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Ministry of Public Service and Labour

Analysis of Employment and Skills in the Maize Value Chain in Rwanda

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SKILLS RWANDA

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Acronyms

AAS	—	Annual Agricultural Survey
AfCFTA	—	African Continental Free Trade Area
AgriSETA	—	Agricultural Sector Education Training Authority
ARC	—	Agricultural Research Council
CIMMYT	—	International Maize and Wheat Improvement Centre
CIP	—	Crop Intensification Programme
DAFF	—	National Department of Agriculture, Food and Rural Development
DALRRD	—	Department of Agriculture, Land Reform and Rural Development
FAO	—	Food and Agriculture Organisation
FISP	—	Farmer Input Support Programme
FRA	—	Food Reserve Agency
GAP	—	Good Agriculture Practices
GDP	—	Gross Domestic Product
GMOs	—	Genetically Modified Organisms
MAAIF	—	Ministry of Agriculture, Animal Industry and Fisheries
MAZ	—	Millers Association of Zambia
MINAGRI	—	Ministry of Agriculture and Animal Resources
MINICOM	—	Ministry of Trade and Industry
MoA	—	Ministry of Agriculture
NAADS	—	National Agricultural Advisory Services
NaCRRI	—	National Crops Resources Research Institute
NAP	—	National Agricultural Policy
NAEB	—	National Agricultural Export Development Board
NISR	—	National Institute of Statistics Of Rwanda
PSTA	—	Strategic Plan For Agricultural Transformation
RCA	—	Rwanda Cooperative Agency
RWF	—	Rwandan Franc
RYAF	—	Rwanda Youth In Agriculture Forum
SADC	—	Southern African Development Community
SEDOs	—	Socio–Economic Development Officers
SIFAZ	—	Sustainable Intensification of Smallholder Farming Systems in Zambia
SMEs	—	Small And Medium–Sized Enterprises
SNS	—	Smart Nkunganire System
SSCs	—	Sector Skills Councils
UBOS	—	Uganda Bureau of Statistics
UGTA	—	Uganda Grain Trade Association
UNBS	—	Uganda National Bureau of Standards
USD	—	United States Dollars
Zamseed	—	Zambia Seed Company

Executive Summary

Agriculture is central to Rwanda's economy, generating substantial GDP and employing a significant portion of the workforce. Recognising this importance, national development strategies (NST1, Vision 2050, and PSTA4) prioritise agricultural modernisation, productivity, and resilience. Initiatives like the Crop Intensification Programme have driven the expansion of priority crops, such as maize, with regulations ensuring quality standards.

This study aims to develop a value chain analysis methodology for use in agricultural planning by focusing on the maize sector. It employs a three–component model examining core value chain functions, supportive infrastructure, and relevant rules. The methodology utilises desk research, a small–scale quantitative survey, and qualitative case studies to gather and analyse perceptions of those working in the value chain and a review of how other countries manage their value chain for skills development and employment in the maize sector.

Structure And Trends In The Maize Sector

The maize value chain in Rwanda consists of five core stages:

- Input dealers supply seeds, fertilisers, and pesticides.
- Production involves individual farmers, cooperatives, and private companies.
- Trade, marketing, and distribution include aggregators, retailers, wholesalers, and institutional buyers.
- Processors transform maize into flour and animal feed, sometimes bypassing middlemen by sourcing directly from cooperatives.
- Support services, like transportation, drying, and storage, underpin the entire chain.

Maize production is concentrated in the Eastern Province of Rwanda, particularly in Nyagatare, Kirehe, Ngoma, Gatsibo, and Kayonza districts. Nyagatare boasts the highest yield, followed by Kirehe. Export data is presented to illustrate dynamics of foreign demand for Rwanda’s maize.

Exports of cereals and flours from Rwanda (including maize) initially declined before COVID–19 but have since rebounded significantly. The sustained rise in exports, along with growing domestic demand from the public and processors, highlights the enormous growth potential for the maize sector.

Key Survey Findings

- **Actor Composition** — The maize value chain actors surveyed were predominantly cooperatives (41%). This was followed by individual farmers and a smaller number of private companies. The focus on production actors reflects their dominance in the chain, with fewer actors involved in upper–stage activities like processing.

- **Output and Turnover** — Cooperatives and private companies handle significantly larger maize quantities compared to individual farmers. This is due to their ability to pool resources like land, fer-

tiliser, and seeds, resulting in higher yields and production. Similarly, these actors reported more significant annual turnover than individual farmers, highlighting the benefits of cooperation and larger–scale operations.

- **Land and Input Use** — Individual farmers typically operate on smaller, privately owned plots of land (around 3.3 hectares) compared to cooperatives, which cultivate larger areas (18 hectares). Cooperatives frequently lease government land, including marshlands, for cultivation — an option unavailable to individual farmers.

- **Input Sourcing** — Both cooperatives and individual farmers predominantly source inputs like seeds, fertiliser, pesticides, and herbicides from local agro–dealers. Smart Nkunganire, a digitised input access platform, further streamlines this supply system. This reflects a well–organised input supply chain in Rwanda.

- **Input Quantities** — Unsurprisingly, cooperatives use significantly more seeds and fertilisers than individual farmers due to their larger–scale operations. This highlights how cooperatives can manage more significant quantities of inputs for greater production volume. Sector agronomists and extension workers also support more cooperatives perhaps the associated impact is greater in terms of reaching a bigger number of farmers through cooperatives as compared to individual farmers. Additionally, NGOs also prefer supporting cooperatives rather than individual farmers, when it comes to provision of training sessions and financial support which could be used to buy inputs.

- **Input Intensity** — Even when accounting for land size differences, cooperatives demonstrate higher input intensity (inputs used per hectare) than individual farmers. This is particularly prominent for fertiliser use and points to the benefits of pooled resources and knowledge within cooperatives.

- **Input Expenditure** — Cooperatives spend significantly more on seeds and fertiliser overall due to larger operations. However, individual farmers interestingly spend slightly more per hectare on fertiliser. This may be due to micro–loans or other forms of financial support commonly provided within cooperatives.

- **Supplier Challenges** — Affordability is a major concern, as many actors cite the rising cost of inputs as a significant challenge. Unexpected supply delays and quality issues are also problematic, demonstrating a need for greater reliability and cost control within the supply chain.

- **Productivity** — Cooperatives boast significantly higher yields (3.5 tons/hectare) than individual farmers (1.7 tons/hectare). This highlights the productivity gains achievable through collaboration and the pooling of resources and knowledge.

- **Marketing** — Both producers and non–producers within the value chain primarily sell to the local market. Export levels remain minimal, suggesting potential for growth in this area of the maize value chain.

- **Employment Composition** — The largest employment share lies within elementary occupations like casual labourers and cleaners. This is followed by skilled agricultural workers (farmers and cooperative

members). Professional, technical, and plant/machine operator roles represent a smaller but important segment of the employment profile.

- **Employment by Gender** — Women are overrepresented in less technical roles (clerical, elementary, and craft–related) and underrepresented in technical occupations. This underscores the need to encourage women's participation in technical training and provide opportunities for practical applications within the sector.

- **Employment by Stage** — Elementary workers dominates across all stages of the value chain. However, input supply stands out for its relatively high proportion of skilled agricultural workers, reflecting the expertise needed in seed multiplication and agro–dealing.

- **Skills Gaps** — Skills gaps impede a significant portion of value chain actors, particularly affecting production activities. The greatest skills shortages are in skilled agricultural occupations, machine operation, and technical roles.

- **Consequences of Skills Gaps** — Skills gaps primarily hinder production volume, quality output, and the ability to meet customer expectations. They can lead to technology underutilisation, operational cost increases, post–harvest losses, and even the discontinuation of certain products or services.

Qualitative Case Study Findings

Understanding the complexities of the maize value chain in Rwanda requires in–depth insights into the experiences and perspectives of diverse actors. This study combines qualitative data from various actors (seed multipliers, farmers, cooperatives, processors, and others) with quantitative survey results. This combined approach sheds light on critical themes such as employment and skills issues, value chain blockages, the role of technology, and the impact of government policies.

Employment and Skills

Employment in the maize value chain is concentrated primarily in the production stage, requiring mainly casual labour for tasks like planting, weeding, and harvesting. Workers are often recruited locally and possess limited formal skills. Skills gaps exist across different stages of the value chain, particularly in:

- Skilled Agricultural Work — Effective pest/disease control and fertiliser application.
- Technical Operation and Maintenance — For processors and larger operations.
- Post–Harvest Handling — Especially to minimise moisture content and aflatoxin infestation.

These gaps stem from limited access to training, low awareness of the benefits of hiring skilled labour (especially among cooperatives), and a lack of financial resources. The voluntary nature of leadership within some cooperatives further compounds the skills gap, as unpaid committee members juggle their traditional farming duties with management tasks. Some actors are addressing these challenges by proactively training and upskilling workers, seeking support from NGOs and development partners, and investing in specialised hires.

Blockages to the Value Chain

Several challenges hinder the maize value chain, preventing actors from scaling up production and moving up the value ladder. Key blockages include:

- Limited Access to Finance — Hinders investment in productivity–enhancing technologies and expansion.
- Inconsistent Seed Quality and Supply — Disrupts production and leads to yield variation.
- Poor drying and post–harvest handling — Low–quality maize is often rejected, limiting market access and income generation.
- Unreliable Power Supply — This mainly affects processors — especially for those operating outside industrial zones — leading to production inefficiencies and higher costs.
- Low prices and unreliable contracts demotivates production and threaten market stability.

The Role of Technology

Technology adoption remains limited due to financial constraints and small–scale operations. Manual methods for pest/disease control are still prevalent. However, there are promising developments:

- Smart Nkunganire System (SNS) — Facilitates access to inputs, but some actors highlight issues with inflexibility and digital literacy gaps.
- Digital payments are becoming more common, and processes are being streamlined.
- Emerging e–commerce use — Potential for broader market access but requires support to upskill actors.
- Innovative drying and storage — Technologies are available, but broader adoption requires scaling up access and support.

Influence of Government Policies

The Rwandan government has played a significant role in shaping the maize value chain through diverse policies and programmes:

- Crop Intensification Programme (CIP) — Promoting maize production.
- Subsidised Inputs — Improving affordability and encouraging adoption.
- Post–Harvest Loss Reduction — Investments in infrastructure and training are having a positive impact.
- Smart Nkunganire System (SNS) — Facilitating input access but with some concerns regarding seed choice and farmer adaptability.
- Made–in–Rwanda Policy — Supporting domestic seed production, with mixed views on its impact on productivity.
- Skills Development — Capacity–building initiatives are gradually enhancing farmers' knowledge base.
- Agriculture Insurance Programmes — Subsidies support adaptation to climate change risks.

Lessons from International Best Practice

Zambia — The Zambian maize value chain is marked by a predominance of smallholder farmers who provide the bulk of maize grain. However, limited access to agricultural inputs, finance, and markets constrains their productivity and market integration. Despite government initiatives and a growing milling sector, post–harvest losses remain a significant challenge, undermining food security and income potential. Additionally, the relatively informal nature of the market, with heavy reliance on intermediaries, can create price fluctuations and limited transparency for small–scale producers. As far as skills development in the maize value chain is concerned, the government plays an active role. The government provides training in production and post–harvest handling through the Ministry of Agriculture's crop extension services. The Food Reserve Agency (FRA), which is the largest buyer of maize grain, offers training to farmers on quality standards. FRA positions agents at various maize assembly centers who regularly train and sensitise farmers on quality requirements and regulations passed by FRA and helps farmers with regulatory compliance. The agents in turn are trained annually to ensure effective communication with farmers. This continuous capacity building model could be adopted by Rwanda, where MINAGRI offers the mainstream farming skills while MINICOM and RCA jointly with RFDA, RICA and RSB play a similar role of Zambia's FRA.

Uganda — Uganda's maize value chain exhibits a blend of smallholder production and a growing presence of larger commercial farms. While the country boasts higher maize yields than many regional counterparts, significant portions of maize are traded informally, hindering price stability and limiting the reach of regulatory quality controls. Despite a sizable milling sector, especially in urban areas, infrastructural challenges and high energy costs hinder the sector's competitiveness and contribute to higher consumer prices for processed maize products.

