IGC

POLICY FRAMING PAPER

What constrains agricultural productivity in Zambia?

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JANUARY 2024

DIRECTED BY

LSE UNIVERSITY OF OXFORD

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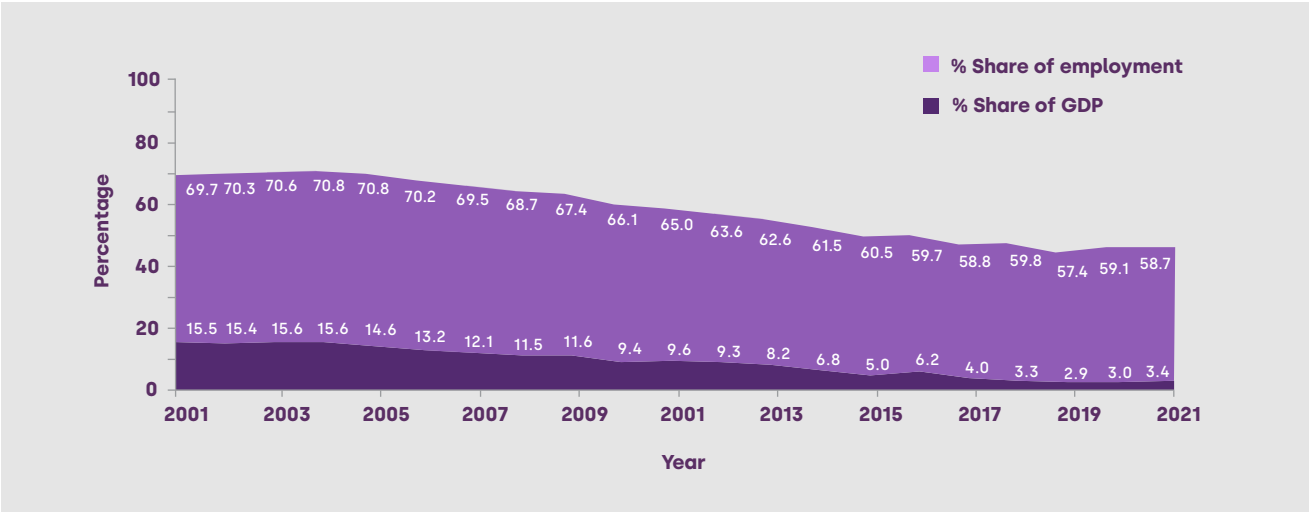
Summary and policy recommendations

The agricultural sector is a fundamental cornerstone of the Zambian economic and social structure. The sector's influence extends wide, with some estimates indicating that agriculture **plays a role in the livelihood of 8 out of 10 Zambians**, either directly or indirectly.[1,2]

However, the sector's productivity currently falls short of its potential. **Figure 1** underscores this disparity: **the sector engages 59% of the workforce yet contributes merely 3.4% to the national GDP**[3,4]. This means that many Zambians are working towards relatively little output. This underperformance becomes especially apparent in maize yields: Zambia has unrealised potential yields of up to **10 metric tonnes per hectare**, marking it one of the highest yield gaps in the region.[5]

Figure 1: Agricultural contribution to GDP and employment in Zambia between 2001 and 2021



Data source: World Bank. (2022). Agriculture, forestry, and fishing, value added (% of GDP) – Zambia & Employment in agriculture (% of total employment) (modelled ILO estimate) – Zambia. **https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=ZM & https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ZM**

Given the wide-reaching socio-economic impact of the sector, **improving its productivity represents an opportunity for sustainable economic growth, poverty reduction, and overall betterment of societal well-being in Zambia.** However, numerous challenges stand in the way of realising this.

1 Chikowo. Description of cropping systems, climate, and soils in Zambia. Global Yield Gap Atlas. **https://www.yieldgap.org/zambia**

2 Ministry of Agriculture and Livestock. (2013). Zambia National Agriculture Investment Plan (NAIP) 2014-2018. **https://www.fao.org/faolex/results/details/en/c/LEX-FAOC169508/#:~:text=The%20National%20Agriculture%20Investment%20Plan,security%20and%20disaster%20risk%20management.**

3 World Bank. (2022). Agriculture, forestry, and fishing, value added (% of GDP) – Zambia. **https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=ZM**

4 World Bank. (2022). Employment in agriculture (% of total employment) (modelled ILO estimate). **https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ZM**

5 Global Yield Gap and Water Productivity Atlas. (2019). **https://www.yieldgap.org/gygaviewer/index.html**

This paper aims to shed light on these challenges, drawing from the academic and practitioner literature and relying on insights from stakeholders within the sector. After providing an overview of the sector and its current state, the paper continuous by exploring the government policies that aim to support agricultural producers. The paper also presents key statistics that underline the productivity issues at hand. Finally, the paper discusses the primary constraints hindering Zambia's agricultural productivity. In doing so, it provides a comprehensive understanding of challenges related to:

1. Resilience to climate change,
2. Improving access to agricultural finance,
3. Market access, and
4. Adoption of agricultural technologies

By presenting evidence on these issues, the paper contributes towards the broader discussion on the future of agriculture in Zambia and the pathways towards sustainable growth in the sector. The table on the next page presents a set of policy options for the Zambian Government's consideration, as informed by subsequent sections of this policy framing paper.

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Table 1: Summary of policy options by theme

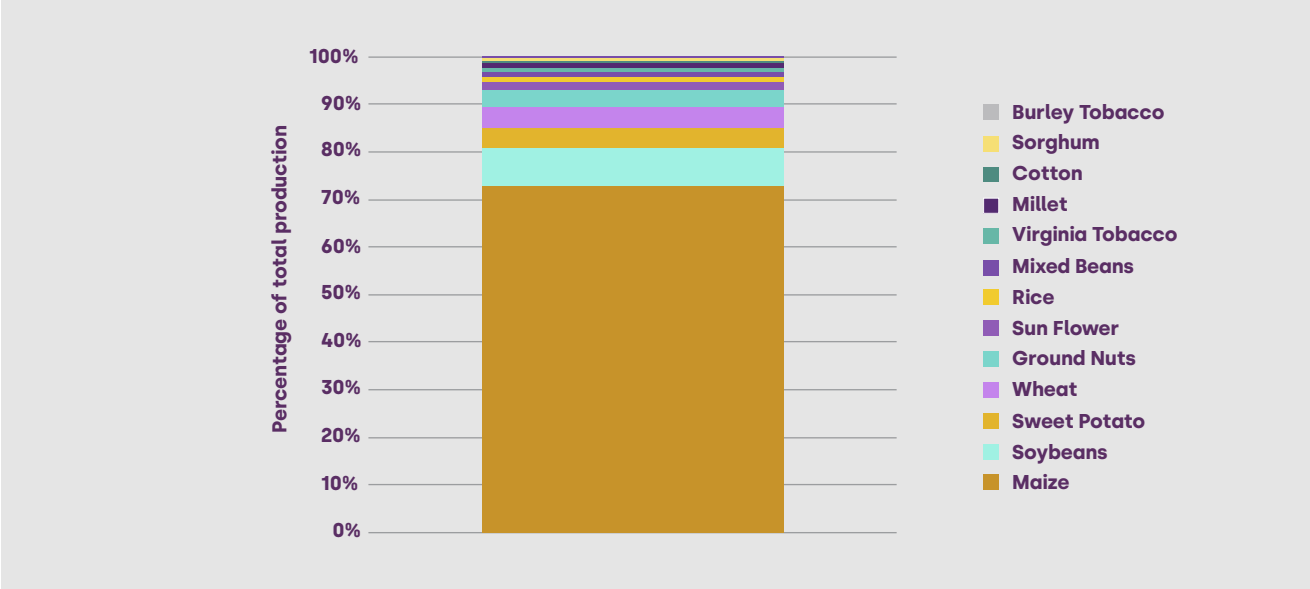
Theme	Policy options
Zambia's existing agricultural policies	**Data-driven evaluation of agricultural programs:** Collaborate with researchers to understand and optimise the impact of programs like FISP and CATSP.
	Enhanced targeting of agricultural inputs: Improve the targeting of agricultural inputs under input subsidy programmes, prioritising farmers most in need.
	Ensure a strategy for farmers' graduation from input support programs: Develop and transparently communicate distinct pathways for transitioning away from input assistance.
	Clear strategic reserves benchmarks for the FRA: Establish a purchasing benchmark based on Zambia's consumption and production trends to avoid over-purchasing and minimise market interventions.
	Private sector participation in agricultural programs: Foster partnerships with private entities for improved efficiency and innovative solutions in agricultural programs.
	Boost R&D expenditure: Allocate more public investment towards agricultural research and development to promote innovation and understand effective policies for Zambia's unique context.
Building resilience to climate change	**Promote climate-smart agriculture:** Incentivise adopting of sustainable, resilient farming techniques to boost productivity and farmer incomes.
	Upgrade extension services: Increase recruitment and training of extension officers and improve communication methods.
	Enhance climate information services: Provide detailed weather forecasts to empower farmers in making informed planting decisions.
Improving access to agricultural finance	**Agricultural loan programs:** Consider establishing credit programs for smallholder farmers and SMEs with subsidised interest rates and extended repayment periods.
	Incentives to lending: Consider boosting private sector loans to agricultural producers by introducing incentives to banks such as credit guarantee schemes, first-loss coverages, and origination incentives.
	Promote weather-indexed insurance: Mitigate climate risks and stimulate investments by making efficient weather-indexed insurance products available and trusted.
	Financial literacy programs: Improve financial management skills among agricultural enterprises to increase their attractiveness to lenders.
Market access	**Infrastructure-productivity research:** Collaborate with researchers to guide infrastructure investments benefiting small-holder farmers.
	FRA role evaluation: Assess and optimise the Food Reserve Agency's effectiveness in facilitating market access for smallholder farmers.
	Policy stability: Maintain a predictable policy environment to encourage agricultural investment and consider implications of sudden policy changes.
Adoption of agricultural technologies	**Subsidies for adoption and continuation:** Encourage consistent use of new technologies by combining adoption subsidies with continuation rewards.
	Enhance agricultural mechanisation: Implement strategies to improve access and adoption of farming technologies to boost productivity among smallholder farmers.
	Support development of irrigation systems: Promote shift to water-efficient irrigation systems through subsidies, education, and improved access to credit.
	Mitigate post-harvest losses: Strengthen partnerships with development organisations to reduce post-harvest losses through innovative storage equipment and handling techniques.
	Digital extension services: Facilitate adoption of digital agricultural extension services by ensuring user-friendliness, accessibility, unbiased information, and effective promotion, possibly through partnerships with specialised entities.

Note: The context for these policy options and further elaboration of each of them will follow throughout the document.

Overview of Zambia's agricultural sector

Agricultural production in Zambia consists of a range of activities, including crop production, livestock rearing, and fishery. **Maize constitutes over 70% of the total output (Mt) among all primary crops** for which the Zambian government provides production statistics, as shown in **Figure 2**. In addition to maize, Zambia produces sorghum, millet, and cassava, which predominantly cater to domestic consumption. Conversely, crops such as sugar, soybeans, coffee, rice, cotton, and horticultural produce are primarily cultivated for export markets[6]. **This heavy reliance on a single crop introduces a risk to the sector**. It heightens susceptibility to climate change impacts, pest and disease outbreaks, market price fluctuations, and can contribute to soil degradation and nutritional deficiencies.

