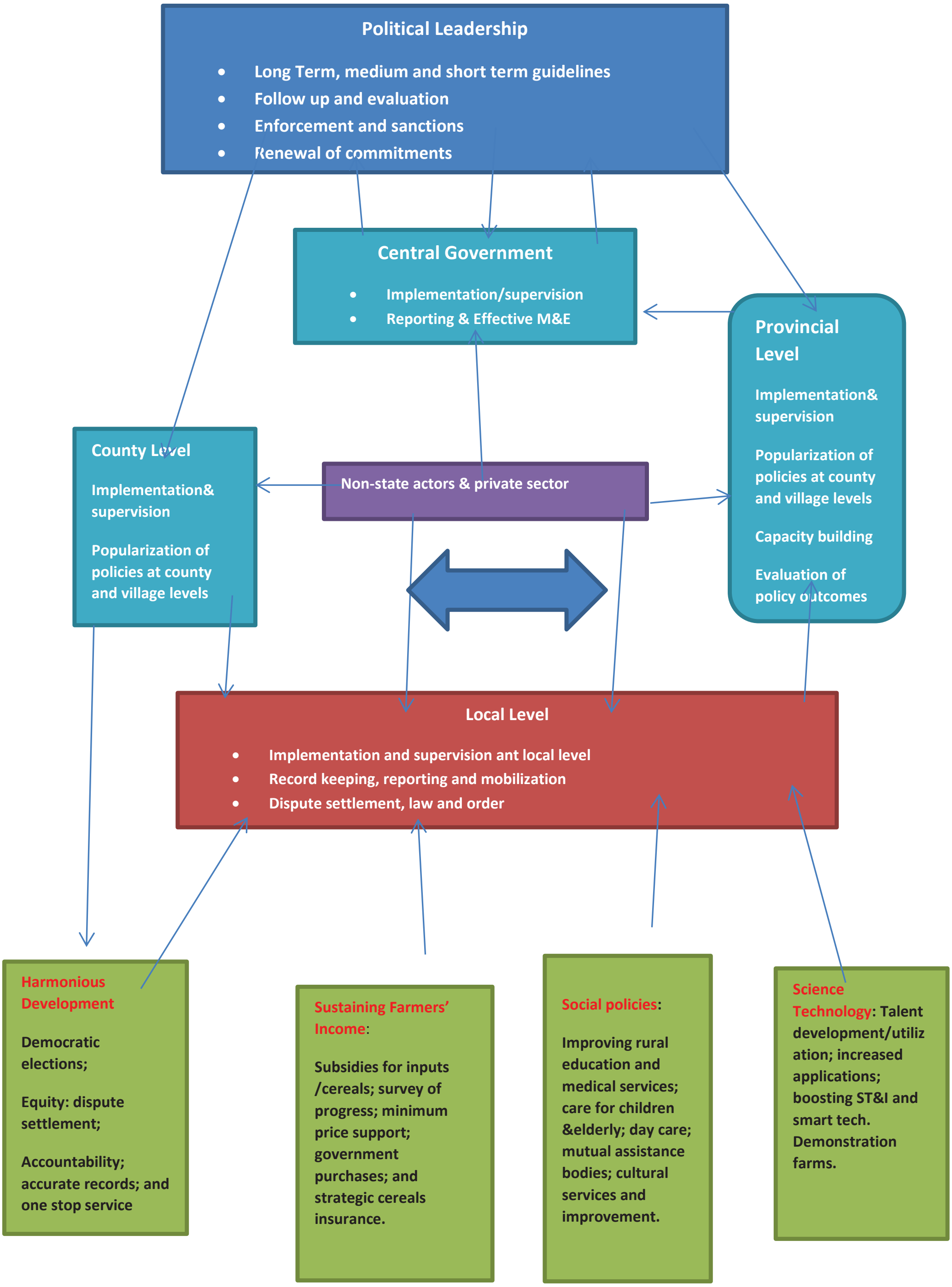
The second element is that the policy should aim at guiding farmers to increase labour productivity, promote the development of a market economy and speed up mechanization and industrialization in the rural areas. The third important element suggested by Dong-Yang is that, the mission of the transfer should be to make good use of rural natural resources and make technology acquired usable and applicable to rural conditions. This helps create a critical mass of rural technicians, management personnel and farmer entrepreneurs in rural areas to promote the existence of well to do farming communities.