South Africa — South Africa stands out as the regional leader in maize production and value addition, boasting a highly developed and commercialized maize value chain. The country's sophisticated agricultural sector benefits from well–integrated markets, advanced technologies, and strong research and development capacity. However, the dominance of a few large–scale players can create market concentration issues. Additionally, ongoing debates surrounding land ownership and reform highlight some of the socio–political complexities connected to the maize value chain in South Africa.

Overall, while each of these countries showcases varying levels of development within their maize value chains, there are some common themes. These include the need for greater investment in post–harvest handling and storage to reduce losses, improved infrastructure to support market access and integration, and policies that promote fair competition and inclusivity for smaller–scale actors within the sector. Aside from South Africa, not much effort is given to skills development and employment.

Recommendations and Conclusions

The agricultural sector presents complex and diverse skills needs across varying value chains in different countries. Understanding these requirements is key to crafting effective skills development and training programmes aligned with the realities of the sector. This analysis offers insights into the multifaceted nature of

skills and employment issues within selected agricultural value chains, highlighting the need for targeted interventions that address specific value chain dynamics and local contexts.

- **Skill Types & Dynamics** — The skills required in agriculture are diverse, spanning technical, managerial, entrepreneurial, and soft skills. Farmers and other value chain actors need proficiency in crop/livestock management, post–harvest handling, quality control, and basic business practices. The rise of agribusiness and value addition increasingly necessitates higher–level skills in areas like food processing, packaging, and marketing, making technical and vocational training pivotal for sector growth.

- **Skills Gap Challenges** — A significant challenge within agricultural value chains is the widespread skills gap hindering productivity and quality improvement. Low levels of formal education among many farmers, limited access to extension services, and inadequate training opportunities exacerbate this issue. There's a mismatch between the skills possessed by workers and those demanded by the evolving agricultural sector, hindering both employment creation and the adoption of new technologies.

- **Women & Youth Employment** — Women and youth represent a substantial portion of the agricultural workforce, yet they often face unique challenges. Limited access to land, finance, and training, coupled with gender–based discrimination, restrict their opportunities for decent employment and income generation. The agricultural sector needs more targeted programmes to empower women and youth and address their specific skills and employment needs.

Maize produces good crops in various climatic zones and it prospers in areas too dry for rice and too wet for wheat; thus fitting into a niche between the two. Maize grows quickly and produces almost double the yield of wheat.

Introduction

Agriculture is a primary contributing sector to Rwanda's economy, contributing 25% to the country's Gross Domestic Product (GDP) in 2022 (NISR, 2022). The Labour Force Survey 2022 estimated that over 3.4 million adults were employed in market–oriented agriculture, accounting for 46.8% of the working population in 2022 (NISR, 2023). It is important to note that, according to NISR, under the new international standards, employment in the agriculture sector includes only those who produce agricultural goods intended mainly for sale or barter and those who are paid to work in agriculture. Hence, 46.8 per cent of those employed in agriculture are accounted for by this new definition. Otherwise, when those involved in substance farming are included, a significant 70% of the population derives their livelihoods from agriculture. The employment rate in market–oriented agriculture is notably higher among women (55.6%) compared to men (39.8%), presenting an enormous opportunity for women's economic empowerment by promoting female–dominated activities or supporting women to engage in higher–value activities along the value chain. The relative importance of the agriculture sector is further reflected in the composition of exports, with traditional export crops like tea being among the single most important contributors to export revenues in Rwanda (NAEB, 2023).

According to the Rwanda Establishment Census of 2020, there were 405 establishments operating in the agriculture, forestry and fisheries sector, representing approximately 0.2% of the total number of enterprises (NISR, 2020). Of these, 31.7% were micro (employing 1–3 workers); 50.8% were small (employing 4–30 workers); 11.4% were medium (employing 31–100 workers); and 6.1% were large (employing over 100 workers). Although the trend of agriculture–related enterprises reduced by about 28% between 2014 and 2020, these enterprises still play a pivotal role in job creation. In 2020, a total of 16,813 workers — including 8,114 males and 6,899 females — worked in agriculture, forestry and fisheries–related establishments, representing 2.4% of the total number of workers covered by the census. The agriculture, forestry and fisheries sector is particularly important when it comes to employing women who represent about 51.7% of the total number of workers in the sector. Overall, it is clear that agriculture is quite crucial for the socio–economic development of Rwanda as a source of income, employment and livelihood especially to the rural population.

Given the relative importance of the agriculture sector, it is not surprising that it has been prioritised in national development in an attempt to leverage its potential contribution towards sustainable and inclusive growth. The fourth phase of the Strategic Plan for Agriculture Transformation (PSTA4, 2018–2024) also has strategic interventions meant to boost productivity and modernize agriculture and livestock, as well as build the resilience of agricultural systems and livelihoods to the adverse effects of climate change and extreme weather events (MINAGRI, 2018).

Priority Area 6 of the National Strategy for Transformation (2017–2024) focuses on the modernisation and increasing production of agriculture and livestock (Republic of Rwanda, 2018). The following strategic interventions were stipulated in the NST1 document:

- Strengthen the commercialisation of crop and animal resource value chains.

- Work with the private sector to increase the surface of consolidated and irrigated land and promote agricultural mechanisation.
- Promote new models of irrigation scheme management.
- Increases the land area covered by terraces and ensure their optimal use.
- Enhance farmers' access to improved seeds.
- Promote research and develop new seed varieties.
- Increase average productivity of key crops measured in tons per hectare.
- Work with the private sector to build post–harvest handling and storage facilities across the country and to add value to agricultural produce (processing).
- Scale up the production of high–value crops including horticulture (flowers, vegetables, fruits), among others.
- Establish a programme to improve professionalization of livestock farmers and increase their output in terms of quality, volume and productivity.
- Attract private sector and farmers to invest in flagship projects in the livestock sub sector.
- Put in place mechanisms to increase access to finance for farmers.

The National Strategy for Transformation also emphasises expanding the area planted to priority crops, from 635,603 hectares in 2017 to 980,000 hectares in 2024. This stimulated the large–scale growing of crops like maize and beans, including in marshlands later authorised for crop cultivation. The maize value chain is further guided by specific regulations, such as the requirement for a moisture content of less than 13.5% as a standard governing the proper drying of maize to maintain good quality and prevent aflatoxin infestation.

Agriculture and wealth creation is one of the five pillars of the country's Vision 2050 (Republic of Rwanda, 2020). The focus of the Vision 2050 is:

- Modern market–oriented and climate resilient agriculture.
- Scale up use of modern inputs and technologies to maximize productivity.
- Increased access to agriculture finance and risk sharing facilities.
- Integration within global value chains for higher–value products.

These policy developments complement earlier initiatives like the Crop Intensification Program (CIP), established in 2007 and instrumental in promoting certain priority crops, including maize, where the main emphasis was on increasing acreage and productivity. While maize production trends have increased over time in Rwanda, inadequate drying facilities coupled with limited skills in proper drying among farmers and cooperatives continue to imply higher–than–recommended moisture content. As far as moisture content is concerned, value chain actors have relatively low compliance, due to a combination of both lack of adequate drying facilities and knowledge in proper drying of maize. According to Codex Alinmentarus Commission (2017), the recommended moisture content to avoid moulds ranges between 12.8% and 15.2% wet basis, while the Food and Agriculture Organisation of the United Nations (FAO) recommends between 13–14%. The corresponding moisture content standard for the East African Community is 13% (EAS 2: 2011 ICS 67.060). However, the maize produced by individual farmers and cooperatives in Rwanda has a much higher moisture content than this threshold. Benchmark prices set by the Ministry of Trade and Industry reflect this phenomenon; in Season A of 2024, a minimum price of 400 RWF per kilogram was

set for maize with moisture content between 13.5% and 18%, while some farmers produce maize with moisture content as high as 25%, whose minimum price was set at 350 RWF per kilogram. This high moisture content often translates into high aflatoxin infestation, affecting the quality of maize grain. Concerted effort is hence needed to understand to boost compliance with moisture content, aflatoxin and other related maize quality standards.

Objectives of the Study

The objectives of the study are as follows:

- Develop a practical methodology for undertaking value chain analysis that can be used by planners and managers at the Sector Skills Councils and the CSO.
- Pilot the methodology in the agricultural sector and refine the approach for use in other identified sectors.

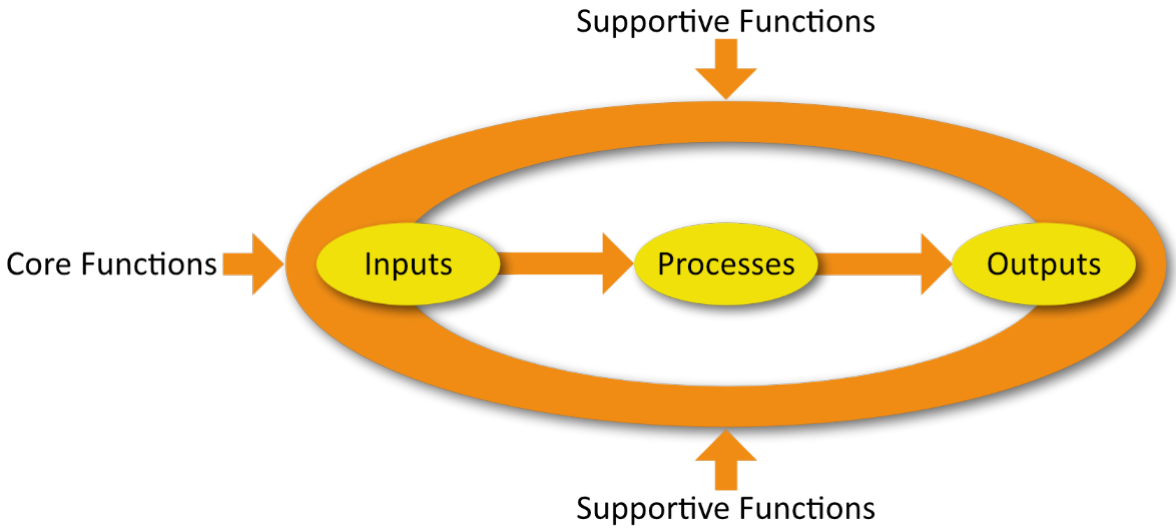
In 2022, maize was the world's 68th most traded product, with a total trade of $64.7B. Between 2021 and 2022 the exports of Corn grew by 19.3%, from $54.3B to $64.7B. Trade in Corn represent 0.27% of total world trade.

(https://oec.world/en/profile/hs/corn)

Theoretical Model and Conceptual Assumptions Underpinning the Study

Our model focuses on three components of selected agricultural value chains (Figure 1). The first part of our conceptual model focuses on the operation of the core functions associated with a value chain and consists of the inputs, the producer, and the buyer. This may be more complex since the relationship between the three stages may combine and not be stand–alone. Using this approach, we can understand the operations of different stakeholders involved in the value chains (selected input suppliers, operators of storage and transport facilities, providers of packaging materials, and buyers), their corresponding relationships, and, more importantly, how they influence production and management practices occurring between farmers and more formalised enterprises, and correspondingly how these impacts on employment and skills.

Figure 1: Conceptual model guiding the study



The second component of our approach focuses on what Porter calls the supportive infrastructure and what economists refer to as the enabling environment.[1] This is primarily concerned with the ease of doing business in the maize sector and what factors have facilitated or impeded this process. The former may relate to skills or human resource issues, organisational factors, and the availability of information about certain issues, including access to markets. Increasingly, one of the most critical issues affecting infrastructure is the role played by digitalisation and how it may bring stakeholders together, as well as the delivery of services. The final component of our approach focuses on rules, covering issues associated with legislation, regulations, and commitment to standards. The former is particularly important to the agricultural sector since they also cover trade agreements, which are essential for determining what type of markets Rwanda can access and what standards they need to achieve.

[1] Porter's, V. C. M. (1985). What Is Value Chain. *E–Commer.*, 1–13.