Figure 2: Relative contribution of crops towards entire expected crop production (in Mt) - 2019

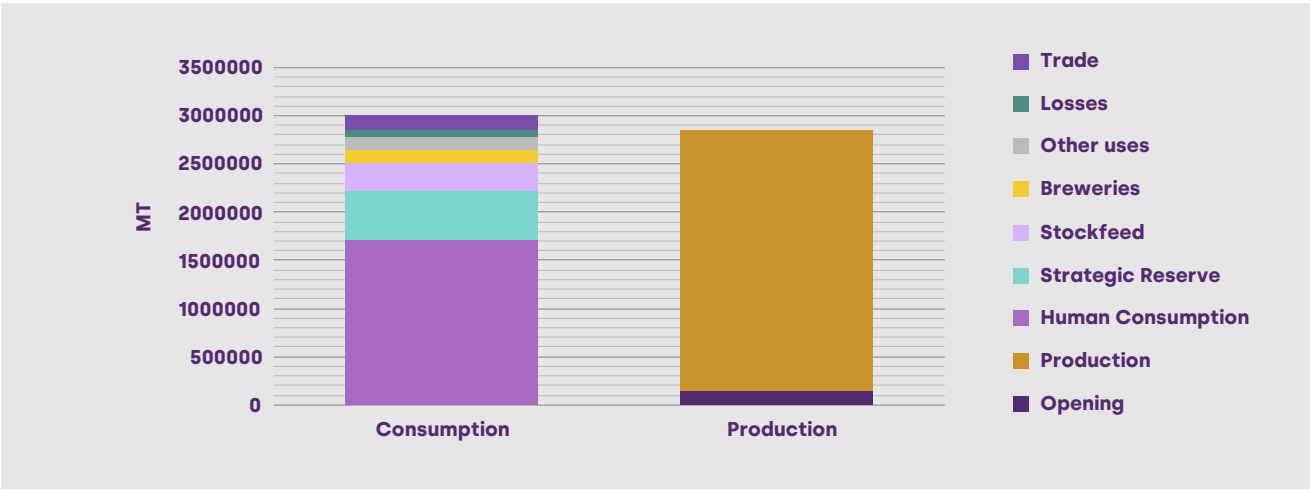


Notes: The underlying data includes expected agricultural production statistics for 13 crops for which ZamStats provides production data. Data source: ZamStats. (2020). Agriculture Statistics, 2020. **https://zambia.opendataforafrica.org/etqmqgf/agriculture-statistics-2020**

Examining **Figure 3** reveals that, in 2022/23, **the predominant use for maize was by far for human consumption**, followed by allocation for strategic reserve stocks and animal feed. The data indicates that 2.7% of the maize produced was lost in the process, while 5% was exported to international markets. On the supply side, 95% of the available maize was derived from the year's total production, with the remaining 5% sourced from the opening stock from the preceding year.

6 International Trade Administration. (2022). Zambia – Country Commercial Guide. **https://www.trade.gov/country-commercial-guides/zambia-agriculture**

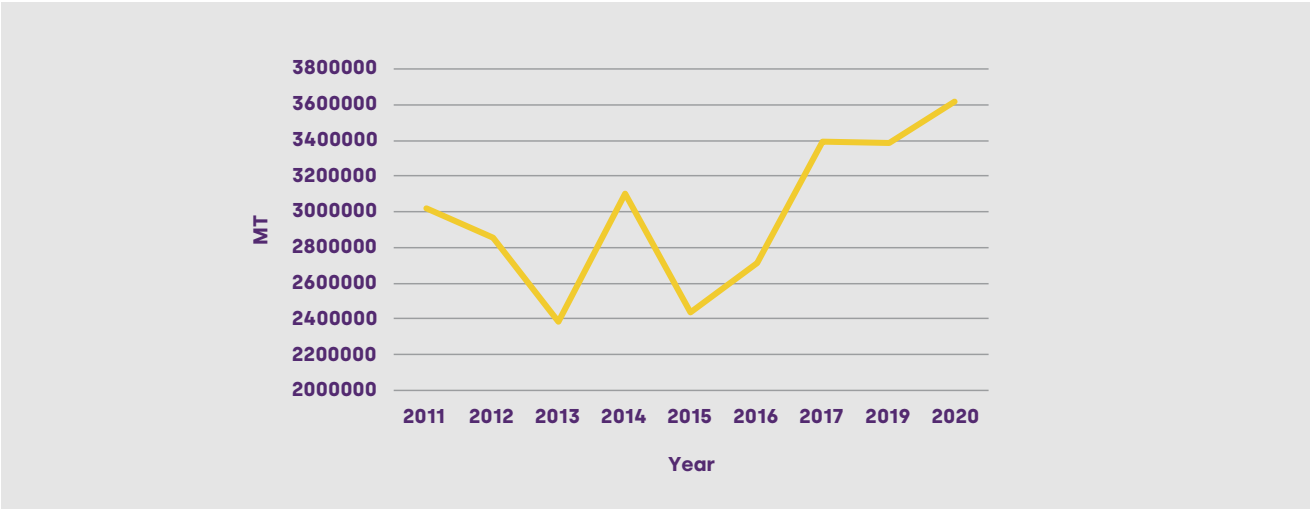
Figure 3: Composition of maize production and consumption (in MT) - 2022/23



Data source: ZamStats. (2023). Crop Forecast Survey

It is important to acknowledge that **maize production can exhibit substantial fluctuations, contingent upon the prevailing climatic conditions of each growing season.** As illustrated in **Figure 4**, production has experienced significant variability, varying from 2.4 million MT in 2013 to 3.6 million MT in 2020. While maize supply exhibits such variability, demand tends to remain considerably more stable. **This disparity triggers concerns regarding production shocks and, consequently, food security.**

Figure 4: Annual maize production (in MT) between 2011 and 2020



Data source: ZamStats. (2020). Agriculture Statistics, 2020. **https://zambia.opendataforafrica.org/etqmqgf/agriculture-statistics-2020**

Agricultural production in Zambia is spread throughout the country, with different crops growing in different regions. The heterogeneity in agricultural production can be explained by the fact that **Zambia is comprised of three distinct agroecological zones**, each with its unique climatic characteristics. Looking at **Figure 5**, we can see that these zones pass through the country from west to east at a slight angle. Zone 2 stands out as the most fertile zone, hosting the majority of Zambia's commercial farming. It includes significant portions of the Eastern, Central, Southern, and Lusaka Provinces. Zone 1 poses

challenges to agricultural production due to its periodic droughts and occasional acidic soil conditions. It includes parts of the Eastern, Western, and Southern Provinces. Lastly, Zone 3 experiences abundant rainfall, but excessive water movements have depleted minerals and nutrients from the soil, leaving highly acidic soil conditions[3]. The unique climatic characteristics of each region make it necessary to tailor agricultural policies to the needs of specific agroecological zones. Only by **considering each region's climatic context**, policy can help enhance agricultural resilience, boost productivity, and improve farmers' livelihoods across Zambia.

Figure 5: Agroecological zones in Zambia

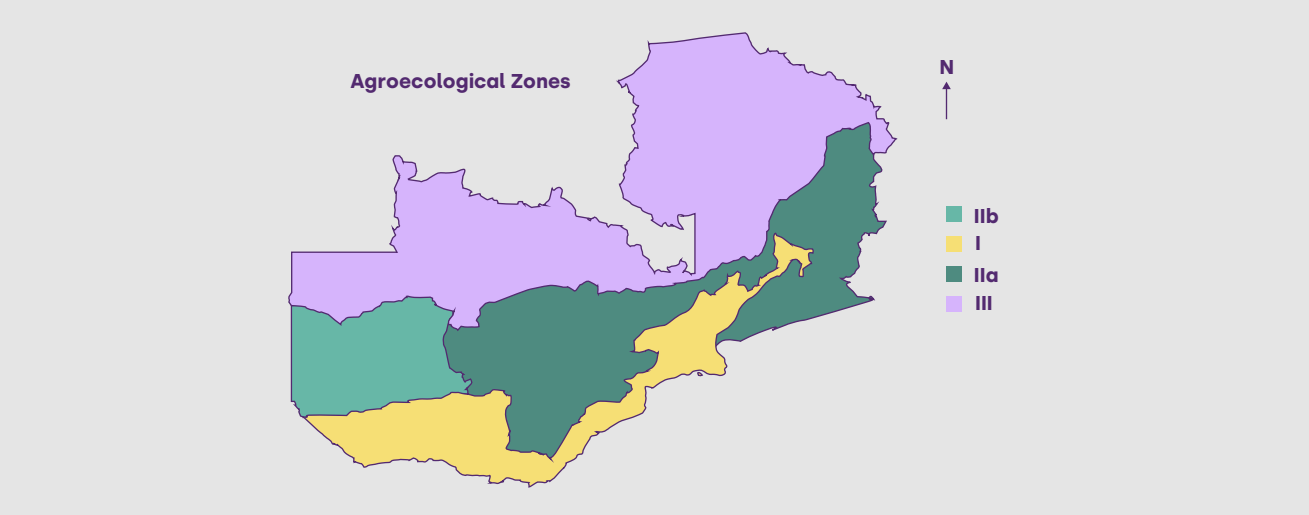
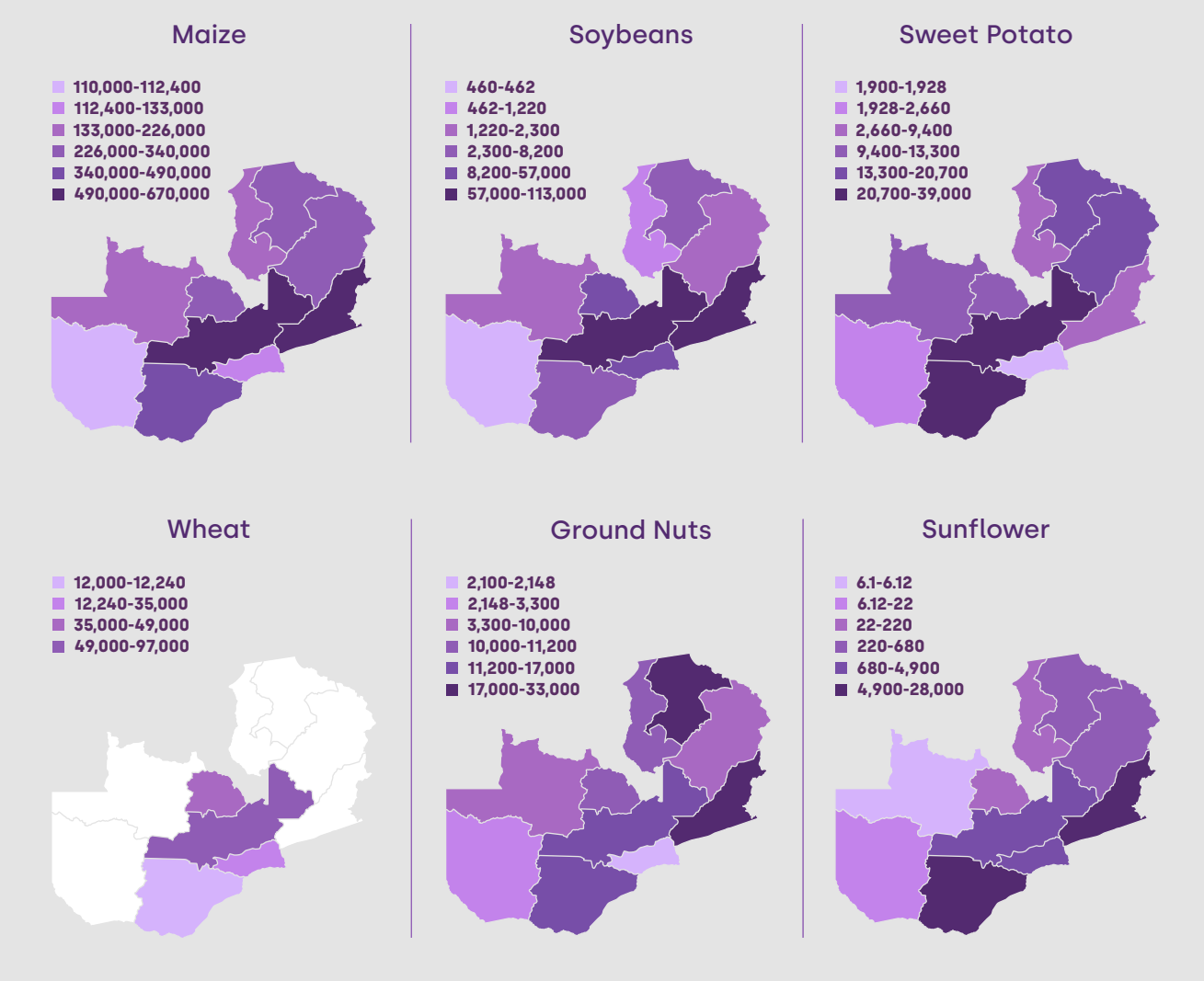


Image source: World Bank. (2018). Increasing agricultural resilience through better risk management in Zambia. https://documents1.worldbank.org/curated/en/330211524725320524/pdf/125784-WP-25-4-2018-9-34-36-ZambiaAgResilienceRiskMgtweb.pdf

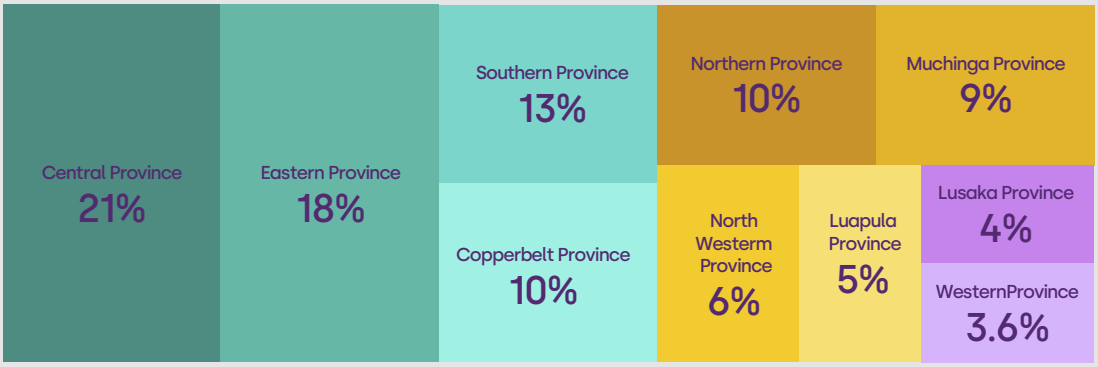
Figure 6 maps the geographical concentration of the production for different crops while **Figure 7** showcases agricultural production by province. **The bulk of maize and soybeans is produced in the Central and Eastern Provinces**, whereas sweet potatoes are primarily grown in the Central and Southern Provinces. The Central Province is the main source of wheat, while groundnuts are commonly cultivated in the Eastern and Northern Provinces. Sunflowers are primarily grown in the Southern and Eastern Provinces. **The Central and Eastern Provinces are major areas for agricultural production, contributing towards approximately 39% of Zambia's total crop output**. The Northern, Southern, Copperbelt, and Muchinga Provinces also play a crucial role in the sector.