Further studies on the way science and technology in China have been organized to support rural transformation and poverty alleviation indicate that after a period of decline in funding for S&T institutions, China embarked on intensive funding of technology popularization centres, retained staff and increased focus on smallholder farmers. It passed a special legislation on Agricultural Technique Extension, introduced a Green Certificate System and established The High Technology Research and Development Programme together with the National Science and Technology Advancements Spreading Programme (Dong-Yang 2017). A lot of research went into seed quality. The Economic Work Conference held in 2020 reiterated the importance of seed development for agricultural transformation and noted that seeds were expected to contribute 60% of the total farming output (Yuxin, 2020). It was noted that as from 1st of November 2021, the Ministry of Agriculture and Rural Affairs was going to introduce new standards for cultivation to raise germination percentage from 85% to 93%. In addition, China has taken germplasm development seriously with a germplasm bank. Most of the efforts undertaken have combined various research approaches. They put emphasis on biotechnology that enabled most cereals and cotton farmers to increase output by up to 30%, and to a very large extent control plant and animal diseases.

13.4 A summary of experiences and possible lessons for Tanzania and other African countries

Most of the challenges that China faced before its current stages of development, also found in many African countries. China has been and still largely a rural agricultural country and 90% of its land is farmland with 80% of the population still living in rural areas. However, it has managed to make big strides in reducing poverty because it has managed to develop an effective policy formulation, implementation, enforcement and evaluation system that ensures delivery of development results.

Figure 13.1: The political and administrative policy structure for rural policy in China



***Source*:** Authors' construct

Figure 13.1 above summarizes the basic policies discussed in this section in four blocks at the bottom of the diagram. The integrated and holistic nature of the policy structure testifies to the seriousness attached by the Chinese government to poverty eradication in rural areas. It placed multipronged strategy, which combined political, economic, social, technological and environmental approaches at the core in confronting the challenge of rural poverty. These were a gist of China's successes in poverty reduction in the early days of the reforms. Most researchers (Yaohong et.al, 2025; Guo and Li, 2024, Marchisia 2024; Yansui et.al 2020) attribute the success to some of the factors outlined below:

- Village and township industries helped to absorb a good number of unemployed people and between 1978 and 2001 there was an increase of 26.7% of rural labour being absorbed into these enterprises. (*In our view the lesson for Tanzania is that rural industrialization will help to absorb surplus labour*).
- Easy labour mobility to urban areas especially recruitment of new graduates from rural colleges helped to increase employment opportunities as between 1982 and 2000 about 206,750,000 people moved from rural to urban areas and this represented 45% of the total urban population. This was a conscious effort involving registration of job seekers at village, county and provincial levels and placing them with demand sectors.

Lessons for Africa are two-fold. The first is that migration to urban areas is not a problem in itself, if is organized for gainful employment purposes. The second is that labour market information systems become effective and results oriented when they engage in conscious concerted efforts to tackle unemployment from the supply and demand sectors and facilitate mobility of labour from the surplus labour enclaves.

- Rural poverty reduction is effective only if the wage income for farmers go up substantially. In China the proportion of farmers' incomes as part of wage incomes went up from 13.2% in 1985 to 30.4% in 2000 and according to these authors, the peasants enjoyed benefits of urbanization and non-agricultural industries.

(*The lesson for Tanzania is that what matters is the net income of the farmers and the higher that income is, the less tempted they are to move out of rural areas*).

- Export oriented labour-intensive production increased wages and employment as export of labour-intensive products increased 32 times between 1985 and 2001 and expert processing zones in cities such as Guandon and Zheijiang became magnates of labour taking close to 39% of total labour force in the country during that period.
- Minimum purchase prices for strategic agricultural products encouraged farmers to produce more and protect domestic industries because if the prices are not good farmers sell to parallel markets.
- Direct payments to farmers to offset production cost for strategic crops, helped governments to ensure the provided support used by those targeted and reduce farmers' production costs.
- Farm subsidies covered a wide range of inputs such as fuel, fertilizers, electricity and seeds. They work best when targeting the specific needs of farmers' groups instead of blanket cover of groups. (*This is important because the electricity subsidies managed through the Rural Electricity Authority (REA) in Tanzania enable rural people to access cheap electricity but most of it goes into social activities rather than agricultural processing, small enterprises and other forms of production)*
- Chinese banking reforms have made provision for extending support to financing of insolvent banks and credit unions that provide support to rural farmers and entrepreneurs. In addition, microfinance institutions have been allowed flexibility in setting interest rates under close supervision. These measures help to increase access to credit by rural entrepreneurs and farmers, lower costs of production and increase farmers' incomes.
- Transfer of technology to farmers involves promoting the diffusion of new technologies by farmers through extension services and farmers' education. In many parts of China, this involves working with farmers to upgrade their crops for example by replacing old ones with new plants, grafting, or improving agronomic care. (*It is*