Methodology

The study was undertaken using a mixed–methods approach and entailing complementary desk–based and field–based activities. Information gathered from relevant documents as part of the research exercise were supplemented with available secondary quantitative data and collected primary quantitative and qualitative data.

Desk Research

The desk research exercise entailed reviewing relevant documents to create a thorough understanding of the context within which the value chain analysis was conducted. Additionally, quantitative information collected from some reports was used to present patterns and dynamics of maize production and/or export, which were presented tabularly and graphically. International case studies were also documented based on a comprehensive review of documents on value chains in other countries, with a view of picking lessons for and benchmarking with Rwanda. The documents reviewed during desk research include but are not limited to:

- Policy documents to shed light on the existing policy developments to promote modern and sustainable agriculture in Rwanda and skills and employment issues. Such documents include the National Strategy for Transformation (NST1, 2017–2024), the fourth phase of the Strategic Plan for Agricultural Transformation (PSTA4), and Vision 2050.
- Annual reports from MINAGRI and seasonal agriculture survey reports from the National Institute of Statistics of Rwanda (NISR) were meant to provide trends and dynamics of relevant agriculture indicators, such as the production of crops like maize.
- Annual reports from the National Agricultural Export Development Board (NAEB) show trends of volumes and values of cereals and flours — including maize — exported, serving as a proxy for foreign demand for Rwandan maize.
- Labour Force Surveys conducted by NISR indicate the proportion of people employed in agriculture compared to other sectors.
- Reports on maize value chains from other countries from which lessons would be drawn for benchmarking with Rwanda's context.

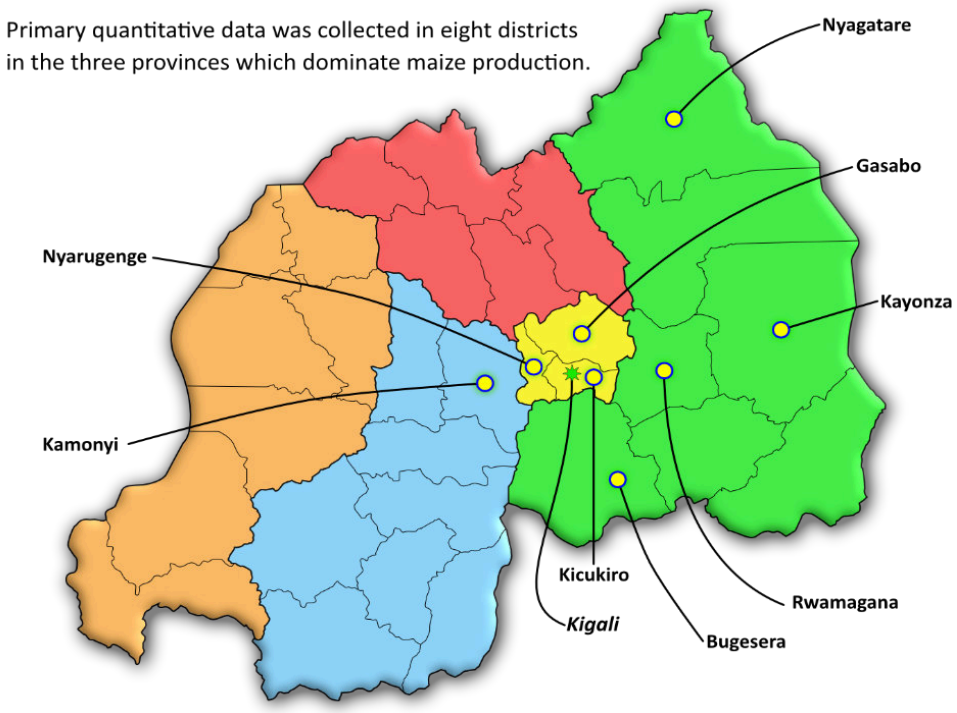
Collection of Primary Quantitative Data

Primary quantitative data was collected through a mini–survey of 36 actors along the different stages of the maize value chain. This covered eight districts and three provinces (Figure 2), which dominate maize production. Within the districts, value chain actors were selected through snowball sampling, where local leaders and interviewed actors would recommend other actors to be interviewed depending on their role and level along the value chain. Caution was, however, taken to ensure that the selected actors constitute reasonable representativeness of the different stages of the value chain.

Overall, the mini–survey involved 35 actors including two actors in input supply, 21 actors in production — including 10 individual farmers and 11 cooperatives — two actors in aggregation, eight in processing and packaging, and two in marketing and distribution. It is important to note that this disaggregation follows the

main activity reported by the respective actors. Moreover, several actors are involved in secondary activities in addition to their reported primary roles. The geographical scope of consulted actors is Bugesera, Kayonza, Nyagatare and Rwamagana districts in the Eastern Province; Gasabo, Kicukiro and Nyarugenge districts in the Kigali City Province; and Kamonyi district in the Southern Province (Annex). A structured questionnaire was used to elicit detailed information on identifying the actors, activities undertaken, output and turnover, employment, skills and skills gaps, success factors and challenges related to business growth, among others. Analysis was done descriptively, highlighting patterns cross–tabulating key characteristics of the actors and their processes along the different stages of the value chain.

Figure 2: Study/survey locations



Collection of Primary Qualitative Data for Case Studies

As part of the study, selected actors were profiled to gain deeper insights into the functioning of the maize value chain. A total of 10 actors were profiled, including two actors involved in seed multiplication (input supply), four actors in production, four processors and one aggregator. Information collected for the qualitative case studies included how the actors operate, how they managed to circumvent challenges to expand operations and/or move up the value chain, technologies used and how these have shaped production and performance, and skills gaps and how the government could support addressing them. The ultimate goal of the case studies was to provide in–depth evidence on how lead actors in the maize sub–sector are responding to change, the innovation they have introduced and the type of support they would like to be provided by the government. The case studies were built upon the mini–survey by identifying details of the specific blockages to the effective functioning of the value chain and providing an understanding of why they are occurring and how they could be addressed.

Data Analysis Strategy

A mixed–methods approach was used to analyse the collected data. The quantitative survey data was analysed using statistical techniques to identify trends, correlations, and the relative importance of factors influencing the maize value chain, especially around the drivers of change, skills formation, and employment–related issues. The qualitative interview data was coded and analysed thematically, especially around skills and employment and blockages to the value chain, revealing in–depth insights into stakeholders' experiences, challenges, and opportunities within the value chain. This thematic analysis helps contextualise and add explanatory power to the quantitative results.

The combined analysis was used to critically reflect on the study's original objectives, approach, and key findings. In addition, this was informed by a review of international practices for the sector, drawing on the experience of a few other maize producers in Africa. Based on this reflection and evidence, several recommendations were developed for policy improvements, particularly around strengthening the value chain, how they could positively impact decent work, and the implications for skill development.

On a final note, the analysis also considered the methodological implications of the approach, particularly in terms of how value chain assessment and analysis could be incorporated into sector skills planning, especially for the country's Sector Skills Councils (SSCs). This is an important dimension since it will allow the SSCs to take on board economic drivers of change and to consider how they could influence the employment agenda, especially around anticipating future skills in priority value chains.

Limitations of the Enclosed Study

With only 36 actors interviewed in the survey, the representativeness of the data for the entire maize value chain might be limited in statistical terms. However, it should be noted that the study was more concerned with exploring relationships between different drivers of change, their impact on employment, and their implications for skills development. Therefore, while the study might not be totally representative in statistical terms, it was representative in terms of explaining casual relationships around skills and employment and the factors that influence them. Additionally, some degree of representativeness is gained by covering actors of different sizes, operating along various stages of the value chain and in diverse geographical locations. Where necessary, some information from the survey and case studies was supplemented by the Seasonal Agricultural Survey of 2023 as well as the Rwanda establishment Census of 2014, 2017 and 2020 (NISR, 2021) in order to increase the validity of the findings.

Characterisation of the Maize Value Chain in Rwanda Chain in Rwanda

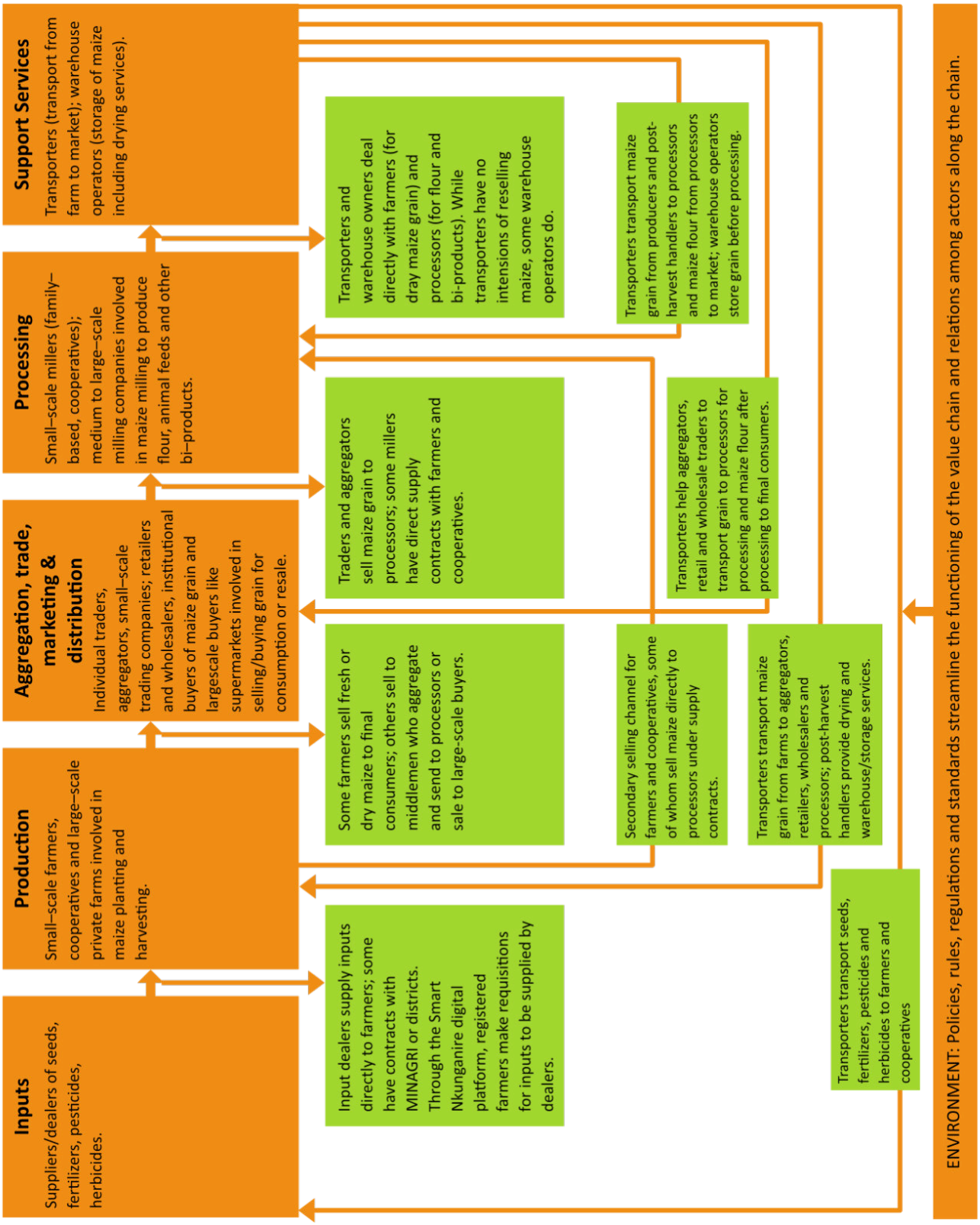
The structure of the maize value chain is characterised by five major stages: input dealing, production, trade, marketing and distribution, processing, and support services (Figure 3). This can be summarised as follows:

- **Input dealing** — This stage involves a system of agro–dealers who supply seeds, inorganic fertiliser, herbicides and pesticides as either individuals or small–scale to large–scale companies. At the community or village levels, the system of agro–dealers works with national inputs supply systems, including the Smart Nkunganire System (SNS), which requires farmers to register and be part of a database from which orders are placed and delivered by agro–dealers.
- **Production stage** — For the production stage (second stage), three types of actors are involved: individual farmers who don't belong to any cooperative or farmers' groups, cooperatives and groups of farmers, and small–scale to large–scale private farming companies.
- **Trade, marketing and distribution** — The third stage involves trade, marketing and distribution, including aggregators who buy maize grain from farmers and cooperatives and sell it to communities and/or actors at the upper stages of the value chain, for example, processors. Retailers sell maize in small quantities directly to individual customers. Wholesalers buy and resale maize grain and flour in larger quantities to high–end customers, while institutional buyers like schools mainly buy flour for final consumption.
- **Processing** — In the fourth stage are processors, which operate as either small–scale milling companies owned by individuals and cooperatives or large–scale factories that process maize into flour for human consumption and animal feeds like maize bran. Some large–scale processors like African Improved Foods (AIF) source maize directly from cooperatives and routinely train them on proper post–harvest handling for quality assurance. This approach, therefore, bypasses aggregators and retailers in the traditional chain flow and renders middlemen less important as farmers are connected directly to buyers. The processors often deal with farmer cooperatives with which they sign supply contracts, stipulating supply quantities and prices. The contracts are usually simple and terms and conditions are discussed and mutually agreed between the processors and farmer cooperatives prior to contracting.
- **Support Systems** — The final stage involves providers of support services like transporters and operators of drying facilities and warehouses for the storage of maize grain. These actors interact with all other actors. Transporters transport maize grain from individual farmers and cooperatives to aggregators, processors and consumers, maize flour and animal feeds from processors to end users. Operators of drying facilities help farmers and cooperatives to dry their maize grain. At the same time, warehouses store grain mainly for aggregators, traders and processors as it transitions to the upper stages of the value chain.