Figure 6: Geographical concentration of expected agricultural production (Mt) in 2019 for different crops in Zambia



Data source: ZamStats. (2020). Agriculture Statistics, 2020. **https://zambia.opendataforafrica.org/etqmqgf/agriculture-statistics-2020**

Figure 7: Geographical concentration of the 2019 total expected agricultural production by Province (Mt)



Note: The underlying data includes expected agricultural production statistics for 13 crops for which ZamStats provides production data. Data source: ZamStats. (2020). Agriculture Statistics, 2020. **https://zambia.opendataforafrica.org/etqmqgf/agriculture-statistics-2020**

Zambia has an advantageous climate, abundant water resources, and vast expanses of fertile land, forming a solid foundation for agricultural development. Its strategic geographical position within the region and its substantial labour force offer significant agricultural potential. The country's varied agroecological zones, which range from humid and sub-humid to semi-arid areas, accommodate a diversity of crops. **Furthermore, only a small fraction, 15%, of the 42 million hectares classified as medium to high potential agricultural land is currently being cultivated**[6]. Despite the sectors promise, Zambia grapples with the persistent issue of agricultural productivity that needs addressing to unlock the full potential of this sector.

Zambia's agricultural policies

The following sections discuss the Farmer Input Support Programme (FISP), its historical evolution, and its current challenges. It also explores the Food Reserve Agency (FRA) as well as other notable agricultural policies and programs, illustrating their interconnections and the government's efforts in effectively addressing agricultural sector limitations.

Farmer Input Support Programme (FISP)

The first version of FISP was launched in 2002 under the "Fertiliser Support Programme" or FSP. It aimed to promote income growth and food security for smallholder farmers and to reduce poverty. FSP provided maize seeds and fertilisers to 120,000 farmers in Zambia. By 2008, FSP grew to support 500,000 farmers, providing each with 8 bags of 50kg of fertilizers and 20kg of maize seeds.

In 2009, FSP was renamed "Farmer Input Support Programme" (FISP). In the process, the number of farmers supported by the programme doubled to 1 million while halving inputs provided to individual farmers. Furthermore, there was an attempt to diversify agricultural production, by including other seeds into the input subsidies. Agricultural production witnessed substantial growth from 1.8 to 2.7 million metric tonnes within a single agricultural season following FISP's initial launch[7], although this increase cannot be solely attributed to the introduction of FISP.

In 2015, the government introduced the "Electronic Voucher System" which allowed farmers to select the inputs required for their production. This system used an online platform for the delivery of inputs, as well as payments to dealers and retail agents, with distribution handled in collaboration with the private sector. However, implementing the Electronic Voucher System included various challenges, such as payment delays to agro-dealers, technological issues, and limited availability of inputs. Consequently, these obstacles led to discontinuing the Electronic Voucher System, resulting in a return to the direct input support model.

FISP consumes a considerable amount of the Ministry of Agriculture's budget - 73% in 2022.[8] Over the years the spending on FISP has been significantly increasing, with an estimated allocation of around K9.1 billion (approximately £400 million) for 2023.[9]

As currently designed and implemented, FISP faces several challenges:

- **We lack a holistic understanding of FISP's impact:** This is despite the scale of public investment. Key areas that need further exploration include

7 Government of the Republic of Zambia. (2022). Action plan for the full migration of the farmer input support programme to an electronic agricultural input support system. **https://www.agriculture.gov.zm/wp-content/uploads/2022/12/FISP_Action_Plan_27.12.2022-Final-7.pdf**

8 Mulenga, Kabisa, Chapoto. (2021). Zambia Agricultural Status Report 2021. IAPRI.

9 National Assembly of Zambia. (2022). National Assembly of Zambia Report of the Expanded Planning and Budgeting Committee on the estimates of Revenues and Expenditure for the Financial Year 1st of January to 31st of December 2023 for the second Session of the thirteenth National Assembly. **https://www.parliament.gov.zm/sites/default/files/documents/committee_reports/Report%20of%20the%20Expanded%20Planning%20and%20Budgeting%20Committee.pdf**

FISP's influence on climate change adaptation, its effect on input prices and wage rates, its role in altering income and poverty rates, and the behavioural shifts incentivising smallholder farmers.[10]

- **FISP is often delayed, undermining its potential impact:** Inputs are frequently delivered late, sometimes even after the planting season ends, diminishing their potential impact[11,12]. In 2022, the Zambian National Farmers Union called for the establishment of an Inter-Ministerial Committee to manage delays in seed and fertiliser availability[13].
- **It is unclear if FISP is effectively targeting farmers most in need:** FISP has encountered difficulties in effectively reaching its intended beneficiaries, with persistent concerns remaining around unequal distribution of resources. It has been observed that larger and wealthier households are more often the recipients of fertilisers and receive more subsidised inputs, as opposed to their smaller, poorer counterparts.[10] In doing so, FISP is more likely to target farmers who would have purchased fertiliser even in the absence of the program, raising concerns around fertiliser additionality. Furthermore, input diversion from intended beneficiaries to wholesale markets is likely hindering FISP's impact on agricultural fertiliser use. Estimates suggest that each additional ton of fertiliser distributed increases fertiliser use by only 536 kg due to this diversion. Consequently, FISP's effect on fertiliser use in Zambia could be overestimated by as much as 62%[14]
- **FISP might be hindering private sector activity:** A study in Zambia highlighted a dynamic where in regions with a less established private sector, government-provided fertilisers boosted usage among smallholder farmers. However, in areas with a more developed private sector, the provision crowded out private sector activities, sometimes even reducing fertiliser use[15].
- **FISP is not considered to be cost effective:** While it is estimated that it is not economic for smallholder farmers to purchase fertilizers at market prices[16], FISP's financial sustainability is questionable as its costs most likely surpass its benefits. FISP is estimated to have a financial benefit-cost ratio of just 0.523, where a ratio of 1 would imply that the program breaks even[14]. This raises concerns about the program's financial efficiency and long-term viability.

10 Mason, Jayne, Mofya-Mukuka. (2013). Zambia's Input Subsidy Programs. Agricultural Economics. **https://onlinelibrary.wiley.com/doi/epdf/10.1111/agec.12077**

11 World Bank. (2021). Zambia's Farmer Input Support Program and Recommendations for Re-designing the Program. **https://documents1.worldbank.org/curated/en/469081624277250536/pdf/Zambias-Farmer-Input-Support-Program-and-Recommendations-for-Re-designing-the-Program.pdf**

12 African Farming. (2017). Zambian Smallholder Famers face another Season of Delayed Inputs. **https://www.africanfarming.com/zambian-smallholder-farmers-face-another-season-delayed-inputs/**

13 Lusaka Times. (2022). Farmer's Union Cites Delays DISP Distribution as a Setback. **https://www.lusakatimes.com/2022/09/22/farmers-union-cites-delayed-fisp-distribution-as-a-setback/**

14 Jayne, Mather, Mason, Ricker-Gilbert. (2013). How do fertilizer subsidy programs affect total fertilizer use in sub-Saharan Africa? Crowding out, diversion, and benefit/cost assessments. Agricultural Economics. **https://onlinelibrary.wiley.com/doi/full/10.1111/agec.12082**

15 XU, Burke, Jayne, Govereh. (2009). Do input subsidy programs "crowd in" or "crowd out" commercial market development? Modeling fertalizer demand in a two-channel marketing system. Agricultural Economics. **https://onlinelibrary.wiley.com/doi/full/10.1111/j.1574-0862.2008.00361.x**

16 Burke et al. (2019). Understanding fertilizer adoption and effectiveness in Zambia. Food Policy. **https://www.sciencedirect.com/science/article/pii/S0306919218302331**

Food Reserve Agency (FRA)

The Food Reserve Agency (FRA), launched in 1995, is mandated to stabilise food prices and ensure food security in Zambia. It therefore builds and manages strategic reserves, simultaneously facilitating market access for smallholder farmers. Through buying, storing, and releasing stocks, the FRA aims to mitigate food price volatility and even engages in the international trade of produce. In a dialogue with FRA representatives, it was revealed that their current secure storage capacity stands at 950,000 metric tonnes while plans exist to increase this capacity to 2 million metric tonnes by 2026.

The optimal quantity of maize that the FRA should store to maintain national food security remains undetermined. Estimate suggest that a reservoir of 150,000 to 350,000 metric tonnes of maize could suffice for a functioning strategic grain reserve[17]. Nonetheless, the FRA's purchases consistently surpasses this benchmark. **Figure 8** illustrates the FRA's purchases vis-à-vis the total projected maize production from 2003 to 2018, showcasing that a substantial proportion of Zambia's maize harvest is being acquired by the FRA year on year.

Figure 8: FRA purchases as fraction of total anticipated maize sales between 2003 and 2018

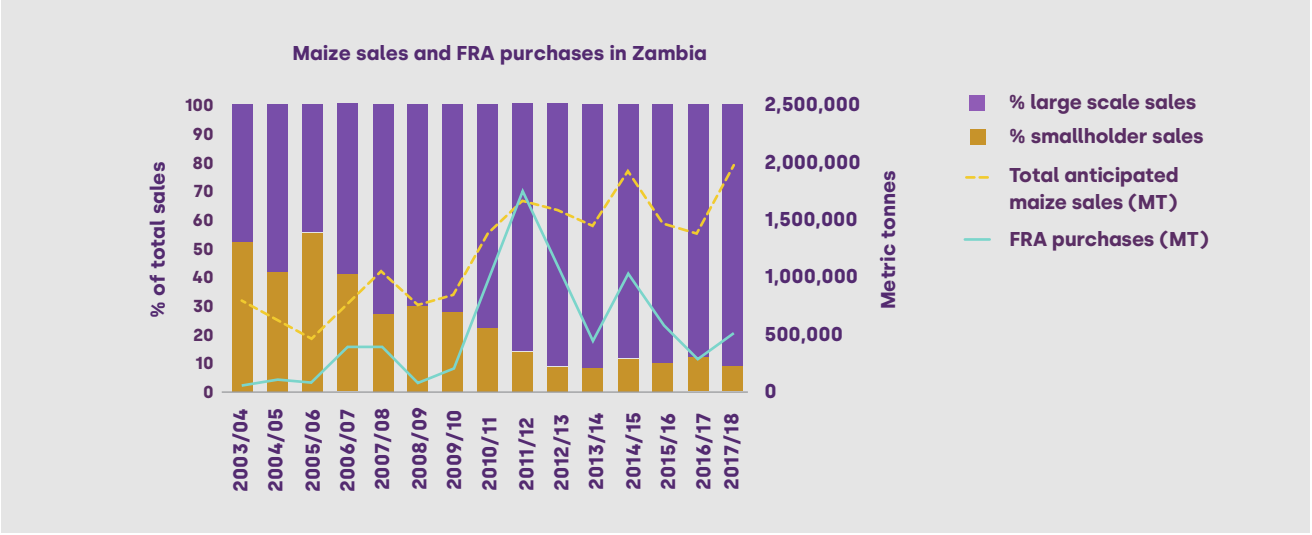


Image source: World Bank. (2018). Increasing agricultural resilience through better risk management in Zambia. **https://documents1.worldbank.org/curated/en/330211524725320524/pdf/125784-WP-25-4-2018-9-34-36-ZambiaAgResilienceRiskMgtweb.pdf**

While **studies show that FRA activities have dampened price fluctuations**, evidence suggests that maize prices increased because of FRA's market interventions. It is estimated that between 2003 and 2008, maize prices in Lusaka were 17% higher because of FRA purchasing maize from producers at prices above the market level. As such, **FRA's intervention, though beneficial for net sellers, tend to adversely affect the net buyers, primarily consisting of urban consumers and the poor rural population**[18].