not easy in China to find a community located near a research institution with which it has no institutional link at all as is the case in some regions where universities and research institutions are located in Tanzania).

- National Master Land Use Plans work well if they are strictly enforced and supported by regulations, which are publicized and popularized from the top to the village level. They become useful to rural development if they set aside land for farming and non-farming activities and are not violated with impunity by local governments or village committees.
- Agricultural infrastructure needs to be planned in a holistic manner covering road, telecommunications, energy and power systems, storage, warehousing and irrigation on the one hand and systems that impact on these structures and have direct impact on agriculture such as education, technical education, medical infrastructure, information networks and financial systems on the other.
- The Chinese FDI Regulations encourage investments that enhance productive capacity and prohibits the involvement of foreign companies in the production of genetically modified plants and animals. It emphasizes the use of FDI to increase technology in rural areas especially high-quality storage, transportation, and food safety infrastructure and since 2007 FDI involving new investment in the development of breeding and production of varieties of crops and seeds must be through joint ventures under the control of Chinese partners.

13.5 Conclusion and Recommendations

Tanzania is in the same situation as China was in 1984 in terms of economic growth and poverty levels. Relative to other African countries, China has recorded high levels of growth, partly due to a series of reforms since the 1980s, and partly owing to its economic diversification. It embarked on an ambitious new industrialization drive in which the transformation of agriculture, SMEs and industry in general have been crucial. All these changes and plans are taking place in the backdrop of increasing unequal distribution of wealth and threatening decline in peace and harmony. It needs therefore to re-invent itself and learn from countries that had similar challenges but have recorded phenomenal success in moving a large number of people out of poverty and maintaining peace and harmony in a relatively short time. This study has concluded that while Tanzania has very good policies seeking to reduce poverty, they are constrained by several factors.

First, many policies suffer from poor coordination and a short-term focus, often being abandoned just as implementation begins to gain traction. Second, while these policies often reflect a pro-poor orientation, they lack the intensity and strategic coherence of China’s anti-poverty agenda, which frames poverty reduction as a 'war on poverty.' Third, the strong political oversight that characterized earlier phases of governance—where the ruling party actively monitored implementation, evaluated outcomes, and enforced accountability—has diminished over time. This erosion of political discipline contributes to a fourth challenge: weak enforcement. Most policies either poorly implemented or only partially executed with limited evaluation and minimal use of results to inform policy adjustments.

The fifth observation is that agriculture gets very little support and perhaps the experiences of China could help to improve the situation. Sixth, SME support does not seem strategically planned to support their growth. The policy frameworks could benefit from the Chinese experience. Finally, the Tanzania approach to promoting science, technology and innovation is limited to the industrial clusters, which cover only a few municipalities and a few enterprises. Such an approach is not adequate for the transformation of SMES, which are supposed to be the main partners of large-scale enterprises in the industrialization drive. In the light of these observations, it is recommended for the government to take stock of and draw the following lessons from the Chinese policies and practices, with the view to distilling those which can be used to enhance the achievement of the goal of rapid rural transformation under Vision 2050 and beyond. Four specific recommendations are outlined below:

i. ***Political party leadership*:** In Africa political parties are very active in popularizing their policies during elections. However, between elections very few make robust efforts to make pronouncements on implementation or to use evaluation to make policy adjustments or new pronouncements. In Tanzania, the practice was more advanced during the first phase government but since the political reforms of the 1990s and the reinstatement of multi-party politics, such pronouncements have not been as regular as during the first phase. As was discussed earlier, the Communist Party of China has taken a prominent lead on policy and has kept reviewing and modifying policy as implementation proceeds. This is a useful policy practice. There are lessons to be learnt from this practice.