Regulations governing manufacturing practices of food products and licensing to manufacture, store, operate as wholesale and retail seller of processed foods and related products, are defined in the following:

- Food Safety Management Systems (FSMS–ISO 22000).
- Certification schemes for Good Agriculture Practices (GAP) and organic farming.
- National policies on agriculture: NST1 (2017–2024), PSTA4, Vision 2050.

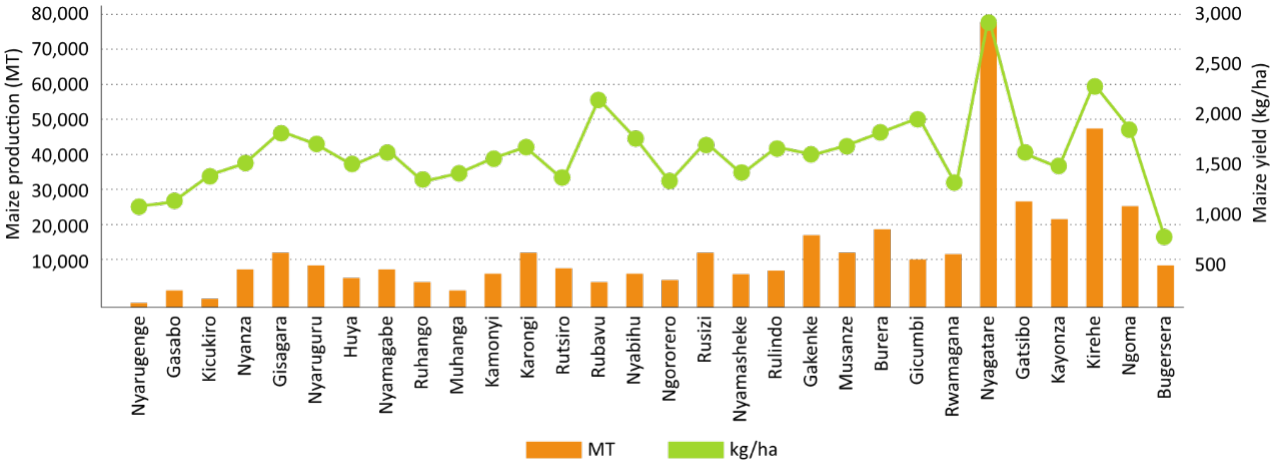
Figure 3: Structure of the maize value chain in Rwanda



Trend of Production and Export of Maize at the National Level

This sub–section analyses trends in the production and export of maize using secondary administrative data.[2] Maize production is mainly concentrated in the Eastern Province, with Nyagatare, Kirehe, Ngoma, Gatsibo and Kayonza districts as major contributors (Figure 4). The same pattern is observed for yield; Nyagatare district has the highest yield of three tons per hectare, followed by 2.2 tons per hectare in Kirehe, both districts being above the national yield of 1.7 tons per hectare. The eastern Province — particularly Nyagatare District — has favourable climatic conditions and soils for maize growing, and the flat nature of the terrain allows for large–scale cultivation resulting into larger–scale production relative to other regions.

Figure 4: District–level production of maize in Season A of 2023



Source: *Rwanda Seasonal Agricultural Survey 2023 Season A*

While local demand would be a good indicator of the overall demand dynamics and potential, data limitations complicate the exercise. To circumvent the challenge, the dynamics of exports are used as a proxy for measuring demand, presenting trends of export volumes and values over the period 2017–2023 (NAEB, 2023; 2022; 2021; 2020; 2019; 2018). Export trends are presented in Figure 5, indicating the volume and value of products exported between 2017 and 2023.[3] One issue with these statistics is that they are not disaggregated for some crops. For example, the volume and value of maize exported are not provided separately but rather grouped with other cereals and flours derived from them.

Table 1 shows further dynamics of area under maize cultivation, metric tons of maize produced and average yield between 2021 and 2023 for both seasons A and B, as well as value added per hectare.

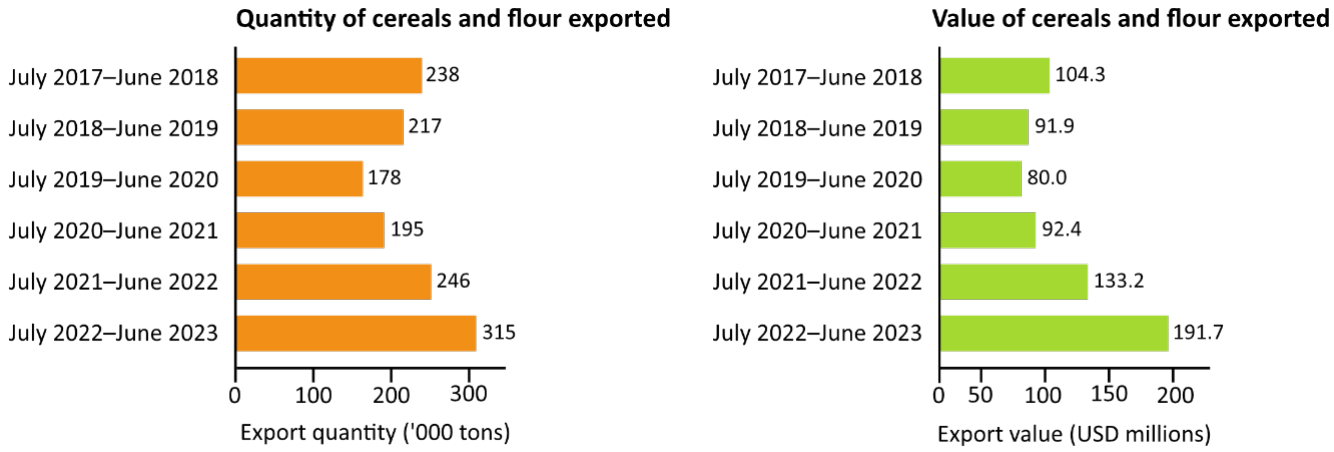
Export volumes and values for cereals and flours were on a downward trend even prior to COVID–19, from 238 metric tons in the fiscal year 2017/2018 to 178 metric tons in the fiscal year 2019/2020. However, volumes and values have risen consistently, reaching 315 metric tons and 191 million USD, respectively, in 2022/2023. The sustained rise in exports, coupled with the growing domestic demand by

[2] Production data is drawn from the Seasonal Agricultural Survey, Season A of 2023 report produced by the National Institute of Statistics of Rwanda (NISR).

[3] Volume is used in the NAEB reports to mean the total quantity of the product exported, measured in metric tons. On the other hand, value relates to the monetary value in United States Dollars, of the products exported.

the public and processing companies, jointly present an enormous potential for growth in demand for maize grain and maize flour.

Figure 5: Volume and value of cereals and cereal products exported: July 2017–June 2023



Source: *NAEB export statistics*

Table 1: Indicators related to maize production based on Seasonal Agriculture Survey

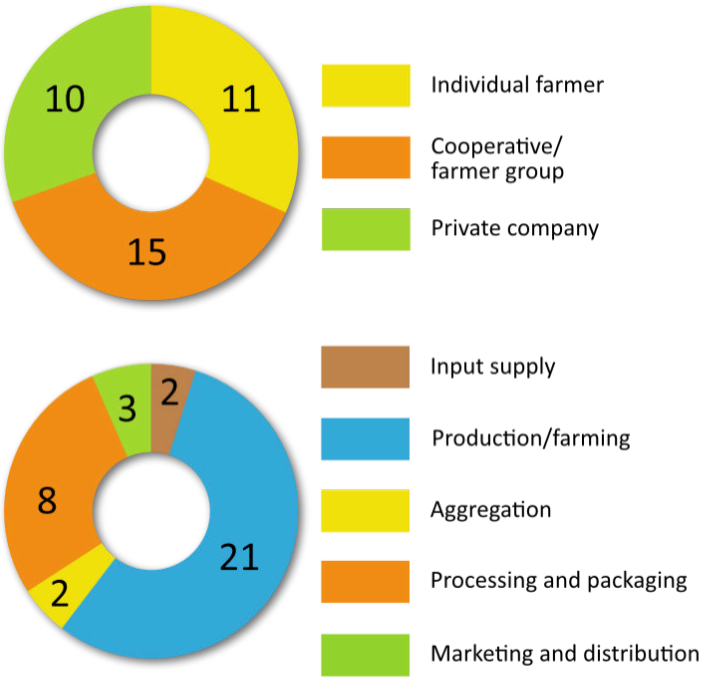
Indicator	SAS 2021		SAS 2021		SAS 2021		Changes between 2022 & 2023
	Season A	Season B	Season A	Season B	Season A	Season B	
Cultivated area (ha)	236,642	80,570	219,683	81,339	226,982	93,927	Increased by 3.3% for season A; 15% for Season B
Maize production (MT)	378,641	104,041	348,907	109,615	390,879	117,613	Increased by 12% for season A; 7.3% for Season B
Average yield (kg/ha)	1,600	1,291	1,595	1,349	1,737	1,254	Increased by 8.9% for season A; reduced by 7.0% for Season B
Gross value–added per hectare in 2017 prices (billion RWF)	378,754		390,303		407,284		Increased by 4.3%

Source: *NISR (2023) — Seasonal Agriculture Survey 2023 Report*

General Characteristics of the Value Chain Actors

The distribution of actors interviewed during the data collection phase, disaggregated by type of operation (individual, cooperative/farmer group and private company) as well as by activity or stage along the value chain (input supply; production/farming; aggregation; processing and packaging; and marketing and distribution) are presented in this section (Figure 6). By type of operation, cooperatives constitute the largest proportion of actors, 15 out of 38, or approximately 41% of the 36 actors that were surveyed. By level of activity or value chain stage, 21 out of the 36 actors surveyed were involved in production or farming. The oversampling of actors in production was motivated by the fact that farmers constitute the greatest share of maize value chain actors at the national level, with fewer processors and other actors in the upper stages of the value chain.