17 Kwon, Myers, Mason, Samboko. (2019). Can maize price stabilization reduce malnutrition and save lives? The case of the Zambia Food Reserve Agency. **https://ageconsearch.umn.edu/record/303622/**

18 Mason, Myers. (2013). The effects of the Food Reserve Agency on maize market prices in Zambia. Agricultural Economics. **https://onlinelibrary.wiley.com/doi/full/10.1111/agec.12004**

Moreover, research indicates that smallholder farmers situated at a greater distance from FRA depots tend to employ more diverse cropping systems. This implies that the presence of the FRA may inadvertently deter the incorporation of more sustainable agricultural practices[19].

Other notable policies and programs

Zambia National Agricultural Policy 2012-2030: The Zambia National Agricultural Policy 2012-2030 outlines the government's vision for developing the agricultural sector. The government wants to build a competitive, diversified agricultural sector driven by equitable and sustainable development. The framework emphasises increasing agricultural productivity, improving input and product markets, boosting agricultural exports, and enhancing access to resources and services for smallholder farmers, especially women and the youth. It focuses on promoting sustainable farming practices, crop diversification, efficient water resource management, and the adoption of modern technologies to address food insecurity and poverty.[20]

Second National Agricultural Policy: The Second National Agricultural Policy expands on the objectives of the National Agricultural Policy 2012-2030. It presents specific measures to achieve a set of policy objectives. Objectives include increasing agricultural productivity, agricultural R&D, private sector participation, and agricultural finance opportunities, to improve agricultural training, efficiency of agricultural markets, responsiveness to climate change, and food security, and to promote sustainable management and issues related to gender and AIDS[21].

Comprehensive Agriculture Transformation and Support Program (CATSP): CATSP is a sector policy framework whose implementation period ranges from 2022 to 2026. It consists of 7 strategic priorities as well as 7 broad areas of investment each consisting of multiple investment subsections. CATSP wants to improve the quality of public expenditure, promote inclusive local supply chains, provide access to financial services, upgrade infrastructure, improve technology adaption, improve land tenure security, and avoid distortive interventions by the government.[22]

It should be noted that all the above **programs and actors are, to a certain extent, interlinked** and none stand in isolation. Furthermore, these 3 policy programmes emphasise an **awareness by the government around issues the sector faces**. Nevertheless, addressing all the constraints effectively will be the major challenge faced by the government.

19 FAO. (2018). Cropping system diversification in Eastern and Southern Africa. **https://www.fao.org/3/ca1562en/CA1562EN.pdf**

20 FAO. (2011). Zambia National Agricultural Policy 2012-2030. **https://leap.unep.org/countries/zm/national-legislation/zambia-national-agricultural-policy-2012-2030**

21 Zambian Ministry of Agriculture. (2016). Second National Agricultural Policy. **https://faolex.fao.org/docs/pdf/zam183104.pdf**

22 Zambian Ministry of Agriculture. (2023). Understanding the comprehensive agriculture transformation support programme (CSTSP). **https://eaz.org.zm/articles/2023/05/18/presentation-on-understanding-the-comprehensive-agriculture-transformation-and-support-program-catsp/**

Zambia's agricultural policies – Policy options

1. **Assessing the impact of agricultural programs:** There remains a lack of comprehensive understanding of the effects of programs such as the FISP on producers, consumers, and the market overall. As a solution, the government could actively collaborate with researchers to conduct empirical evaluations of FISP and upcoming agricultural policies like CATSP. This data-driven approach would enable the government to optimise the impact derived, thereby ensuring maximum efficacy of their agricultural initiatives.
2. **Enhanced targeting for agricultural programs:** Larger and wealthier farmers benefit more frequently from FISP, revealing a potential discrepancy in resource allocation. It's critical to address this issue to ensure subsidies are received by farmers who are most in need. A re-evaluation of the targeting criteria for input subsidies could help guarantee that these resources reach the intended beneficiaries, improving the overall effectiveness of the input support program. This also involves adjusting inputs based on farmer needs, which can vary based on size of operation, crop, and agro-ecological zone.
3. **Ensure a strategy for farmer's graduation from FISP:** Many farmers benefiting from FISP are unaware of any graduation pathways. Given the large budget allocation, it may be worthwhile to ensure that graduation pathways are communicated and abided by. Phasing out assistance to farmers as they reach a certain level of income or productivity might free up resources for other farmers who may need the assistance more.
4. **Establish clear strategic reserves for the FRA:** It would be helpful to establish clear benchmarks for strategic reserves based on Zambia's consumption and production trends. This could help avoid over-purchasing and reduce costs, while keeping market interventions to a minimum.
5. **Enhance private sector participation in agricultural programs:** Agricultural programs could explore ways to enhance private sector participation, contributing to improved efficiency and effectiveness of the programs. For FISP, this could be through partnerships for distribution, wherein private entities collaborate in the supply chain, optimising the reach and impact of the program. In addition, such alliances could spur innovative solutions by leveraging the strengths of private sector players.
6. **Increasing research and development expenditure:** At present, the Zambian Ministry of Agriculture spends only 0.2% of its budget on research and development, a figure that should be reassessed. Allocating a larger portion of the Ministry's budget towards R&D could act as a catalyst for innovation and enhancement in farming techniques and technologies, providing support specifically tailored to meet Zambia's distinct needs and conditions.

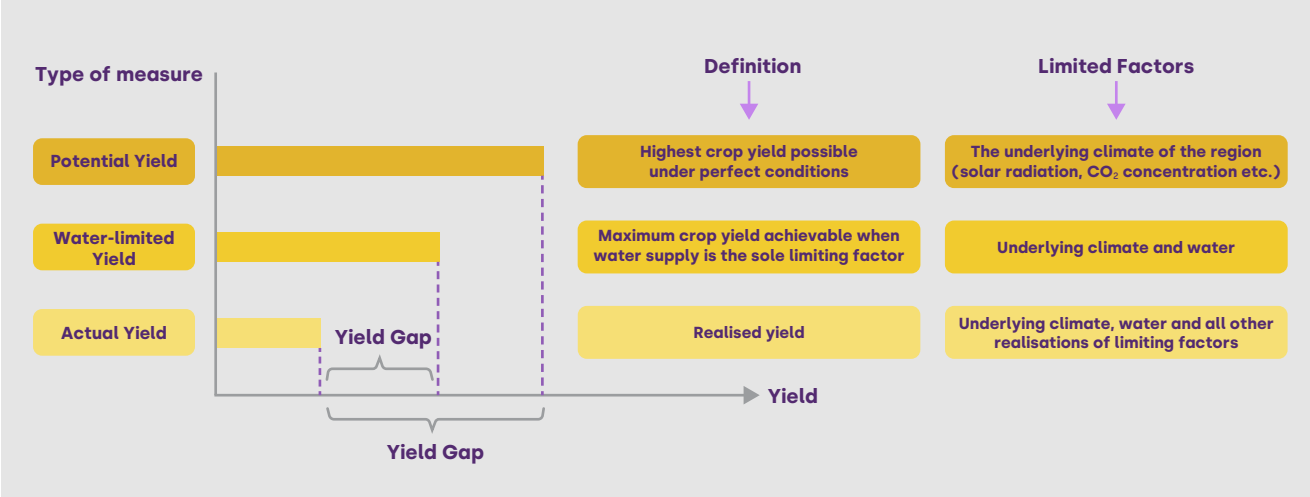
How productive is Zambia's agriculture sector?

Productivity is the ability of an economy to transform inputs into outputs. This section examines two fundamental inputs in agricultural production: **land and labour**. We begin by examining productivity of land in maize production. We then look at employment in the sector in relation to economic output. While we can look at statistics for land and labour separately, they are clearly interconnected, and it is difficult to disentangle these measures of productivity. Labour productivity affects land yields, the land's productivity influences labour productivity, and technology amplifies productivity in both areas. As a result, these dimensions are understood in tandem.

Land

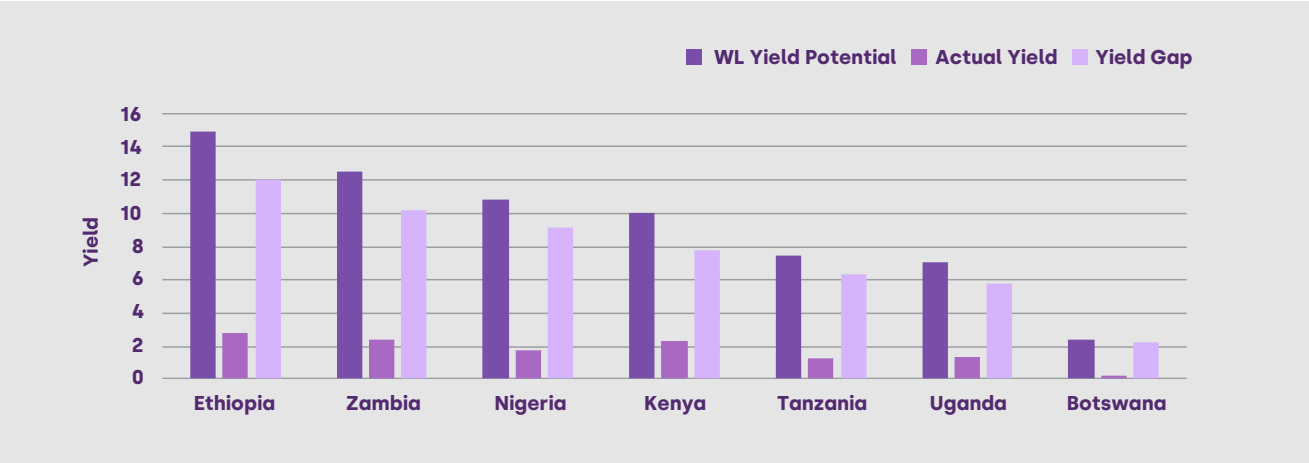
A substantial maize yield gap exists in Zambia, primarily driven by very high potential yields that don't materialise. The **estimated yield gap for Zambia is around 10 metric tonnes per hectare**. When referring to agricultural productivity, it is useful to introduce the concepts of yield potential, water-limited yield potential, and actual yields, which are outlined in **Figure 9**. Yield potential represents the highest crop yield possible under perfect conditions – when there's ample water, ideal nutrients, and effective control of pests and diseases. Conversely, water-limited yield potential refers to the maximum crop yield achievable when water supply is the sole limiting factor, making it a useful measure for rainfed crops. Both yield potential and water-limited yield potential vary by location due to differences in the underlying characteristics of the region. Lastly, actual yields are what farmers attain in a region. The difference between water-limited yield potential and actual yield is what is referred to as a yield gap. We can think of this as what is lost in production because of imperfect conditions[5].

Figure 9: Illustration of potential yield, water-limited yield, and actual yield. Diagram made by the authors.



Note: Diagram made by the authors.
Global Yield Gap and Water Productivity Atlas. (2019). **https://www.yieldgap.org/gygaviewer/index.html**

Figure 10: Water-limited yield potential, actual yield, and yield gap for a selection of countries between 2000-2020.



Note: Sorted by yield gap. Data source: Global Yield Gap and Water Productivity Atlas. (2019). **https://www.yieldgap.org/gygaviewer/index.html**

This measure shows that maize productivity in Zambia, when measured by the yield gap, is significantly lower compared to other African countries. **Figure 10**, **comparing Zambia's yield gap against various African countries reveals that it surpasses that of Nigeria, Kenya, Tanzania, Uganda, and Botswana**. This is mainly driven by high potential yields in Zambia which are not being captured by farmers.