ii. ***Anti-poverty policies*:** Some people say that 'In some countries, poverty is sweet because the poor can easily accept dictates from the leadership' and some go further to say that African leaders concentrate on managing rather than fighting poverty. The Chinese approach shows a determination to fight poverty. The policy documents talk about 'winning the war against poverty'. The anti-poverty measures such as minimum purchase prices for strategic crops; annual increase in subsidies on farm inputs; total abolition of nuisance taxes on agricultural products and the numerous far-reaching policies on technology transfer and extension services indicate an *anti-poverty stance* as opposed to simply *pro-poor policies* (Focus on China 2019). A shift form managing poverty to a war on poverty can deliver more tangible, equitable and sustainable results.

iii. ***Incentives for graduates and professionals to work in rural areas*:** It is easy to look at incentives only at workplaces and for encouraging production or increasing productivity on farms and in firms. However, very few African countries consider providing public employees with incentives to work and live in rural areas. Chinese policies ensured the wages of rural workers kept at par or higher than what other public servants earn. In addition, there were incentives given to graduates working in rural areas in terms of compensation for their tuition fees and student loans, etc. Such incentives make a difference. In Africa with a lot of unutilized land, many local authorities could consider implementing similar strategies by allocating pieces of land to primary and secondary school teachers, university, medical and extension services staff working in their localities. This is because some of these workers never transferred or leave rural areas unless they get other jobs and conditional leases could be an incentive not to leave in search of new or other jobs. The categories of possible incentives are so many. This could be the right time to experiment and learn.

iv. ***Shifting from the notion of transfer to that of acquisition of technology:*** No country has developed by technology transferred to it willingly by its friends or partners. Most transfer technology that either have become obsolete in their own systems or makes the recipient economies dependent on suppliers for inputs, maintenance, or troubleshooting. Farms and firms become technologically empowered when they acquire technology from outside and develop local capacity for its adoption, adaptation, assimilation, diffusion, and ultimate innovation. This happens when learning systems at local level strengthened, as was the case in China.

The second path is to acquire technology from outside and establish partnerships for its gradual transfer while limiting the involvement of foreign firms in critical areas such as seeds and other germplasms as we saw in the case of China.

The third channel, through which technology is acquired, is through local research bodies being equipped to develop technology and to transfer it to local farms or firms independently. As discussed in the chapter on transfer of knowledge from researchers and research institutions to farmers (chapter 5), Tanzania has a lot more work to do to achieve this transformational path towards high agricultural productivity and accelerated rural poverty reduction.

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Chapter 14 Conclusions and Recommendations

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14.1 Introduction

This book has examined the key factors that both enable and constrain the Government of Tanzania's efforts to raise agricultural production and productivity across Mainland Tanzania. Drawing on diverse contributions, the chapter brings together the central findings and strategic recommendations using the PESTEL framework—Political, Economic, Social, Technological, Environmental, and Legal—to distill the major drivers shaping sector performance.

A central conclusion emerging from the analysis is that, although the Government of Tanzania has demonstrated sustained commitment to land reforms and has significantly increased investments in the agricultural sector over the past three decades, these efforts remain insufficient to deliver the scale of productivity gains required. Substantial and better-targeted investments—particularly in agricultural inputs, irrigation and rural infrastructure, extension services, and agricultural research—are urgently needed to unlock the sector's full potential and ensure long-term, sustainable growth.

What follows is a synthesis of the main findings, conclusions, and actionable recommendations across the six PESTEL dimensions that collectively influence the performance, competitiveness, and future trajectory of Tanzania's agricultural sector.

14.2 The Political Ecosystem for Innovation

Chapter 1 concluded that land reforms have been at the centre of agricultural policies since 1961 in Tanzania, but land tenure has not undergone substantial change as ownership has remained limited to short-term leases and most of the land has remained under customary tenure offering land ownership without property rights. The impact of this on decisions by smallholder and large-scale farmers to invest for a long time remains clear. However, **Chapter 2** concluded that economic reforms and liberalization which began in the 1990s have had had mixed impacts on smallholder farmers. ASDP I created conducive environment for agricultural productivity, but both ASDP I and II have been severely constrained by funding limitations and low prioritization of agriculture at the local level. It was noted that in the implementation of policies in general and in projects in particular coordination and information sharing are yet to reach the desired optimal levels.