Figure 6: Number of actors surveyed disaggregated by type

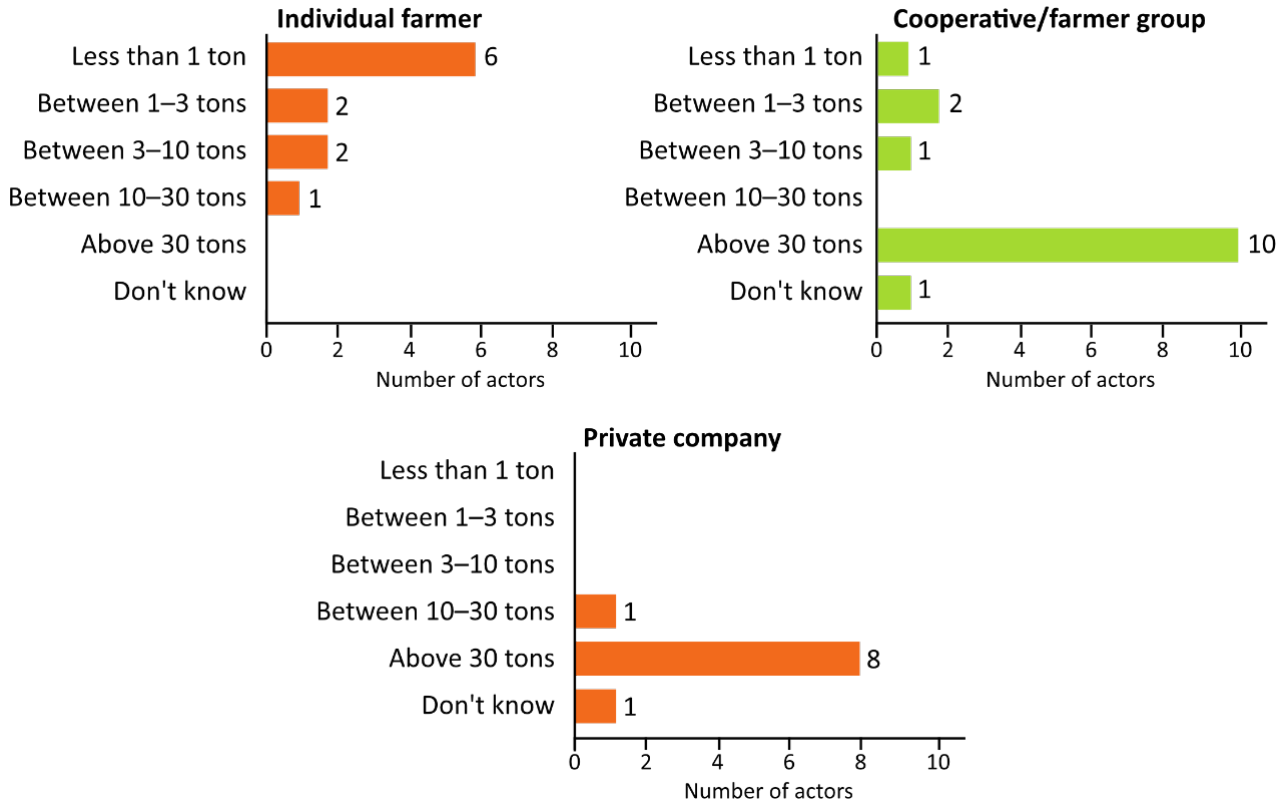


Annual Output and Turnover

The quantities of maize produced or handled by actors vary substantially by type of actor, with cooperatives and private companies handling larger quantities than individual actors (Figure 7). Specifically, only one out of 11 individual actors reported producing or handling[4] maize in the range of 10–30 tons per year. In contrast, ten cooperatives and private companies reported annual quantities of maize produced or handled exceeding 30 tons. The difference in production levels is driven by the fact that cooperatives and companies pool inputs like land, seeds and fertilisers to produce on a larger scale relative to individual farmers.

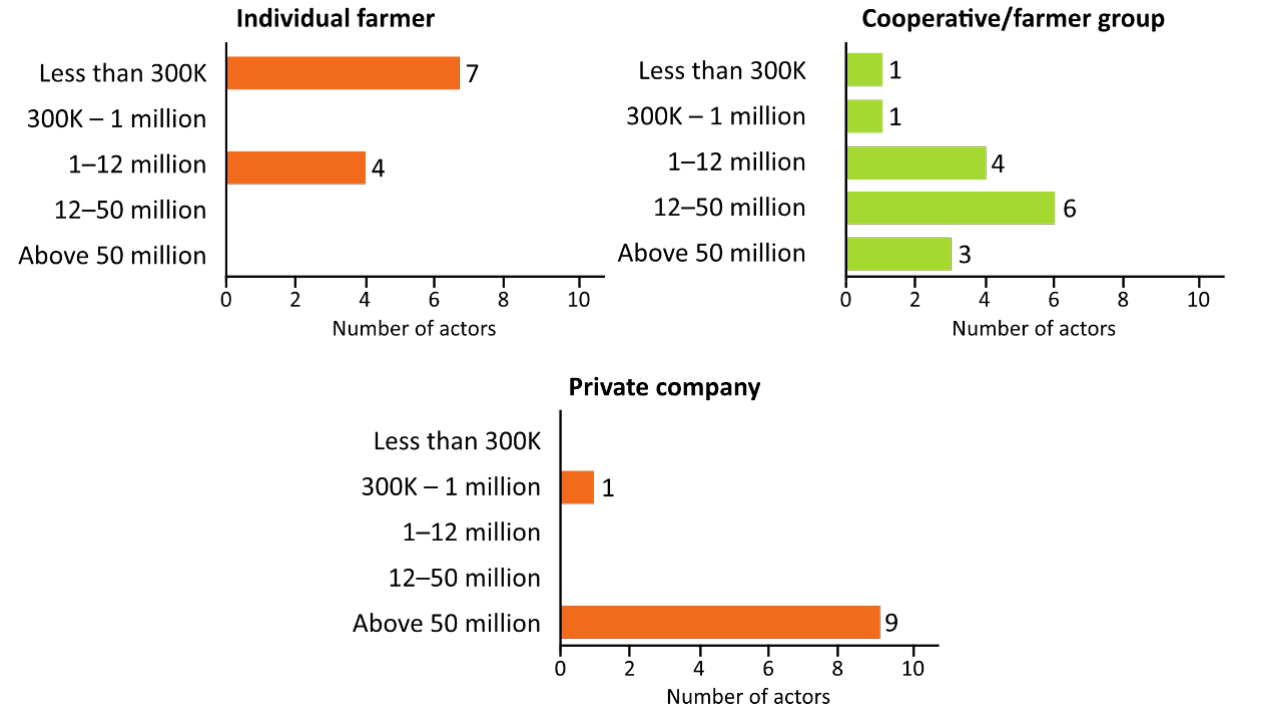
[4] Handling is used in this context to mean other activities performed on maize besides production, including aggregation, trade, drying and storage at drying and warehouse facilities, and processing.

Figure 7: Quantities of maize produced and/or handled by different types of actors



Similar to outputs, annual turnover varies substantially by type of actor, with a majority of those operating individually reporting turnover of less than 300,000 Rwandan Franc (RWF) per year. In contrast, many cooperatives and private companies reported over 12 million RWF (Figure 8). This illustrates the importance of forming cooperatives and groups to undertake joint operations for higher output and turnover.

Figure 8: Number of actors reporting annual turnover range, disaggregated by actor type

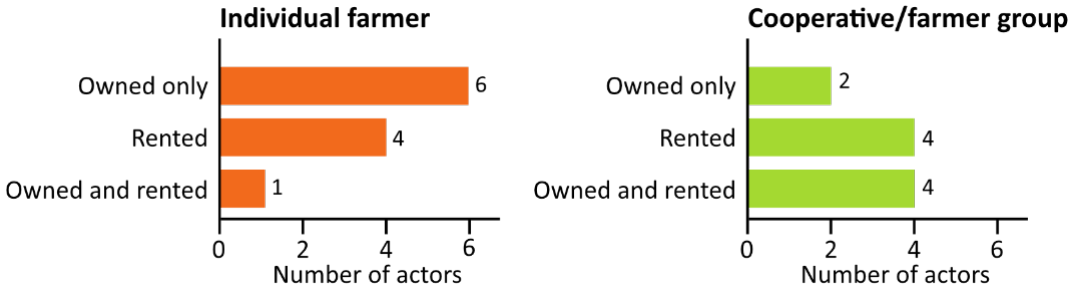


Land and Agricultural Inputs

This subsection highlights patterns of land size and ownership as well as usage of agricultural inputs[5] such as improved seeds and fertilisers, and to protect crops from pests and diseases such as pesticides and herbicides. The size of land available to producing actors is a crucial determinant of the level of production and harvest. The average land size cultivated in the season preceding the survey differed notably among producing actors, with individual farmers cultivating on smaller plots of 3.3 hectares on average compared to 18 hectares cultivated by cooperatives and other groups of farmers.

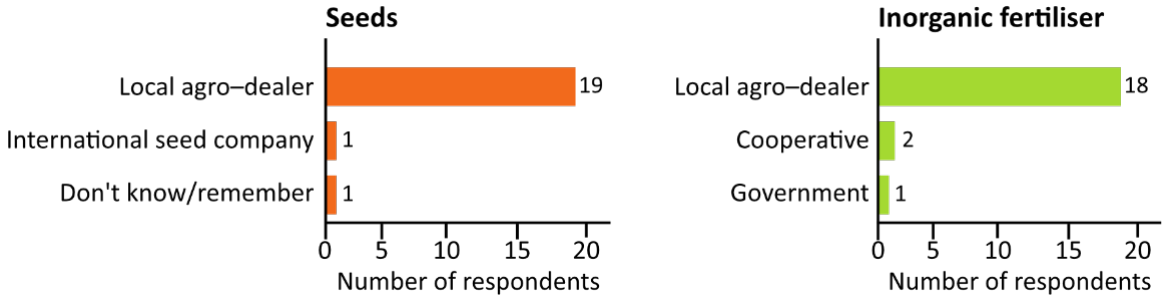
In terms of land ownership type, most individual farmers operated on privately owned land while cooperatives either entirely rented or combined owned and rented land for maize cultivation (Figure 9). This is not surprising, given that cooperatives commonly lease government land freely, including marshlands that were recently authorised for cultivation. In 2003, the Government of Rwanda authorized cultivation in marshlands, a move meant to address the shortage of arable land. However, the opportunity to lease marshlands from the government is only available to cooperatives rather than individual farmers, which explains the relatively higher propensity of renting land among cooperatives compared to individual farmers.

Figure 9: Land ownership types by maize producer category



The primary source of agricultural inputs for almost all the individual farmers and cooperatives is local agro–dealers (Figure 10). This reflects the fact that the seed and fertiliser supply system is generally well organised, where private dealers obtain inputs like fertiliser and improved seeds from maize farmers, some of which are subsidized by the government. The recent introduction of Smart Nkunganire, a digitised platform and database used by farmers to access inputs from agro–dealers, is another reason for the relative importance of this source. All the surveyed farmers reported sourcing pesticides and herbicides from local agro–dealers.