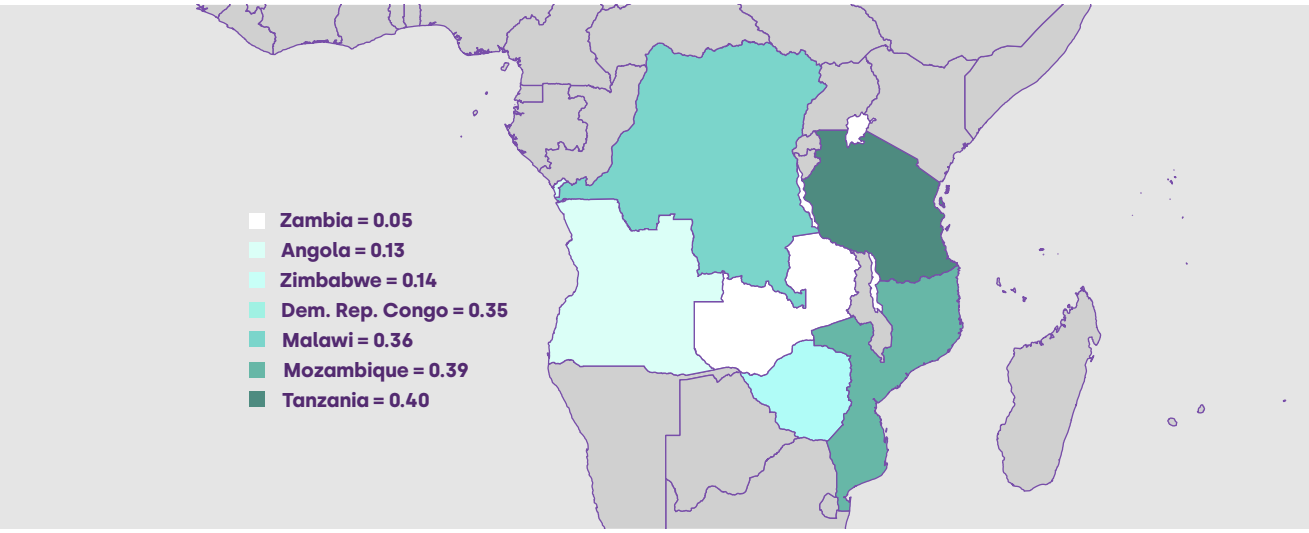
The magnitude of this gap is a cause of concern and reflects a missed opportunity for the Zambian economy. In 2021/22 Zambia produced 3.6 million metric tonnes of maize[23]. **If in 2021/22 Zambian farmers would have produced at potential, the country would have produced an additional 15.3 million metric tonnes marking a 525% increase over actual production**. Although producing at potential is unlikely as some inefficiencies always persist, when looking at the high yield potential, implementing policies that assist farmers in reaching their potential could have significant impacts on overall production.

Labour

In 2021, 58.7% of the workforce worked in the sector which contributed to 3.4% of GDP[1,2]. Low levels of agricultural productivity translate into many Zambians working for few outcomes. Although agricultural sectors in developing countries generally tend to employ a larger fraction of people relative to the sectors contribution to GDP, Zambia's case is exceptionally stark. By dividing the contribution to GDP by the contribution to employment we receive a rough measure of a country's efficiency of converting labour into agricultural output. **Figure 11** presents this coefficient for several countries in the region. The figure reveals that Zambia's ability to convert agricultural labour into agriculture output is notably lower compared to neighbouring countries.

23 USDA. (2022). Zambia Corn Availability Appears Sufficient Despite Lower Production. **https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=%20Zambia%20Corn%20Availability%20Appears%20Sufficient%20Despite%20Lower%20Production_Pretoria_Zambia_ZA2022-0001.pdf**

Figure 11: Agricultural contribution to GDP relative to agricultural contribution to employment in Zambia and neighbouring countries in 2022



Date Source: World Bank. (2022). Agriculture, forestry, and fishing, value added (% of GDP) – Zambia & Employment in agriculture (% of total employment) (modelled ILO estimate). **https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=ZM & https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=ZM**

Developments

While Zambia's agricultural sector has seen productivity gains over the years, these improvements have predominantly favoured medium and large-scale farmers. In contrast, smallholder farmers, who make up most of the Zambia's farming population, have not experienced significant benefits. **Productivity among smallholder farmers remains stagnant**. It is therefore **unlikely that the sector's progress has sufficiently contributed to reducing poverty or improving food security**. Rural provinces like the Eastern and Western Province still face significantly higher poverty rates compared to urban areas such as Lusaka and the Copperbelt[20]. This **highlights the need for targeted policies that support smallholder farmers**, to ensure that agricultural advancements lead to equitable and meaningful improvements across the country.

JuliaSeal, Getty Images

What limits agricultural productivity?

Below is a summary of a wide range of obstacles that affect agricultural productivity across different farmer groups in Zambia.

Table 2: Summary of the obstacles to agricultural productivity in Zambia

Limitations	Elaboration
Low spending on agricultural R&D	In 2021 and 2022, the Zambian Ministry of Agriculture **allocated only 0.2% of its budget towards Research and Development**[8]. R&D is crucial for improving the accessibility, and effectiveness of technology. Furthermore, enhancing our understanding of what works and what doesn't work in Zambia's agricultural sector could boost the sector's overall productivity by improving spending efficiency.
Inefficient extension service delivery	**The ratio of extension workers to farmers in Zambia stands at approximately 1:1000**[24]. While there is no established international standard for this, 1:1000 signifies an insufficient number of extension service officers to effectively serve farmers. Furthermore, field extension workers often struggle to integrate farmers into the learning process which is essential for effectively demonstrating agricultural technologies. Communication hurdles arise from technological, infrastructural, and cultural factors. Furthermore, administrative task related to the distribution of input subsidies often place an additional burden on extension workers prohibiting them from providing sufficient educational services[25].
Low resilience to climate change and shocks	It is estimated that **three-quarters of smallholder farmers in Zambia are vulnerable to climate shocks**[26]. Agricultural production is predominantly rain-fed and therefore vulnerable to climate variability. Climate change is anticipated to alter both the average levels and the variability of temperatures and rainfall patterns in Zambia. This dual effect is expected to have adverse effects on the agricultural sector, as it undermines the very foundation upon which farming practices in the region are built.[27]
Poor knowledge and application of good agricultural practices	**Around 80% of Zambian Households cultivate three or less crops while 18% only cultivate one**[28]. Smallholder farmers in Zambia frequently struggle with a deficit of awareness and accessibility of effective agricultural practices. A symptom of this is that Zambia exhibits one of the lowest levels of crop diversification across Africa[29]. The widespread use of monocropping, a practice involving the cultivation of the same crop on fields without rotation, results in considerable depletion of soil quality[30]. This, in turn, can undermine the effectiveness of fertilisers and leads to a substantial reduction in crop yields.
High dependence on rain-fed agriculture and lack of irrigation systems	**Irrigation systems are rarely used among smallholder farmers, with only 1% employing them**[31]. Dependence on rain-fed agriculture coupled with insufficient investment in irrigation systems presents a threat to agricultural productivity. Climate change exacerbates this issue, as Zambia will increasingly face hotter and drier weather conditions, thereby intensifying concerns regarding water scarcity.

24 Reliefweb. (2021). Breaking the cycle of poor harvests. **https://reliefweb.int/report/zambia/breaking-cycle-poor-harvests#:~:text="The%20current%20farmer%20to%20extension,ratio%20of%20about%20400%3A1.**

25 Chavula et al. (2022). An overview of Zambia's Agricultural Extension and Advisory System. International Journal of Academic and Applied Research. **https://www.researchgate.net/publication/364955600_An_overview_of_Zambia%27s_Agricultural_Extension_and_Advisory_System**

26 Ngoma, Finn, Kabisa. (2021). Climate Shocks, Vulnerability, Resilience and Livelihoods in Rural Zambia. **https://openknowledge.worldbank.org/server/api/core/bitstreams/3cf19fcc-6485-57c2-9977-9bfaa8caaba1/content**

27 Ngoma, Lupiya, Kabisa, Hartley. (2021). Impacts of climate change on agriculture and household welfare in Zambia: an economy-wide analysis. Climatic Change. **https://link.springer.com/article/10.1007/s10584-021-03168-z**

28 Mwanamwenge, Cook. (2019). Beyond maize: Exploring agricultural diversification in Zambia from different perspectives. **https://www.iied.org/g04422**

29 World Bank. (2019). Zambia climate-smart agriculture investment plan: Analyses to support the climate-smart development of Zambia's agriculture sector. **https://documents1.worldbank.org/curated/en/358291552021231101/pdf/Zambia-Climate-Smart-Agriculture-Investment-Plan-Analyses-to-Support-the-Climate-Smart-Development-of-Zambia-s-Agriculture-Sector.pdf**

30 Kumwenda et al. (1995). Soil Fertility Management for Maize-Based Systems in Countries of Southern Africa. The Emerging Maize Revolution. **https://original-ufdc.uflib.ufl.edu/UF00080084/00001**

31 Ngoma et al. (2019). Irrigation Development for Climate Resilience in Zambia: The Known Knowns and Known Unknowns. **https://ageconsearch.umn.edu/record/303048/**

Limitations	Elaboration
Usage of modern inputs such as improved seeds and fertiliser	Around 63% of smallholder farmers report to be using fertiliser and roughly 72% of households reported to use improved seed varieties[8]. Moreover, Zambia's fertiliser consumption of nearly 80 kg per hectare of arable land exceeds that of its neighbouring countries[32]. **Despite this, there is limited data on the types of improved seed varieties used and whether farmers still rely on older, lower-yielding ones.** Furthermore, the heterogeneous climate conditions question the effectiveness of a uniform fertiliser approach, as soil characteristics and pH levels influence its impact. Some estimates suggest that a portion of farmers may operate at a fiscal loss when using fertilisers at commercial prices and only some may have sufficient incentive to use fertiliser based on prevailing costs. Hence, more emphasis must be put on using appropriate technology rather than the sole use of it[16].
High post-harvest losses	It is estimated that **17% of smallholder farmers face post-harvest losses, with losses** for some households **reaching up to 50% of their production**[33]. This can often be attributed to a lack of access to post-harvest storage solutions and management.
Limited access to and availability of appropriate finance and insurance	Roughly **85% of the credit dedicated to the agricultural sector is taken up by large-scale commercial producers**[34]. A lack of access to financial services can constrain firm growth by restricting potential investments with high rates of return.
Limited usage of land	**Only 15% of the potential agricultural land is being utilised for agricultural production**[6]. Although arable land has increased from 3.1% in 1980 to 5.1% in 2020[35], utilised farmland remains low. In Zambia, this can be at least partly attributed to a lack of investment and infrastructure along with gaps in technology.
Price volatility	Volatility in agricultural prices affect stakeholders depending on their position in the supply chain. Extreme price volatility can adversely impact smallholder farmers by affecting their income and food security. It can also discourage farmers from making input investments, thereby reducing production in the next season. While much of these price fluctuations are market related, government interventions have exacerbated the issue in the past[36].
Government intervention	Estimates indicate that between 2003 and 2008, **maize prices in Lusaka were consistently 17% higher due to the FRA purchasing maize at rates beyond the prevailing market price**[17]. Governmental interventions, though mostly well-intentioned, can inadvertently lead to outcomes that hinder agricultural productivity and negatively affect end consumers. Export restrictions can discourage farmers from investing, therefore enhancing their production[37].
Low adoption of technologies such as mechanisation	**Only 0.2% of farmers own tractors, while only 1.7% utilise tractor services. Mechanisation could not only boost agricultural efficiency but also be crucial for conservation agriculture**[38]**.**

32 World Bank. (2020). Fertilizer consumption (kilograms per hectare if arable land) – Zambia. **https://data.worldbank.org/indicator/AG.CON.FERT.ZS?end=2020&locations=ZM&start=2020&type=shaded&view=map**

33 World Food Program (WFP). Zambia Annual Country Report 2021. **https://docs.wfp.org/api/documents/WFP-0000137823/download/**

34 World Bank. (2019). Agricultural Finance Diagnostic Zambia. **https://documents1.worldbank.org/curated/en/241301582041593315/pdf/Agriculture-Finance-Diagnostic-Zambia.pdf**

35 World Bank. (2020). Arable land (% of land area) – Zambia. **https://data.worldbank.org/indicator/AG.LND.ARBL.ZS?locations=ZM**

36 World Bank. (2018). Increasing agricultural resilience through better risk management in Zambia. **https://documents1.worldbank.org/curated/en/330211524725320524/pdf/125784-WP-25-4-2018-9-34-36-ZambiaAgResilienceRiskMgtweb.pdf**

37 Aragie, Pauw, Pernechele. (2018). Achieving food security and industrial development in Malawi: Are export restrictions the solution?. World development. **https://www.sciencedirect.com/science/article/pii/S0305750X18301025**

38 Omulo, Daum, Köller, Birner. (2022). Are emerging farmers the missing link for mechanised Conservation agriculture? Viewpoints from Zambia. **https://www.tandfonline.com/doi/full/10.1080/09614524.2022.2036702**

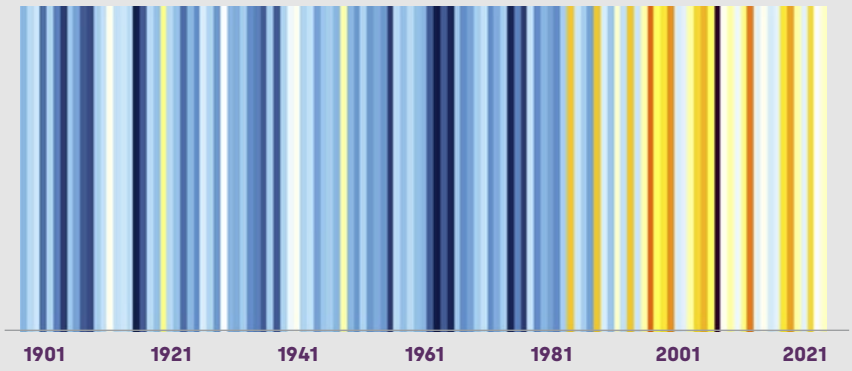
An agenda for policy

To meet the government's objectives to enhance agricultural productivity, it is crucial to address the significant bottlenecks hindering growth in the sector. The sub-sections that follow provide a detailed exploration of limitations related to 1) building resilience to climate change, 2) improving access to agricultural finance, 3) market access, and 4) adoption of agricultural technology. It's crucial to understand that many of these limitations are interconnected and therefore need to be addressed holistically.