14.2.1 Recommendations for strengthening the political ecosystem

To strengthen the political ecosystem for agricultural transformation in Tanzania**,** the analysis underscores the urgent need for synergistic, well-funded, and effectively implemented policies and strategies to unlock Tanzania's agricultural potential, enhance food security, and improve household incomes. To improve the political ecosystem that supports these goals, the following actions are recommended:

i. **Enhance Multi-Stakeholder Collaboration**
Strengthen coordination among key actors—including ministries, farmer organizations, NGOs, the private sector, and local government authorities—to ensure coherent policy implementation and resource alignment.

ii. **Promote Political Inclusion in Agricultural Innovation**
Encourage local government authorities to work closely with agricultural research institutions to promote the adoption of improved technologies such as high-yield seeds and inorganic fertilizers.

iii. **Build Local Institutional Capacity**
Prioritize capacity building for ward and village development committees to enable them to effectively plan, implement, and monitor local agricultural development initiatives.

iv. **Expand Access to Affordable Finance**
Improve access to affordable financial services for smallholder

farmers and create an enabling environment for the adoption of advanced agricultural technologies.

v. **Reform Budgeting and Disbursement Procedures**
Review and streamline budget allocation and disbursement processes to ensure timely and adequate funding for agricultural programs, thereby enhancing their effectiveness and impact.

14.3 Economic factors (Innovation to bridge the gap between production and productivity in Agriculture)

Several chapters in this volume reveal a critical insight: increased agricultural output in Tanzania has largely resulted from land expansion rather than productivity gains. This trend underscores systemic challenges, including low investment levels, input constraints, and persistent budgetary shortfalls, all of which hinder the sector's growth.

The limited adoption of key inputs—such as improved seeds and inorganic fertilizers—is driven by high costs, limited availability, low awareness, and regulatory barriers. Moreover, smallholder farmers face restricted access to affordable finance, limiting their ability to invest in productivity-enhancing technologies and practices. Despite agriculture's central role in the economy, budget allocations have consistently fallen short of the Maputo Declaration targets, and disbursement inefficiencies further weaken impact.

Sector-Specific Insights

Chapter 3 emphasizes that focusing solely on primary production is insufficient. It highlights agro-processing as a critical engine for productivity, especially in the cotton, coffee, and tea sub-sectors. Key recommendations include improving quality, addressing market inefficiencies, empowering women, and enhancing infrastructure and the regulatory environment to restore Tanzania's global competitiveness.

Similarly, Chapter 8 explores the macroeconomic implications of public agricultural investment. It projects that sustained investment in the sector could exceed the 6% growth target and reach over 8% by 2030. However, it cautions against overreliance on borrowing and indirect taxation, which could negatively affect households and the broader economy.

14.3.1 Recommendations for Maximizing Agricultural Investment Impact

i. **Ensure Timely Access to Inputs and Equipment**
Guarantee the availability and affordability of essential inputs and equipment across all farming seasons.

ii. **Promote Knowledge Dissemination and Gender Equity**
Expand access to training on efficient farming and processing techniques, while empowering women to fully participate in and benefit from agricultural value chains.

iii. **Facilitate Strategic Dialogue and Collaboration**
Foster open, coordinated engagement among stakeholders to improve financial outcomes and sector-wide performance.

iv. **Establish a Coordinated Information Framework**
Develop a national platform for stakeholders to share data, align strategies, and monitor progress toward agricultural development goals.

v. **Address Constraints in the Textile and Garment Sector**
Eliminate barriers such as high input costs and complex tax regimes that stifle growth in these value chains.

vi. **Enhance Coffee Production through Innovation**
Support farmer-led innovation and peer learning on sustainable practices, including water management, soil conservation, and organic farming.

vii. **Boost Tanzania's Export Visibility**
Strengthen the global profile of Tanzanian agricultural products to position the country as a competitive exporter.

viii. **Support Tea Sector Productivity and Market Access**
Increase support for smallholder tea farmers and incentivize private investment to expand processing capacity and improve market access.

14.4 Social Dimensions of Innovation in Agriculture

Social factors significantly influence the uptake of new knowledge and technologies in Tanzania's agricultural sector. As highlighted in Chapter 4, Farmer Field Schools (FFS) serve as the primary mechanism for technology transfer. However, they often fail to reach poor smallholder farmers due to non-technical barriers such as insecure land tenure, restrictive land use practices, limited access to credit, and unaffordable agricultural inputs.