Figure 10: Local agro–dealers are the main source of seeds and inorganic fertiliser

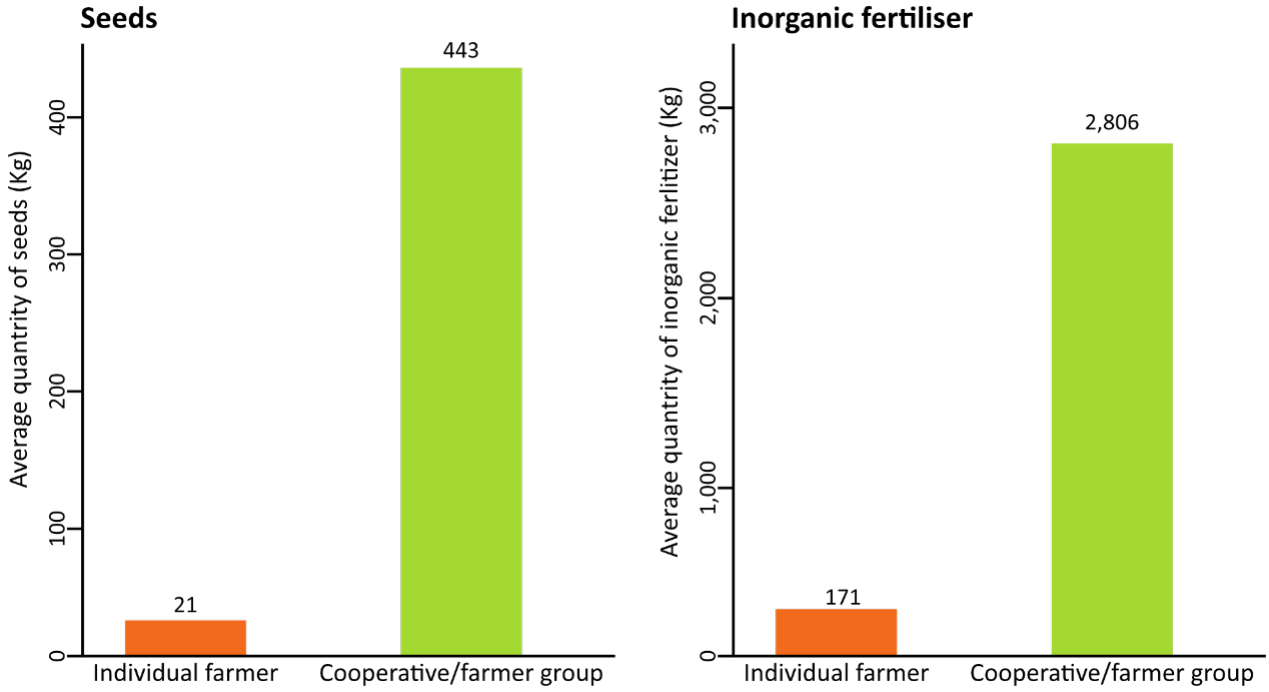


[5] Agricultural inputs are defined in this study as materials used to boost yields.

Quantity of Inputs Used

In terms of the quantity of inputs used, individual farmers planted 21 kgs of maize seeds on average, while cooperatives planted nearly half a ton given their relatively larger operations (Figure 11). Similarly, inorganic fertiliser quantities are higher among cooperatives and other farmer groups that aggregate production (over 2.8 tons in the latest season) than farmers who work individually (171 kilograms).

Figure 11: Average quantities of maize seeds and inorganic fertiliser differ by farmer type



Intensity of Agricultural Inputs Used

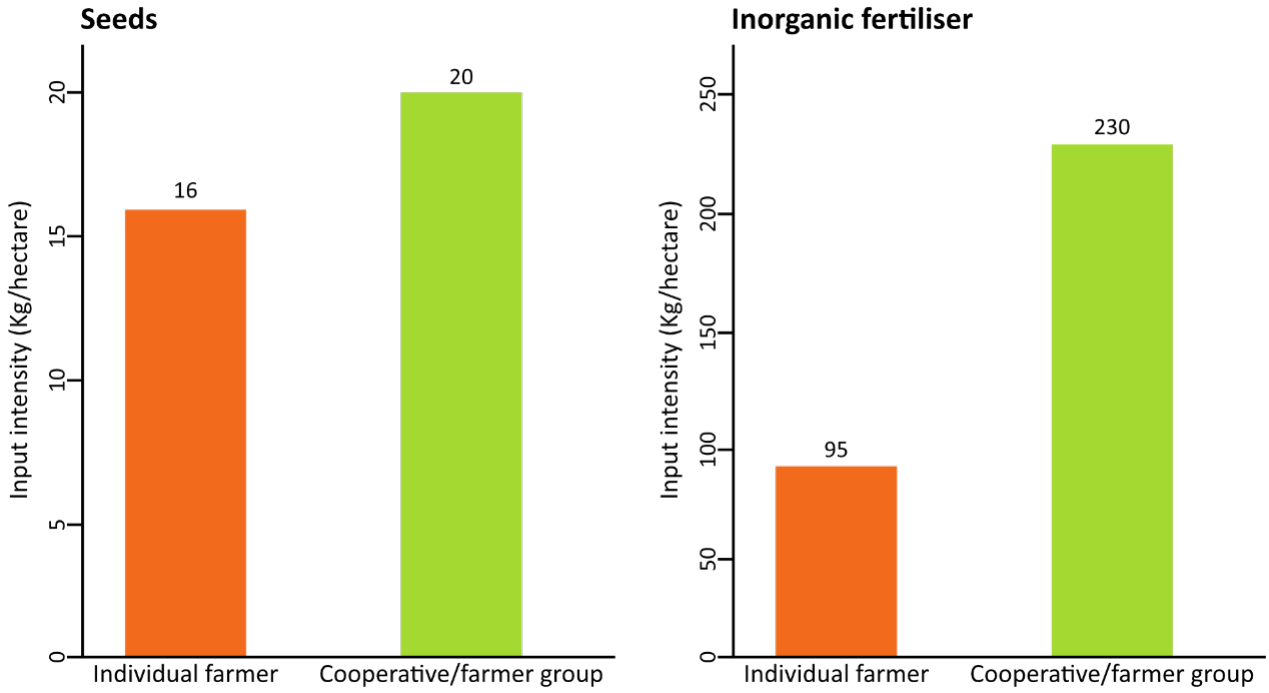
Given that the average scale of operations differs between individual farmers and cooperatives, it is evident that land size, quantity of seeds and inorganic fertiliser are generally higher among the latter. The observed differences between the two types of actors in terms of quantities of maize seeds and inorganic fertiliser used could indeed be majorly driven by differences in land size. In order to assess the real difference between the two types, relative quantities of both seeds and inorganic fertiliser are calculated as ratios of inputs to land size and used as a proxy for what this study refers to as "input intensity". This is calculated as:

$$Input\_Intensity_i = \frac{Input\_Quantity_i}{Land\_Size_i} \quad for\ i = `1, ..., 21$$

Where is the quantity of input — seeds and inorganic fertiliser, entered separately in the equation — used by the farmer in the season that preceded the survey, measured in kilograms; is the size of land in hectares cultivated by the farmer in the previous season; and subscript is denoting farmer. Even after considering the difference in relative farm sizes, the quantities of seeds and inorganic fertiliser are much higher among cooperatives than among individual farmers (Figure 12). The difference is more pronounced for inorganic fertiliser, with the input intensity of cooperatives more than twice as large as that for individual farmers.

The relatively higher input intensity illustrates the rationale for aggregating production by forming farmer groups. Notably, by pooling diverse knowledge and skills among members and often providing micro–loans to purchase crucial inputs, cooperatives can pull off higher input intensity and, consequently, higher yields relative to individual farmers.

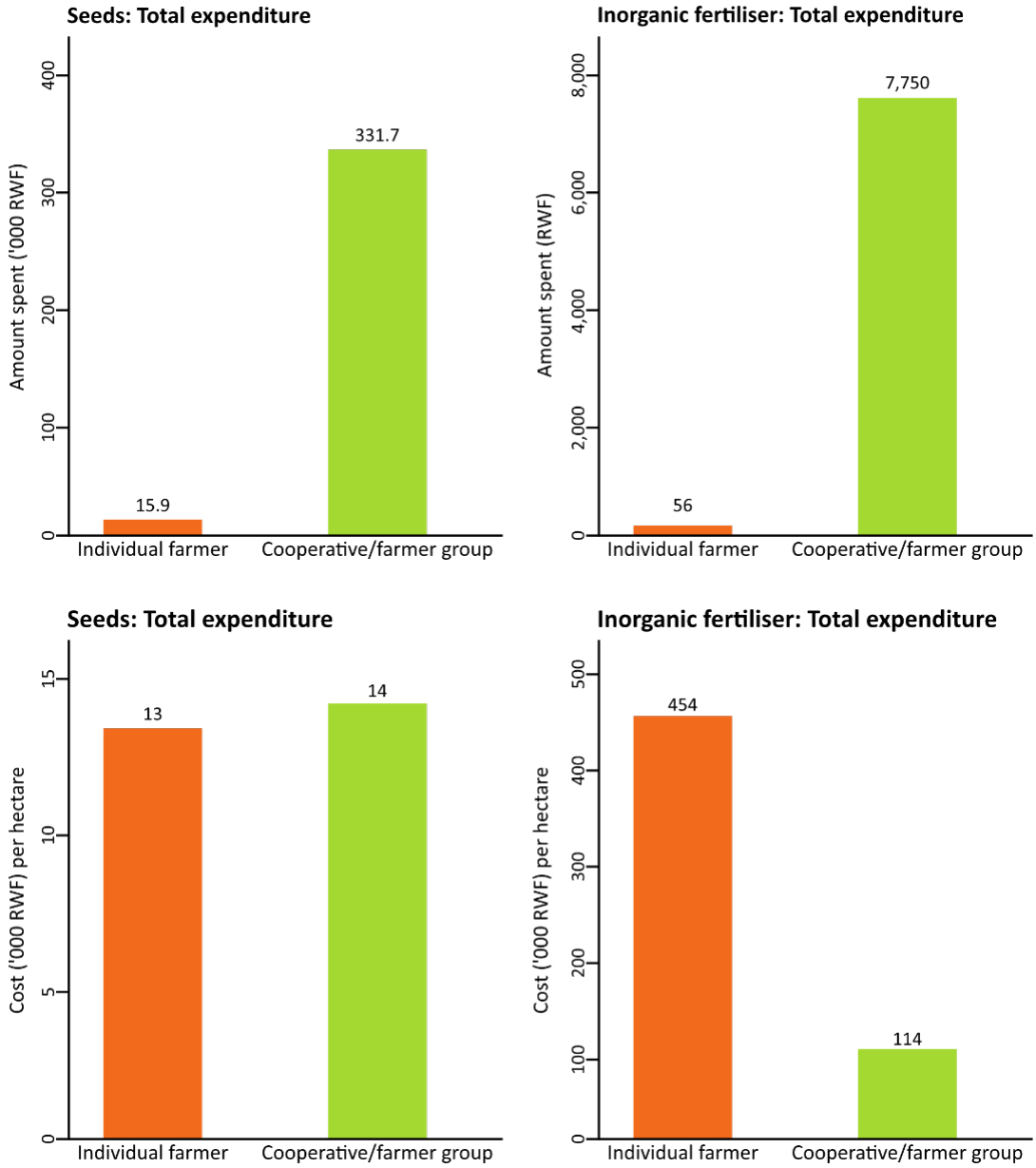
Figure 12: Cooperatives use more seeds and fertiliser per hectare than individuals



Average Expenditure on Agricultural Inputs Used

Figure 13 presents individual farmers and cooperatives' average expenditure on seeds and inorganic fertilisers and the per–hectare expenditure. This more realistic measure takes into account differences in relative farm sizes of these two types of producing actors. Average expenditure on seeds and inorganic fertiliser is much higher among cooperatives and framer groups than among individual farmers, which is not surprising given the notable difference in the size of operations. In terms of average expenditure per hectare, individual farmers spend slightly less on seeds than cooperatives. On the other hand, individual farmers spend more on inorganic fertiliser per hectare compared to cooperatives' inorganic fertilisers, which is surprising considering opportunities such as micro–loans often provided by cooperatives to their members to purchase crucial inputs like seeds, fertilisers and pesticides.