1. Building resilience to climate change

Climate change has the potential to intensify all challenges faced by the agricultural sector, as global changes in rainfall and temperature patterns are influencing farming systems across the world. As shown in **Figure 12**, Zambia has experienced a continuous rise in average temperatures over the past decades, which has had, and will continue to have, repercussions on agricultural production. Between 1963 and 2021, **the 5-year average temperature in Zambia has risen by nearly 1°C**. Similarly, since 1960, **precipitation is said to have decreased by 1.9 mm per decade**[39].

Figure 12: Observed annual mean-temperatures between 1901-2021 in Zambia



Note: Blue indicates colder while red indicates warmer. As a point of comparison, the temperature furthest to the left equals 21.13°C while the one furthest to the right equals 21.95°C. Data source: World Bank. (2020). Climate Change Overview – Country Summary – Zambia. **https://climateknowledgeportal.worldbank.org/country/zambia**

39 USAID. (2012). Zambia Climate Vulnerability Profile. **https://www.climatelinks.org/sites/default/files/asset/document/zambia_climate_vulnerability_profile_jan2013.pdf**

While changes in average temperature and rainfall are expected to affect agricultural production, **physical hazards, and extreme weather events** related to climate change can also disrupt farming activities and lead to significant economic losses both for individuals and the economy as a whole. The most likely climate related physical hazards in the context of Zambia consist of:

- **Droughts and heatwaves:** Worldwide, the agriculture sector absorbs 82% of the total negative economic impact of droughts and heatwaves[40]. This usually leads to losses in crops and livestock, as well as in input supplies, if there are no adequate storage facilities in place. This can lead to higher costs of farming activities, reductions in agricultural productivity and yields, as well as higher prices for end consumers, thereby creating issues related to food security.
- **Variable rainfall, including flooding:** An overwhelming majority of agricultural production in Zambia is rainfed. As such, changes in rainfall patterns can significantly disrupt agricultural production within the country. Additionally, while flooding can cause significant crop damage, it also exposes crop production to chemicals and other contaminants which can affect the supply and quality of agricultural produce[41].
- **Pests and disease:** Among notable pests and diseases in Zambia are the fall armyworm and stock borer. Livestock diseases include foot and mouth disease, contagious bovine pleuropneumonia, and swine fever[36]. Over the past years, these have led to significant losses in crop produce and livestock in key growing areas such as Luapula, Central, Western, Southern and Northern Provinces. Though not the case for all pests and diseases, evidence suggests that the spread of the fall armyworm is exacerbated by climate change.

Climate change is expected to affect different regions in Zambia differently. Projections indicate that **by the year 2050, temperatures across all regions in Zambia are likely to rise by approximately 1.8°C**. Secondly, while the Southern and Western Region are expected to experience significant reductions in rainfall, the Northern Region is expected to receive higher levels of rainfall. These changes are expected to have **adverse effects on crop yields, agricultural production, GDP, and household welfare**. Among the various crops, maize yields are anticipated to be particularly vulnerable to these shifting weather patterns[25].

Given its adverse effects on food production, climate change could significantly worsen issues related to food security. Given that Zambia population is growing at an annual growth rate of 2.8%, placing it 12th globally[42], Zambia could face an escalating challenge. **As the population continues to grow, food security may become more precarious due to increased demand alongside decreased production**. Furthermore, increasing food prices resulting from reductions in yields make it more challenging for

40 FAO. (2021). The impact of disasters and crises on agriculture and food security. **https://www.fao.org/3/cb3673en/cb3673en.pdf**

41 FDA. (2011). Guidance for Industry: Evaluating the Safety of Flood-affected Food Crops for Human Consumption. **https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-evaluating-safety-flood-affected-food-crops-human-consumption**

42 World Bank. (2022). Population growth (annual%) – Zambia. **https://data.worldbank.org/indicator/SP.POP.GROW?locations=ZM&most_recent_value_desc=true**

low-income households to afford high-quality food, which could cause them to rely on less nutritious alternatives, which in turn can have long-lasting effects on health[43]. This is especially concerning as 48% of Zambians are already unable to meet their minimum caloric requirements[32].

Smallholder farmers confront an intensification of challenges related to climate change. This is further exacerbated by restricted access to information on sustainable farming methods, presenting an additional barrier to agricultural productivity. **Smallholder farmers account for roughly 80% of the domestic food supply**[32]. Over the years, the government's promotion of maize production under FISP and the FRA has led to a prevalent trend of **monocropping** among small holders. This practice, **coupled with discouragement of fallowing, has resulted in soil degradation, thus diminishing the efficacy of fertiliser usage**[10], and negatively impacting the productivity levels of smallholder farmers.

Conservation agriculture is a method of agricultural production that encompasses three core principles: **minimising soil disturbance, promoting crop rotation, and maintaining permanent soil covers**. When implemented effectively, conservation agriculture can play a pivotal role in enhancing crop yields and aiding farmers in adapting to climate variability, particularly in challenging climates. Research underscores that the impact of conservation agriculture on yields can vary based on the prevailing climate and the adherence to its core principles. **For instance, in rainfed crop contexts and dry climates, employing all three principles of conservation agriculture can boost crop yields by 7.3%**[44]. In Zambia, a country often viewed as a frontrunner in conservation agriculture, studies also have shown **positive effects of these farming practices on revenue per hectare**[45]. Specifically, in **maize-based systems, conservation agriculture assists in preserving soil moisture, allowing farmers to better navigate dry spells and periods of low rainfall**[46]. However, many Zambian farmers **grapple with the consistent implementation and maintenance** of conservation agriculture practices[47,48], which can hinder achieving optimal yields. Improving implementation, matched with the use of appropriate technologies and inputs could substantially narrow Zambia's maize yield gap[49].

43 Nelson et al. (2009). Climate change: Impact on agriculture and costs of adaptation. International Food Policy Research Institute. **https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/130648/filename/130821.pdf**

44 Pittelkow, Liang, Linquist et al. (2015). Productivity limits and potentials of the principles of conservation agriculture. Nature. **https://www.nature.com/articles/nature13809#citeas**

45 Ng'ombe, Kalinda, Tembo. (2017). Does adoption of conservation farming practices result in increased crop revenue? Evidence from Zambia. Agrekon. **https://www-tandfonline-com.gate3.library.lse.ac.uk/doi/full/10.1080/03031853.2017.1312467**

46 Thierfelder, Chivenge, Mupangwa et al. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on adaptation, mitigation and productivity on smallholder farms in southern Africa. Food Security. **https://link.springer.com/article/10.1007/s12571-017-0665-3#citeas**

47 Arslan et al. (2014). Adoption and intensity of adoption of conservation farming practices in Zambia. Agriculture, Ecosystems & Environment. **https://www.sciencedirect.com/science/article/abs/pii/S0167880913002776**

48 World Bank. (2019). Climate-Smart Agriculture in Zambia. **https://climateknowledgeportal.worldbank.org/sites/default/files/2019-06/CSA%20_Profile_Zambia.pdf**

49 Silva et al. (2023). Narrowing maize yield gaps across smallholder farming systems in Zambia: what interventions, where, and for whom? Agronomy for Sustainable Development. **https://link.springer.com/article/10.1007/s13593-023-00872-1**

The **adoption** rate of conservation agriculture is influenced by several factors. **Extension services and rainfall variability are primary drivers**[47]. Farmers are more inclined to adopt conservation farming when they're equipped with relevant knowledge and when exposed to climate-related risks. It's worth noting, however, that the benefits of conservation farming often take between 2-5 cropping seasons to become evident[46]. **This delayed gratification partially explains high rates of disadoption**. For a comprehensive understanding, further research is essential, both to better understand the reasons behind limited uptake, and to discern the conditions under which conservation farming is most productive.

Building resilience to climate change – Policy options

- **Incentivise climate-smart agricultural techniques:** Agricultural policies by the government should incentivise the adoption of climate-smart agricultural techniques such as conservation farming. These techniques show to be more sustainable and resilient in the face of climate variability. In addition to being more environmentally sustainable, such techniques can also increase productivity and incomes of farmers. Given that farmers experience high rates of dis-adoption of such techniques, it is important to not solely incentivise the adoption but encourage the sustained utilisation through continuous support, education, or reinforcement of benefits.
- **Enhanced extension services:** Given the high ratio of farmers to extension workers, there is a need to increase the recruitment and training of additional extension officers to ensure adequate service provision. Additionally, adopting strategies to improve communication between extension workers and farmers could enhance the learning process. Communication methods that integrate farmers into the learning process could ensure that agricultural techniques and technologies are effectively communicated. Furthermore, reducing the administrative load on extension workers while providing them with the necessary equipment such as motor bikes, ensures that they effectively reach and serve farmers.
- **Improve climate information services:** Enhanced climate information services, providing comprehensive details like rainfall onset and cessation dates, daily weather forecasts, and rainfall predictions, could empower farmers to make well-informed decisions about what and when to plant. A study conducted in Ethiopia underscores the significant impact that access to climate information can have on agricultural productivity[50]. This may include enhancing the accessibility of existing climate data through various channels such as radio broadcasts, television, extension agents, and digital platforms, making it more readily available to those who need it the most.

50 Tamru et al. (2022). Climate information services to enhance agricultural resilience: Evidence from Ethiopia. https://www.theigc.org/blogs/climate-priorities-developing-countries/climate-information-services-enhance-agricultural

> "In Zambia, approximately 85% of the credit allocated to the agricultural sector is absorbed by large-scale commercial farms."

Adrian Wojcik/iStock/Getty Images Plus via Getty Images

2. Improving access to agricultural finance

When credit and insurance choices are limited, even in the presence of high returns on investment, farmers investment activities remain low.[51] As such, **access to finance is widely regarded one of the major constraints to agricultural productivity in developing countries**, especially for small- and medium-sized enterprises. The International Finance Corporation (IFC) **estimates a $4.5 trillion (USD) financing shortfall for SMEs**[52]. This deficit significantly impacts agricultural producers, as financial institutions perceive lending to the agricultural sector as more costly. This perception stems from higher expenses associated with catering to remote locations, a deficiency in financial management capacity as well as the inherent systemic risks endemic to the sector, such as climate and market risks[53].

Agricultural enterprises require access to capital for various reasons. Income is typically generated only once or twice a year, depending on the number of harvest seasons, while costs can arise throughout the entire year. Consequently, working capital loans serve as a valuable resource for agricultural producers to finance their day-to-day activities. Furthermore, access to finance is often utilised by agricultural enterprises to acquire additional inputs, machinery, and engage in other investments that help expand their operations. Additionally, a study in Kenya has documented a positive impact on farm revenues when providing farmers with credit during the harvest season. Given that expenses during this period tend to be high, access to finance enables farmers to store a portion of their produce and sell it during periods of higher prices. By capitalising on price fluctuations, farmers can engage in effective arbitrage, purchasing crops when prices are low and selling them when prices are high[54].