A key tension exists between state-led and farmer-driven technology transfer systems. State actors typically employ top-down approaches, while smallholder farmers prefer participatory, peer-based learning methods. These informal mechanisms, regardless of being effective for farmers, often viewed by state experts as inefficient.

Another area of divergence is the treatment of indigenous knowledge (IK). While farmers regard IK as essential in addressing climate change and agronomic challenges, many state-based experts dismiss it as inferior to formal scientific knowledge.

14.4.1 Recommendations for harnessing Indigenous Knowledge (IK)

To fully leverage the value of IK in agricultural development, the following actions are recommended:

i. **Recognize and Respect Diverse Knowledge Systems**
Acknowledge the legitimacy of indigenous and local knowledge alongside formal scientific approaches.

ii. **Upgrade and Integrate IK in Technology Transfer**
Involve local experts and communities in adapting and disseminating technologies that blend IK with modern practices.

iii. **Incorporate IK into Education Curricula**
Embed indigenous knowledge in school curricula at all levels to foster respect, continuity, and innovation.

iv. **Document and Preserve IK**
Systematically record indigenous agricultural practices to ensure

accessibility, protect against intellectual property theft, and preserve them for future generations.

v. **Build Sector-Wide Capacity on IK**
Train stakeholders—including extension officers, researchers, and farmers—to understand, value, and disseminate IK effectively.

vi. **Facilitate Hybrid Knowledge Systems**
Promote the integration of IK and scientific knowledge to enhance community resilience and adaptive capacity, particularly in the face of climate change.

14.5 Technical factors

Across the three chapters that focused on knowledge transfer and the use of indigenous knowledge (IK), a recurring theme is that related to disconnect between formal research systems and local farming realities. Indigenous knowledge remains undocumented and underutilized. This is particularly so in the implementation of local development projects such as irrigation schemes, which often side-line local experts.

While research institutions such as TARI, LITA, TAFIRI, and the Veterinary Services Department possess the capacity to support knowledge transfer, they face persistent challenges. These include inadequate funding, poor infrastructure, limited human resources, and disconnection between research outputs and practical application on the ground.

14.5.1 Recommendations for addressing technical challenges

To address the technical challenges and bridge the gap between state-led and farmer-driven knowledge systems, the following actions are recommended:

i. **Adopt Participatory Approaches**
Promote inclusive, participatory methods that reflect farmers' real needs, build on existing knowledge systems, and respect cultural contexts.

ii. **Scale up Government Support**
Increase public investment in agriculture, livestock, and fisheries—particularly in research, outreach, and technology transfer—to drive sector transformation.

iii. **Invest in Research Infrastructure**
Strengthen infrastructure for research and extension services, including irrigation systems, laboratories, and rural outreach facilities, to support the adoption of new technologies.

iv. **Enhance Capacity across the Sector**
Build the skills of extension officers, researchers, and farmers to ensure the effective dissemination and adoption of appropriate, adaptable technologies.

v. **Promote Local Input Production**
Invest in the domestic production of key agricultural inputs—such as fertilizers, vaccines, and improved seeds—to reduce import dependency and improve affordability.

vi. **Intensify Public–Private Partnerships (PPPs)**
Expand PPPs in the research sector to mobilize resources, improve infrastructure, and enhance the capacity of institutions beyond what government alone can provide.

14.6 Environmental factors

Chapter 6 on integrating farmer focused innovations through the experiences of SAGCOT provides evidence that creating an environment in which efforts are made to attract private investments, promote public-private partnerships, resource pooling and rural transport connectivity have played a catalytic role in promoting growth within SAGCOT. Its holistic approach involving soil testing, sustainable soil management practices, reliable supply of inputs as well as promotion of agroforestry, conservation farming, and integrated pest management have enabled it to become an incubator for a nationwide growth model under AGCOT.

14.6.1 Recommendations for adapting to shifts in the institutional environmen

To enable AGCOT to build on the solid foundations and traditions of AGCOT, it is recommended to:

i. **Institutionalize best practices** of AGCOT in creating an environment which can innovate capabilities, enhance synergies between actors at local and national levels in order to increase agricultural production, productivity, and competitiveness across the agriculture sector.
ii. **Ensure strategic preparedness** especially in areas of governance, finances, infrastructure, programme planning, monitoring, evaluation, and networking before launching state initiatives.
iii. **Adopt transformative approaches** such as attracting and retaining private investment, leveraging public-private partnerships, and positioning agriculture as a modern, competitive, and sustainable sector.