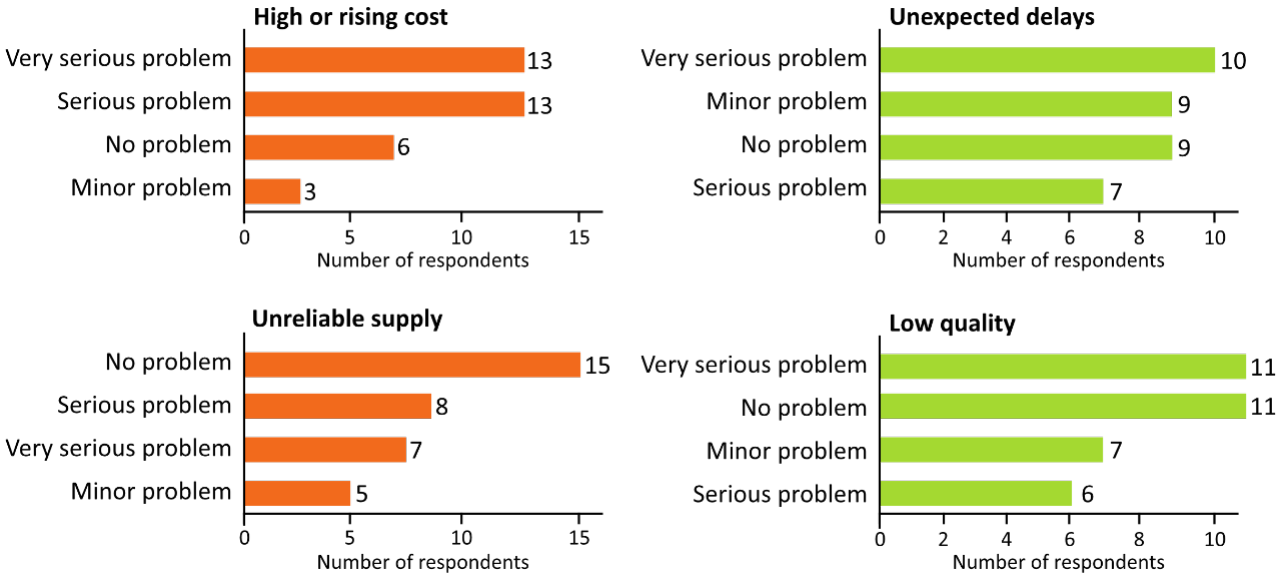
Figure 13: Cooperatives spend more on seeds and inorganic fertiliser per season



Issues Experienced While Working With Suppliers of Inputs and/or Raw Materials

This subsection analyses the relationship among actors along the different stages of the value chain and their suppliers, who include agricultural inputs (farmers and cooperatives involved in production) and maize grain (for non–producing actors such as aggregators, traders and processors). The rising cost of inputs from suppliers is reported as either a serious or very serious problem by 26 out of 35 who responded to this question (Figure 14), reflecting concerns among actors about the affordability of inputs they use in their operations. Another key challenge is unexpected delays in delivering supplies, which nearly one–third of respondents reported to be very serious. The low quality of supplies is also a very serious problem for almost one in every three respondents, while the unreliability of suppliers seems to bother respondents critically.

Figure 14: Main challenges faced by maize value chain actors in dealing with suppliers

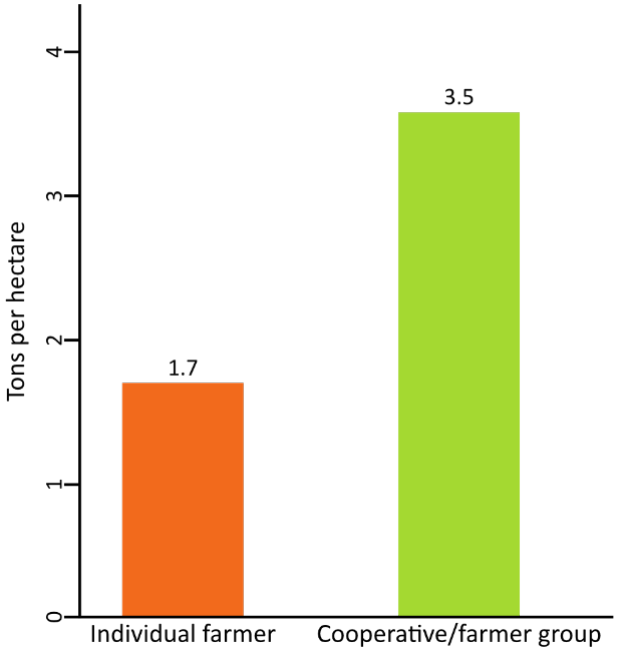


In a nutshell, these observations imply that suppliers are reliable regarding the provision of the required quantities to their clients. However, unexpected delays and rising costs of supplies pose risks to the effective collaboration of actors with suppliers.

Productivity/Yield: Tons Per Hectare

To understand farm productivity, Figure 15 presents the average yield measured in terms of tons of maize produced per hectare, separately for individual farmers and cooperatives. Clearly, individual farmers have a lower yield of 1.7 tons per hectare, which is exactly equal to the average country–level yield reported in Season A of 2023 in the Seasonal Agriculture Survey. On the other hand, cooperatives have a higher yield of 3.5 tons per hectare, which is slightly below the national average yield of 4.3 tons per hectare reported for large–scale producers of maize in Season A of 2023 (NISR, 2023).

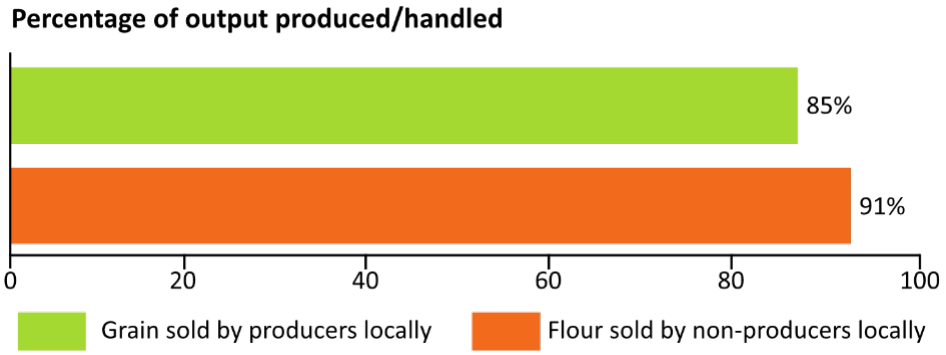
Figure 15: Average yield — tons per hectare — disaggregated by type of producer



Marketing of Produce

The more significant share of output produced by producers (cooperatives and individual farmers) or handled by non–producers — including traders and processors — goes to the local market (Figure 16) compared to the amount exported. For producers, 85% of output is sold in the local market, while for non–producers, as high as 91% of the maize flour handled ends up in the local market. Overall, the export level is minimal for producing and non–producing actors — aggregators, processors, traders, transporters and warehouse operators — in the maize value chain. It is unclear why producers sell less of their output to the local market as compared to non–producers. However, one plausible explanation is that the latter generally have better records and could estimate marketing quantities more easily than the former. The difference could also be partially explained by informal cross border trade who are mainly producers or intermediaries.

Figure 16: Percentage of maize grain and processed flour sold to the local market

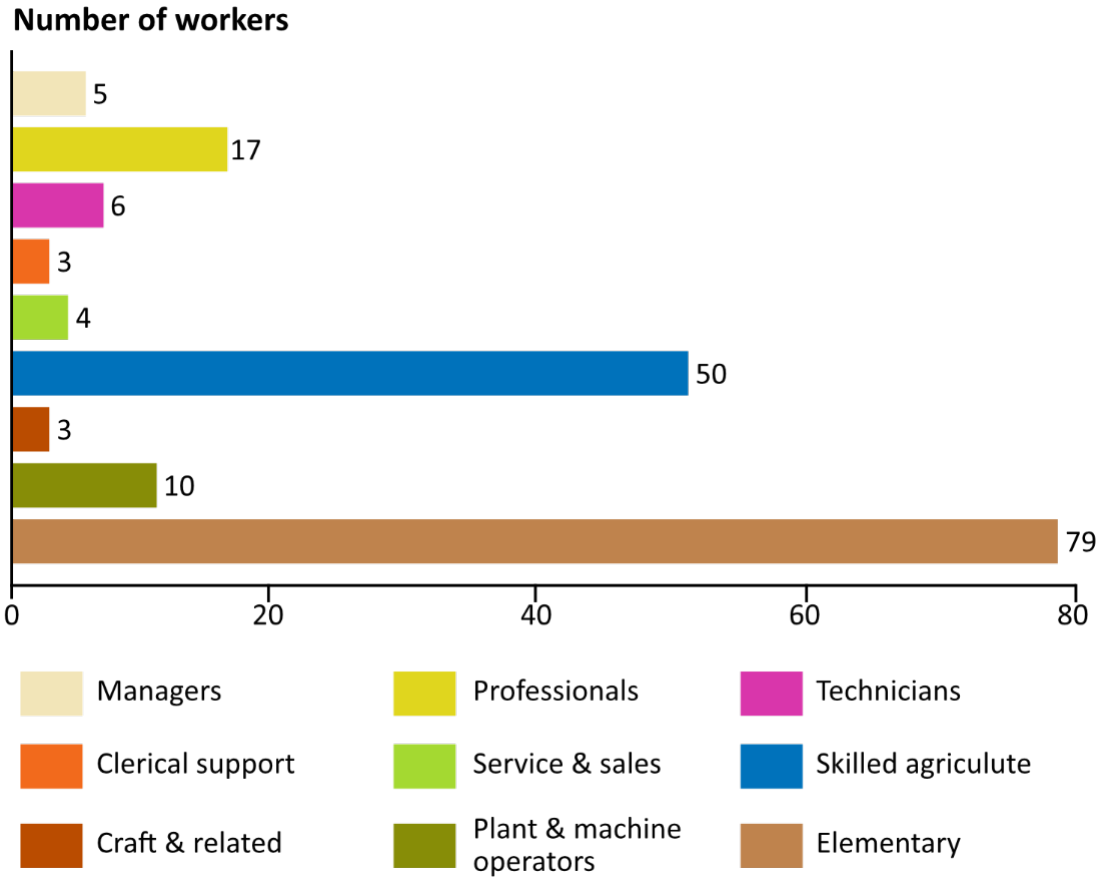


Composition of Employment by Occupation

Figure 17 presents the employment structure of the maize value chain, specifically illustrating the average number of workers per occupational category. The highest number of workers is concentrated around elementary occupations, covering casual labourers hired temporarily in farming, cleaners and security guards in office settings, with an average of 79 workers in a typical establishment that was surveyed, comprising of individual farmers, cooperatives and private companies operating along different stages of the value chain. The occupational category with the second–highest number of workers is skilled agricultural workers, who are mainly comprised of smallholder farmers and members of farmer cooperatives. This is followed by professionals, plant and machine operators, and assemblers, while the lowest number of workers is recorded in the clerical support and crafts and related work.

By gender, there are clear employment patterns where women are more represented in less technical occupations like clerical support, elementary and crafts and related work, with very low presence in technical occupations, especially as technicians, plant and machine operators and assemblers (Figure 18). This necessitates encouraging female students to participate in technical courses offered by Technical and Vocational Education and Training (TVET) coupled with practical training on effectively performing such work within an organisational setting.

Figure 17: Average number of workers in the maize value chain by occupational category



Further aggregation of the number of workers by occupation is made with respect to stage along the value chain (Figure 19). At almost all stages of the value chain, employment is concentrated around elementary categories, including part–time, casual labourers involved in farming activities at the production level and manual work mainly at the processing stage. Skilled agricultural workers dominate employment at the input supply level, reflecting this stage's relatively high skill requirement, including agronomists and other scientists involved in seed multiplication and agro–dealing business.

Table 2 summarises the occupations that represent the most significant number of workers for each stage of the value chain.