In Zambia, approximately 85% of the credit allocated to the agricultural sector is absorbed by large-scale commercial farms. Contrastingly, small- and medium-scale farmers are believed to receive only 8% of the credit, with fewer than 3% of small- and medium-scale producers having access to formal lending channels. Additionally, borrowing costs for agricultural ventures are relatively steep. In 2018, **commercial banks' interest rates for agricultural enterprises usually exceeded 25%**, and on occasion being as high as 50%. Notably, for smaller producers, loans typically do not extend beyond a year. These steep rates can partially be attributed to non-performing loans, which are exacerbated by factors such as climate-induced shocks, export restrictions, and the depreciation of the Kwacha[55]. Examining **Figure 13**, the second most cited reason for agricultural enterprises not accessing credit is due to unfavourable interest terms. **Among the agricultural firms indicating they didn't apply for a loan, only 47% attribute this to not requiring credit**. It's important to highlight that credit requirements and constraints often differ

51 Karlan et al. (2014). Agricultural Decisions after Relaxing Credit and Risk Constraints. The Quarterly Journal of Economics. **https://academic.oup.com/qje/article/129/2/597/1867065?login=false**

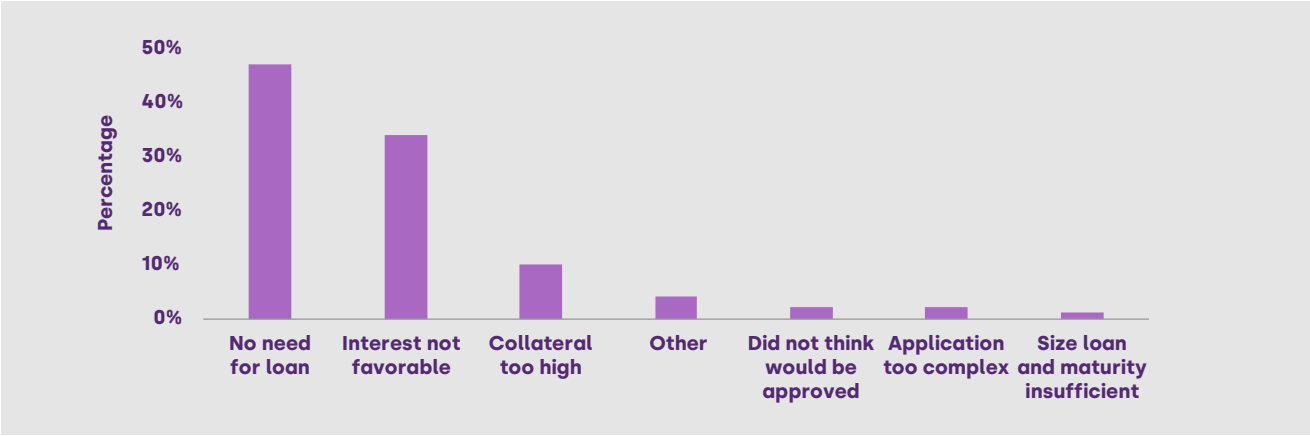
52 IFC. (2017). MSME Fianance Gap: Assessment of the Shortfalls and Opportunities in Financing Micro, Small, and Medium Enterprises in Emerging Markets. World Bank. **https://www.smefinanceforum.org/sites/default/files/Data%20Sites%20downloads/MSME%20Report.pdf**

53 Macchiavello et al. (2023). Evidence Review for agricultural SME finance. **https://www.theigc.org/publications/evidence-review-agricultural-sme-finance**

54 Burke et al. (2019). Sell low and buy high: arbitrage and local price effects in Kenyan markets. The Quarterly Journal of Economics. **https://academic.oup.com/qje/article-abstract/134/2/785/5266398**

55 World Bank. (2019). Agricultural Finance Diagnostic Zambia. **https://documents1.worldbank.org/curated/en/241301582041593315/pdf/Agriculture-Finance-Diagnostic-Zambia.pdf**

Figure 13: Reported reasons for why agricultural firms in Zambia did not apply for loans.



Note: The underlying data comes from the 2019 World Enterprise Survey. Stratification sectors included are "Food" and "Wholesale of Agri Inputs & Equipment." Data source: World Bank. (2021). World Bank Enterprise Surveys.

based on the size of the producer. As such, the diagram may change when analysing small, medium, or large producers specifically.

There is significant evidence showcasing the positive impact of subsidised loans on poor Zambian farmers. A recent study shows that by gaining access to subsidised loans during the hungry season, farmers experience an increase in wages and agricultural output, alongside improvements in food security. This accessibility to credit is particularly vital as it enables farmers to better navigate through seasons of scarcity, ultimately contributing to the stabilisation of their livelihoods. However, the authors of the study also bring attention to the challenges that accompany the provisioning of these loans. High transaction costs, which are a prevalent challenge in rural environments, combined with the risks associated with default and additional implementation expenditures, contribute to the steep interest rates that farmers often encounter. These high rates underscore the necessity for alternative credit mechanisms, leveraging technology to reduce transaction costs and make the provision of credit more economical. Mobile money is one technology which could reduce these transaction costs[56].

56 Kelsey, Fink, Masiye. (2014). Seasonal Credit Constraints and Agricultural Labor Supply: Evidence from Zambia. NBER Working Paper Series. **https://www.nber.org/papers/w20218**

CASE STUDY

There have been studies conducted aimed at investigating the effects of enhancing credit accessibility for SMEs in developing countries. Research indicates that several of these initiatives have successfully increased investment, particularly among smaller SMEs[57]. For smallholder farmers, research indicates that **alongside access to finance, uninsured risk is a pivotal factor in underinvestment**. A study in Ghana showed significant increases in investments by smallholder farmers after receiving rainfall insurance, which had an even more pronounced effect on farmer investment than cash grants[51]. This finding is particularly interesting in Zambia's context, where weather insurance is a prevalent financial service for both large commercial and smallholder farmers. In the 2017/18 season, 900,000 policies were sold, insuring $150 million. Though this insurance aimed to safeguard farmers against extreme weather and stabilise their cash flows, payouts were delayed and executed via e-vouchers redeemable for inputs instead of cash[34]. This added layer of uncertainty around payments might discourage agricultural producers from investing.

Improving access to agricultural finance – Policy options

Among the agri-businesses that reported they did not apply for a loan, only 47% indicated this was due to a lack of need for credit. This suggests that a substantial percentage of agricultural enterprises in Zambia perceive themselves as credit constrained. Although there is no single, clear-cut strategy for the government to address this issue, several potential options exist which the government could consider helping bridge this credit gap.

1. **Agricultural loan programs:** This would involve the establishment of a loan programme specifically designed for smallholder farmers and small- and medium-sized agricultural enterprises. The government could offer loans with subsidised interest rates and longer repayment periods than what the market generally offers to alleviate the burden of high borrowing costs.
2. **Incentives to lending:** The government has the capacity to increasing private sector lending to agricultural producers by offering incentives to facilitate loans to agricultural SMEs. These incentives could take the form of credit guarantee schemes, first-loss coverages, and origination incentives, all designed to mitigate both the cost and risk associated with extending credit to agricultural producers. Such incentive programs have the potential to stimulate banks' willingness to lend, narrowing the credit gap that currently exists within Zambia's agricultural sector.
3. **Weather-indexed insurance:** To mitigate climate-related risks and bolster investments by smallholders, the government could advocate

57 Kersten et al. (2017). Small Firms, large Impact? A systematic review of the SME Finance Literature. World development. **https://www.sciencedirect.com/science/article/abs/pii/S0305750X17301298**

for the broader use of efficient weather-indexed insurance products. To ensure the success and uptake of such products, it's essential to accompany them with awareness campaigns that educate farmers on the unpredictable nature of climate-induced events. These campaigns could underscore the long-term benefits of insurance even in the absence of short-term weather shocks. Such insurance should offer extensive coverage and timely pay-outs for affected farmers, incentivising them to invest more confidently in their operations.

4. **Financial literacy programs:** One perceived risk to financial institutions is smallholders and agricultural SMEs' lack of financial literacy. Among rural households, only 16.2% of are financially literate[58]. By building programs to improve financial management skills among agricultural enterprises, the government could help farmers manage their finances more effectively and become more attractive to lenders. This could involve providing training on basic accounting, financial planning, and risk management.

3. Market access

Market access in the context of agriculture can loosely be thought of as the ability of agricultural producers to sell their goods in both national and international markets. While there are several aspects which might affect farmers ability to sell their produce, we will focus on **infrastructure** and **government policy**.

Infrastructure

Zambia's road infrastructure plays a crucial role in the country's economy and agricultural sector. Nevertheless, the poor condition and limited reach of these roads, particularly in rural areas, pose challenges for market access and productivity, especially for smallholder farmers.

Zambia's road network stretches approximately 68,000 km, with Lusaka functioning as the central node. The network is crucial for the nation's copper exports and includes main trading corridors which are paved and well-maintained, leading from Lusaka to key border points. Secondary corridors, often consisting of a mix of gravel, sand, and dirt roads, are often subject to weather damage but essential for the distribution of goods, especially agricultural produce. Challenges are most pronounced in rural and border regions where the road conditions can be especially challenging[59]. As of 2011, a mere 17% of the rural population in Zambia resided within 2 kilometres of a good road[60]. Some estimates suggest that **just over 50% of smallholder farmers reside within 3 kilometres of a feeder road**. Furthermore, the quality of these roads can vary greatly, which in turn can affect market accessibility. There is some **evidence suggesting a negative association between farmer's distance to a feeder road and a trader's willingness or ability**

58 Bank of Zambia. (2020). FinScope Zambia 2020 Survey Report. **https://www.boz.zm/FinScope-2020-Survey-Report.pdf**

59 Logistic Cluster. (2022). Logistics Capacity Assessments - Zambia. **https://dlca.logcluster.org/23-zambia-road-network**

60 World Bank. (2023). Rural Access Index (RAI). **https://datacatalog.worldbank.org/search/dataset/0038250**

to access these local markets[61]. Despite complaints from farmers about the substandard quality of feeder roads and the resulting lack of market access, there's been limited research specific to Zambia on the influence of road quality improvements on aspects such as agricultural productivity, investment, and costs.

Studies from other countries underscore the significance of road access for agricultural producers. For instance, research from Nepal found that the **market value of an agricultural plot is associated with its proximity to roads**. Shorter distances to roads enhanced engagement in agricultural markets and boosted farm production and incomes[62]. Research from Sierra Leone revealed that **improvements in road infrastructure were associated with a decrease in the market prices of local agricultural produce** due to a reduction in search frictions[63]. However, it's important to note that the efficacy of road improvement programs is highly dependent on context and specific circumstances. A study from India demonstrated that a national rural road construction program did not enhance agricultural outcomes; instead, it facilitated workers' migration away from the agricultural sector[64]. This calls for more Zambia-specific research to investigate the relationship between road infrastructure and agricultural outcomes.

Government intervention

The Zambian government's interventions in the agricultural sector are often intended to protect farmers and stabilise the market, however, these measures can exacerbate market risks and can lead to unintended negative consequences. Short-term actions, such as **imposing export bans, strategic stockpiling, and price controls, despite being designed to mitigate production-related risks, can often increase price volatility**. A particular instance was the imposition of an export ban on maize due to high regional demand, despite a production surplus in 2017. This intervention led to an almost 40% drop in prices, disadvantaging net sellers[36].

The FRA argues that it extends market access to smallholder farmers who would otherwise be overlooked by the private sector. Nevertheless, some early evidence from 2011 suggests that **farmers were more likely to sell their produce to the FRA when located closer to a district town**. Conversely, maize sales in more remote areas were primarily handled by assembly traders. While agricultural policies and the FRA have developed since then, this pattern brings into question the extent to which the FRA provides effective market access for smallholder farmers and highlights the notable reach of the private sector into remote areas[65]. It would hence be useful to understand whether

61 Chapoto,Jayne. (2019). Zambian farmers' access to maize markets. Gates Open Res. **https://gatesopenresearch.org/documents/3-1168**

62 Shrestha. (2020). Roads, participation in markets, and benefits to agricultural households: Evidence from the topography-based highway network in Nepal. Economic Development and Cultural Change. **https://www.journals.uchicago.edu/doi/full/10.1086/702226**

63 Casaburi, Glennerster, Suri. (2013). Rural roads and intermediated trade: Regression discontinuity evidence from Sierra Leone. Available at SSRN. **https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2161643**

64 Asher, Novosad. (2020). Rural roads and local economic development. American economic review. **https://www.aeaweb.org/articles?id=10.1257/aer.20180268**

65 Chapoto, Jayne. (2011). Zambian farmers' access to maize markets. Gates Open. **https://gatesopenresearch.org/documents/3-1168**

this relationship is still persistent today or if policy changes have improved market access and economic outcomes for rural farmers in Zambia.

Restrictive measures such as export bans, often enforced in response to food security concerns, can lead to temporary price reductions and improved food security. However, as evidence from Malawi shows, these measures eventually cause a decrease in farmer income and a long-term reduction in food supply due to diminished production incentives[66]. Moreover, the effects of trade policy uncertainties, which often lead to reduced investment, decreased employment opportunities, and restricted entry into foreign markets, underline the importance of considering producer incentives when formulating policy[67,68,69].

These instances underscore often well-intended but complex and sometimes counterproductive cases of government interventions, affecting market access in Zambia's agricultural sector.