Put more on emphasis on value chain revitalization and innovation: establishing commodity-specific associations and promoting farmer-to-farmer knowledge-sharing platforms.

14.7 Regulatory and Financial factors

Chapters 8, 9, and 11 underscore the critical role of agricultural credit in enhancing long-term productivity. Increased access to credit enables farmers to invest in modern technologies and inputs, leading to higher yields and improved efficiency. However, the studies also reveal that government investments in infrastructure, technology, and research have a more substantial and sustainable impact on productivity than direct financial support from banks.

Challenges persist in the lending environment. High interest rates and inflation raise input costs, create uncertainty, and constrain sectoral growth. Chapter 10 provides an in-depth analysis of the Warehouse Receipt System (WRS), highlighting its benefits in improving access to credit, stabilizing markets, and enhancing market access—particularly for smallholder farmers. The WRS has also helped mitigate some formal and informal regulatory barriers, including those rooted in gender-based cultural norms.

14.7.1 Recommendations for strengthening regulatory and financial frameworks

To build on the gains achieved through mechanisms like the WRS and improve the regulatory environment, the following actions are recommended:

i. **Balance Agricultural Credit and Productivity**
Recognize the reciprocal relationship between credit and productivity, in which credit boosts productivity, and higher productivity enhances creditworthiness.

ii. **Mitigate Misuse of Agricultural Credit**
Establish safeguards and monitoring systems to ensure that agricultural loans are used for productive purposes, reducing misuse, and improving repayment rates.

iii. **Strengthen the Role of the Banking Sector**
Reform and empower the banking sector to expand access to credit for farmers, including the development of effective rural loan markets tailored to agricultural needs.

iv. **Invest in Infrastructure, Technology, and R&D**
Prioritize public investment in infrastructure, technological innovation, and agricultural research to create an enabling environment for sustainable growth.

v. **Develop Tailored Agricultural Lending Products**
Introduce loan products with lower interest rates and flexible repayment terms to ease the financial burden on farmers and encourage adoption of improved practices.

14.8 Cross-cutting issues

The last chapter (**Chapter 13**) on learning from China's experience with poverty reduction examines China's rural transformation strategies, including establishing industrial clusters, promoting Township and Village Enterprises (TVEs), linking human development with income generation, and combining market and non-market mechanisms. The chapter emphasizes the importance of state involvement in stimulating growth and regulating production. It evaluates Tanzania's existing policies for rural transformation and poverty reduction, including the Agricultural Sector Development Strategy (ASDS) and the Poverty Reduction Strategy Paper (PRSP). It acknowledges Tanzania's participation in African Union initiatives aimed at agriculture development and food security.

However, it also identifies challenges such as limited fertilizer use, dependence on rain-fed agriculture, and state-driven irrigation systems that may not align with farmers' needs. The lessons to learn from the Chinese experience indicate that with clear, consistent and coordinated policies, Tanzania can achieve substantial poverty eradication by 2030. To do this requires an integrated and holistic policies, strong leadership commitment, anti-poverty measures, monetary and non-monetary incentives for professionals working in rural areas and shifting the focus from technology transfer to technology acquisition through applied research.

14.8.1 Recommendations to facilitate experiential learning

In the light of these findings, it is recommended to:

i. **Continue learning from other countries** which have conquered poverty over a short period such as China and strive improve upon their strategies in order to develop a national approach suitable o the conditions in Tanzania.
ii. **Adopt holistic approaches** linking human development in the areas of health, education and the environment with income generation in both rural and urban areas.
iii. **Scale up state involvement and strategic preparedness** in rural planning, development and innovation to ensure successful technology transfer.

iv. **Increase mechanisms for coordination and evaluation** of implementation to ensure achievement of desired agricultural development policy China's emphasis on social harmony, equity, and political stability is essential for sustainable development.

v. **Strengthen links between poverty reduction effort and effective governance** and genuine democratic decision making at the local level to ensure growth leaves nobody behind.

vi. **Develop income and non-income incentives** for public servants working in rural areas to make them stay there serving with commitment.

vii. **Use rural industrialization, private enterprise support, and labour mobility** as important strategies for accelerating rural transformation for poverty reduction.

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