Market access – Policy options

1. **Infrastructure investment research:** The government can collaborate with researchers to understand the importance of feeder roads for agricultural productivity. Once it is understood what the relationship between road infrastructure and agricultural productivity is, the government could use this information in its considerations around increasing investments in road infrastructure to improve market access to small-holder farmers.
2. **Evaluating market access through FRA:** The government should consider teaming up with researchers to thoroughly investigate the Food Reserve Agency's (FRA) role in facilitating market access for smallholder farmers. The research should aim to understand the FRA's effectiveness, reach, and the economic outcomes of its operations, particularly in remote areas. Upon understanding these dynamics, the government could utilise this knowledge to reform and optimise FRA's strategies and interventions. This would aim to ensure broader and more effective market access for smallholder farmers, thereby improving their economic outcomes.
3. **Policy predictability:** Creating a stable and predictable policy environment for agricultural policy is important to encourage agricultural investment. Transparency and communication in policy changes can reduce uncertainty and encourage spending. When the government is considering sudden policy changes like export bans, negative production incentives on farmers need to be considered.

66 Aragie, Pauw, Pernechele. (2018). Achieving food security and industrial development in Malawi: Are export restrictions the solution?. World development. **https://www.sciencedirect.com/science/article/pii/S0305750X18301025**

67 Caldara et al. (2020). "The economic effects of trade policy uncertainty." Journal of Monetary Economics. **https://www.sciencedirect.com/science/article/pii/S0304393219302004**

68 Baker et al. (2016). Measuring Economic Policy Uncertainty, The Quarterly Journal of Economics. **https://doi.org/10.1093/qje/qjw024**

69 Crowley, Meng, Song. (2018). Tariff scares: Trade policy uncertainty and foreign market entry by Chinese firms. Journal of International Economics. **https://www.sciencedirect.com/science/article/pii/S002219961830117X**

4. Adoption of agricultural technology

Agriculture has seen substantial changes in recent decades driven largely by technological advancements. These include the improvements in irrigation systems, the development of more efficient farming equipment, the introduction of superior seeds and fertilisers, and increasingly, the incorporation of data-driven practices across the industry. Some evidence suggests that adopting advanced technologies can enhance the well-being of smallholder farmers. In the short-term, these advancements could improve farmers' health, while in the long run, they can contribute to improved food security and increased income[70,71].

Despite evidence around advantages of the use of advanced agricultural technologies, adoption of said technologies can often remain low in low- and middle-income countries. There is suggestive evidence arguing that adoption rates vary based on farmer characteristics. **Education, land size, access to credit, land tenure, contact with extension agents, and membership in farmers' organisations are identified as key factors influencing adoption of agricultural technologies** across multiple technology categories[72].

Technology adaption rates in Zambia are considered to be low. A study from 2016 argues that adoption rates of herbicides and animal traction use are below 50% among smallholder farmers[73]. Mechanisation rates are also low, with only 0.2% of farmers owning tractors and a mere 1.7% utilising tractor services[38]. However, this contrasts with the fact that farmers face labour constraints, particularly in weeding and land preparation, highlighting the potential benefits of mechanisation in these areas. It is estimated that around 50% of households are willing to pay prices exceeding prevailing market rates for ripping services, while 5-10% are willing to do so for direct seeding[74]. These findings suggest that the limited adoption of mechanisation is likely also influenced by restricted access to the necessary technology.

Technology could furthermore help leverage the positive effects of conservation agriculture in Zambia. When improved maize varieties are used in conjunction with conservation agricultural practices, the effects on yields and income are starker then when they are applied in isolation[75].

70 Ayenew, Laken, Kristos. (2020). Agricultural technology adoption and its impact on smallholder farmers' welfare in Ethiopia. African Journal of Agricultural Research. **https://academicjournals.org/journal/AJAR/article-full-text/E44FE6863235**

71 Adams, Jumpah. (2021). Agricultural technologies adoption and smallholder farmers' welfare: Evidence from Northern Ghana. Cogent Economics & Finance. **https://www.tandfonline.com/doi/abs/10.1080/23322039.2021.2006905**

72 Ruzzante, Labarta, Bilton. (2021). Adoption of agricultural technology in the developing world: A meta-analysis of the empirical literature. World Development. **https://www.sciencedirect.com/science/article/pii/S0305750X2100214X**

73 Namonje-Kapembwa, Chapoto. (2016). Improved Agricultural Technology Adoption in Zambia: Are Women Farmers Being Left Behind? Policy Brief. **https://renapri.org/wp-content/uploads/2021/11/IAPRI_PB83_2016.pdf**

74 Ngoma, Hambulo, et al. (2023) "Smallholder farmers' willingness to pay for two-wheel tractor-based mechanisation services in Zambia and Zimbabwe." Journal of International Development.

75 Khonje et al. (2018). Adoption and welfare impacts of multiple agricultural technologies: evidence from eastern Zambia. Agricultural Economics. **https://onlinelibrary.wiley.com/doi/abs/10.1111/agec.12445**

A few possible explanations for low technology adoption rates suggested by cross-country evidence are:

1. **Lack of market incentives:** Even with access to high-quality inputs, farmers might not be incentivised to use them if the current market structure doesn't reward superior produce. This could be due to a lack of technology to validate produce quality[76], or due to buyer exploitation in markets where farmers have few alternatives. Providing farmers with access to a market that rewards quality can lead to increased productivity and income[77].
2. **Ineffectiveness of government extension programs:** Despite heavy investments, government programs aiming to educate farmers about new technologies and subsidise their adoption have been costly and arguably often fail to reach target beneficiaries[10,14]. In contrast, alternative information dissemination methods, such as social networks which disseminate information about new technologies have shown promise in increasing adoption[78].

CASE STUDY

In this case study on technology adoption in Zambian agriculture, researchers explored the challenges hindering adoption and evaluated the impact of subsidies and follow through rewards on farmers' behaviour. The study focused on the planting of Faidherbia albida trees for cotton production, a practice which can result in crop yields soaring by 100% to 400%, compared to the production in the absence of fertilizer.

One issue with technology adoption is that costs and benefits often don't occur at the same time. Costs usually occur early on while benefits sometimes materialise only in the long run. Consequently, farmers can become uncertain around the net benefit of a technology even if it is said to add value. The researchers randomly allocated subsidies for adopting the technology and rewards for following through with them after a year. After having received a day training on how to plant these trees and the potential benefits of them, adoption rates were high for both subsidised and unsubsidised farmers. Conversely, rewards for continued technology usage significantly improved follow-through rates after a year. The findings underscore the importance of not just the initial adoption of technology but also its sustained use. When creating incentive systems around technology adoption, follow-through needs to be considered in the design of policy[79].

76 Do Nascimento Miguel. (2022). Returns to Quality in Rural Agricultural Markets: Evidence from Wheat Markets in Ethiopia. **https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4326165**

77 Bold et al. (2022). Market Access and Quality Upgrading: Evidence from Four Field Experiments." American Economic Review. **https://www.aeaweb.org/articles?id=10.1257/aer.20210122**

78 BenYishay, Mobarak. (2019). Social learning and incentives for experimentation and communication. The Review of Economic Studies. **https://academic.oup.com/restud/article-abstract/86/3/976/5061309?login=false**

79 Bell et al. (2020). The Timing and Effectiveness of Subsidies for Agricultural Technology Adoption in Zambia. **https://www.povertyactionlab.org/evaluation/timing-and-effectiveness-subsidies-agricultural-technology-adoption-zambia**

Martin Harvey/The Image Bank via Getty Images

Policymakers should account for **four critical dimensions: accessibility, context, adoption, and sustained use** when thinking about technological adoption. It is crucial for policies to ensure that farmers have access to advanced technologies that enhance agricultural production specific to their unique circumstances. Additionally, policies must facilitate the adoption of these technologies by farmers, while concurrently ensuring their sustained use over time.

Adoption of agricultural technologies – Policy options

1. **Subsidies for adoption and follow through:** When formulating policies that encourage the adoption of new technologies, it is crucial to encourage not just initial adoption but also the persistent use of these technologies. It can take time for the benefits of technology to materialise, which could result in premature discontinuation if not properly incentivised. Hence, combining adoption subsidies with continuation rewards as well as educational programs around the benefits of specific technologies can effectively help in ensuring that the adoption phase smoothly transitions into a phase of continued usage, thereby allowing the full benefits of the technology to materialise over time.
2. **Enhancing agricultural mechanisation adoption:** In response to low technology adoption rates among Zambian farmers, particularly in mechanisation, the government should consider implementing strategies to broaden access and adoption. Farmers seem to be willing to pay for mechanisation but lack access to such services. The aim is to make essential farming technologies more accessible, thereby enhancing productivity among smallholder farmers.
3. **Supportive policy for development of irrigation systems:** Researchers recommend that, considering the forecasted climate changes in Zambia, farmers should shift from the widespread use of surface irrigation methods to more water-efficient systems, such as overhead irrigation models. The government can encourage this transition through subsidies or educational initiatives. Recognising that water scarcity could elevate irrigation costs, the government should enhance access to credit to help smallholders cover initial investment expenses. Moreover, it is crucial to institute protective measures for smallholders who compete with larger-scale users for scarce water resources. This can be accomplished through enforceable water user rights and fees, transparent methods for obtaining water rights, and well-supervised irrigation development funds reserved specifically for smallholder farmers[30].
4. **Mitigating post-harvest losses:** Smallholder farmers still struggle with significant levels of post-harvest losses, a challenge that, currently, affects about 17% of them. International development organisations, such as the World Food Program, have initiated programs aimed at reducing these losses. They do so by providing post-harvest management solutions to farmers[33]. To enhance the effectiveness and reach of these programs, the Zambian government could enhance its partnership with these organisations. By doing so, they could ensure a broader accessibility to these innovative technologies and foster farmers' understanding of their benefits.
5. **Digital agricultural extension services:** The government could take an active role in the implementation and regulation of digital agricultural extension services, focusing on creating user-friendly, accessible interfaces and simple, easy-to-understand content. This could involve partnering with private companies or development organisations that specialise in these areas. Policy makers would need to ensure that the information provided to farmers is unbiased, context specific, and that the program is well advertised ensuring high adoption rates.

Conclusion

Zambia's agricultural sector holds significant potential but at the same time encounters a diverse set of challenges that demand thoughtful policies to help release the sector's full capacity. The government has several ambitious policies to support the sector, especially smallholder farmers. However, these initiatives often struggle with efficient resource allocation, misaligned farmer incentives, significant market intervention, and an evident gap in impact evaluation. There is a strong need for empirical evaluations that assess the impact of agricultural programs to optimise the reach and effectiveness of government interventions.

The looming shadow of climate change poses another challenge. Changes in temperature and rainfall patterns risk reducing crop yields, with maize being a primary concern. Furthermore, prevailing agricultural practices often result in significant soil degradation. Conservation farming emerges as a potential solution, improving soil quality and climate resilience while holding the potential to improve farmer livelihoods. High rates of dis-adoption, driven by inadequate extension service delivery and delayed gratification of benefits, are very common across Zambia. The government therefore needs to ensure that conservation agriculture practices are incentivised through policy. Improving and expanding extension services and disseminating relevant climate information can further improve outcomes for farmers.

Financial constraints, particularly limited access to credit and insurance, are another source of concern. The agricultural sector, often perceived as high-risk by financial institutions, sees most credit flowing to large-scale entities. This leaves smallholder farmers and agricultural SMEs subject to significant credit constraints. Addressing this imbalance, the government could consider a subsidised loan program for smaller agricultural producers or incentivising lenders when lending to smaller agricultural enterprises. Furthermore, improving the quality and access of rainfall insurance, and prioritising financial literacy initiatives of farmers could increase investment.

While studies underscore the profound influence of road infrastructure on agricultural outcomes, Zambia-focused studies are scarce. Partnering with researchers to fill this gap in the literature could inform the government on potential upsides of infrastructure spending. While well-intentioned, the government's interventions in the agricultural sector sometimes inadvertently injects volatility, deterring potential investment by producers. Negative production incentives for farmers need to be considered when passing short-term restrictive policies.

While there are significant upsides to integrating technology in the production process, the adoption of pivotal technologies, especially mechanisation, have lagged behind. Policymakers must craft strategies that ensure accessibility to pivotal technologies as well as foster their sustained utilisation. Furthermore, the government could support adequate irrigation systems, improve access to post-harvest management practices, and consider introducing digital agricultural extension services.

A lot of constraints that limit agricultural productivity in Zambia are intertwined. Climate change will place additional pressure on the adoption of new technologies. The adoption of technologies is linked to adequate access to finance and current support schemes provided by the government. The willingness of financial institutions to provide agricultural credit is partially determined by the inherent risk of the sector, which in turn is related to climate change. Addressing just one aspect of this intricate system won't trigger fundamental change. If the government is serious about increasing productivity, making Zambia the breadbasket of the region, and ultimately improving the lives of millions who are dependent on the sector, many if not all these issues have to be thoroughly investigated.

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