Table 2: Occupations representing the highest number of workers per value chain stage

Stage	Main Occupation	Number of Workers in Main Occupation	Total Number of Workers at Stage	Percentage of Workers in Main Occupation
Input Supply	Skilled agricultural worker	823	904	91.2%
Production	Elementary workers	92	112	82.1%
Aggregation	Elementary workers	26	64	40.6%
Processing & Packaging	Elementary workers	70	139	50.4%
Marketing & Distribution	Elementary workers	82	186	44.1%

Figure 18: Percentage of female workers disaggregated by occupational category

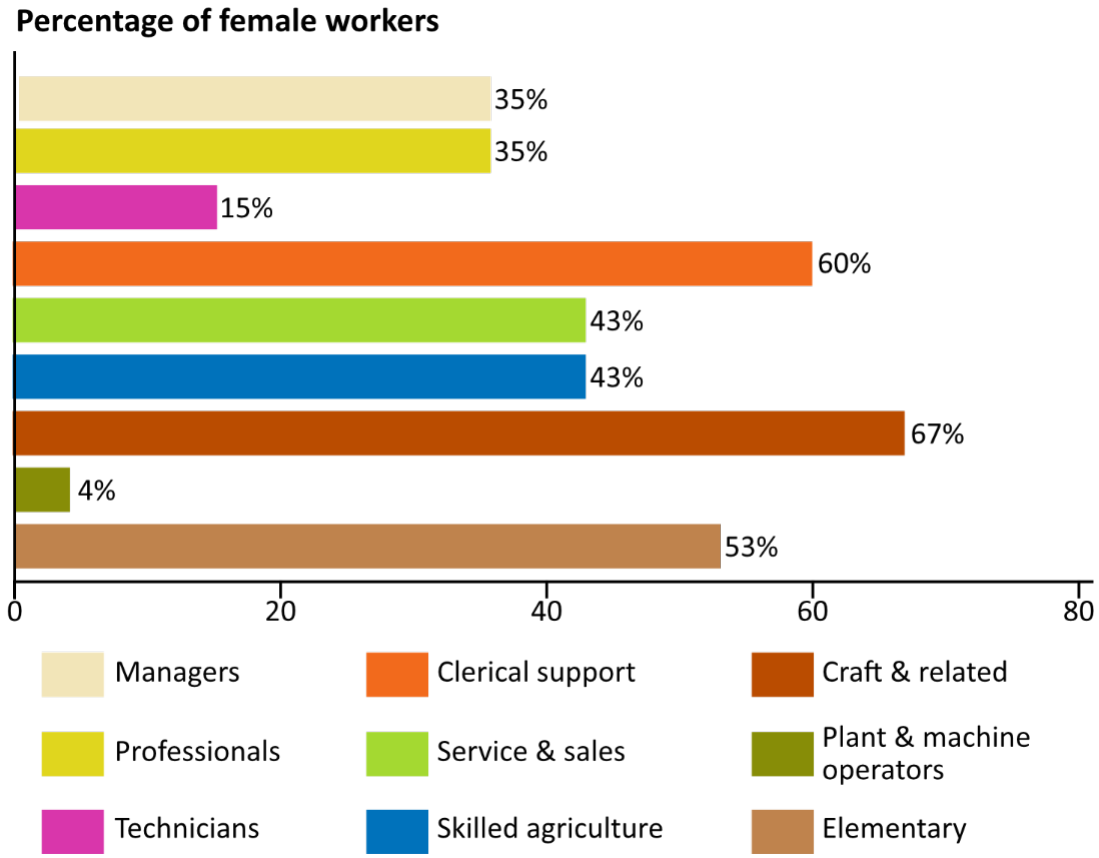
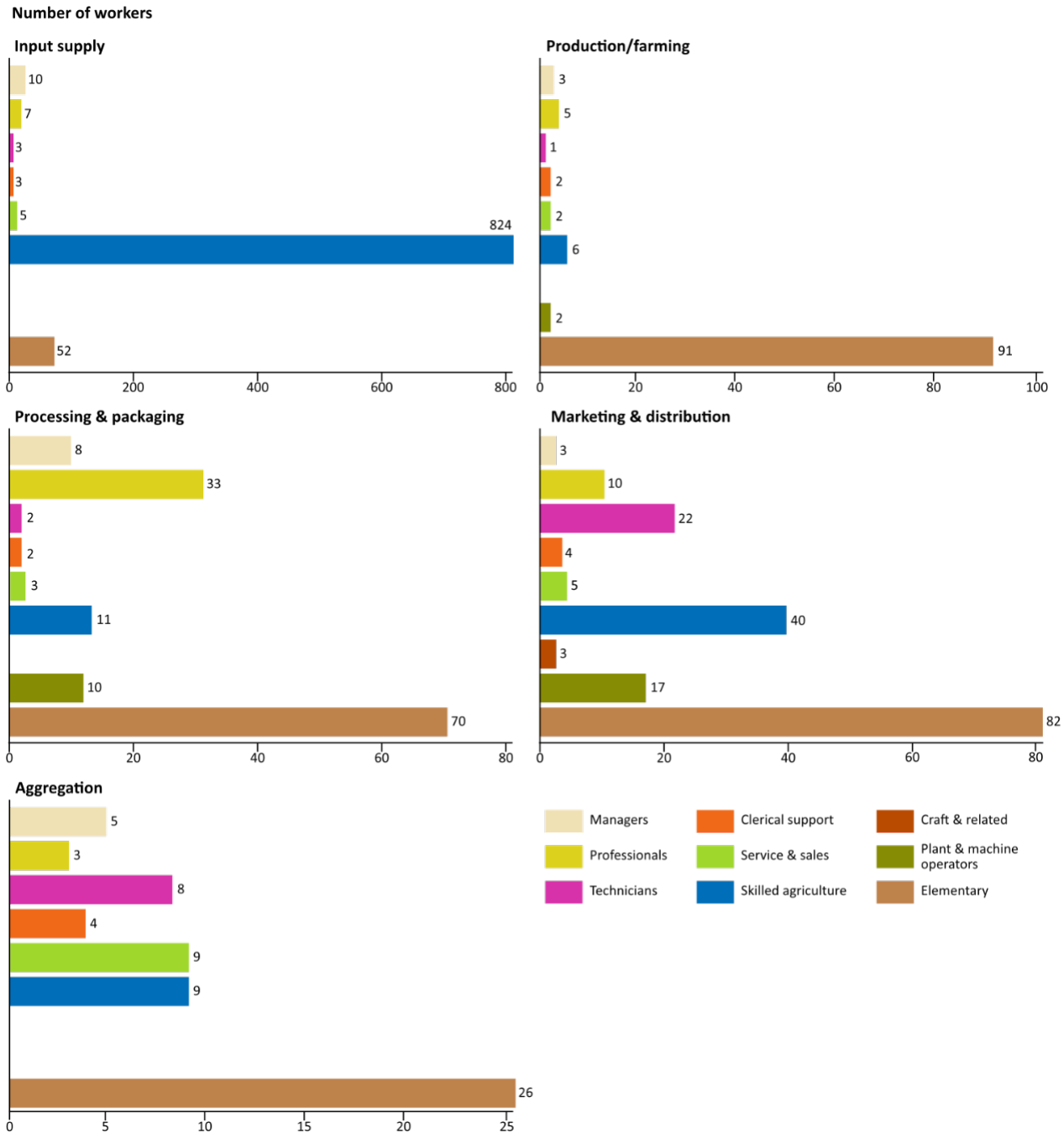


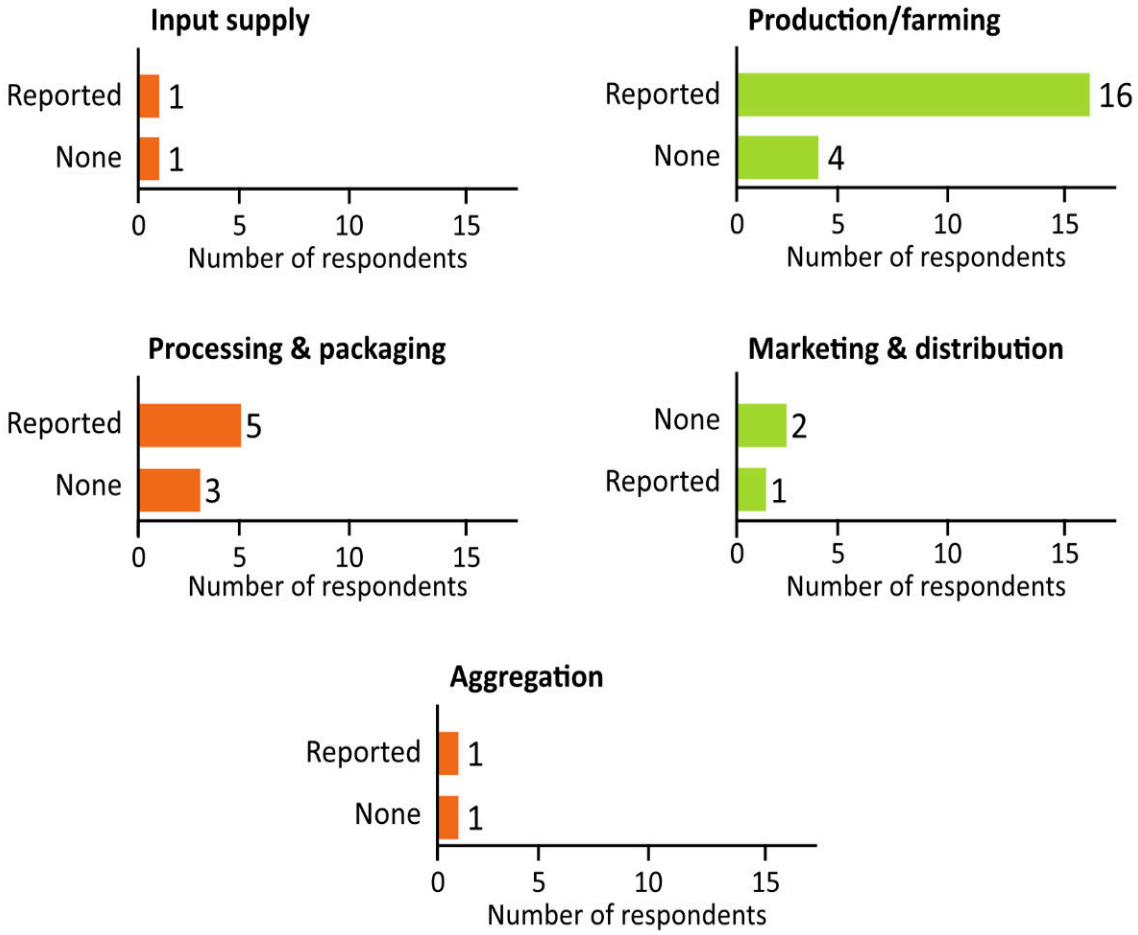
Figure 19: Number of workers by occupation and value chain stage



Propensity of Skills Gaps

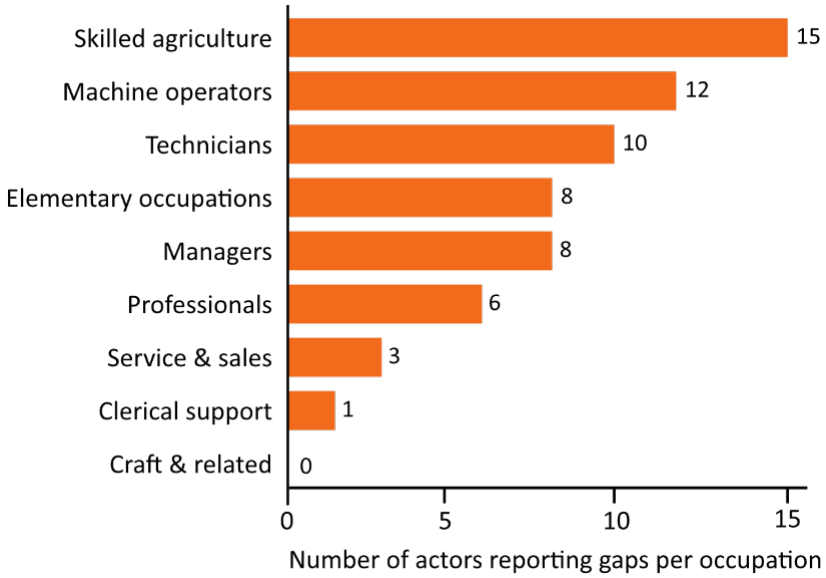
Asked about whether there are certain activities they are not currently undertaking or not doing as well as they wish, most value chain actors reported having skills gaps that make them unable to function effectively or expand the scale of operations. Skills gaps are mainly reported at the production stage, where about 80% (16 out of 20) of actors have ever failed to implement an activity or implement it well due to a lack of adequate skills (Figure 20). According to discussions with value chain actors, those involved in the production stage have less access to practical trainings especially regarding proper fertiliser and pesticide application, while actors involved in upper value chain stages — particularly processors — are more capable of providing in-house training to workers or hiring professional workers. This difference in capacity partly accounts for the discrepancy between the propensity of skills gaps reported by producing and post–production actors.

Figure 20: Number of actors who reported skills gaps by actor type



Disaggregated analysis by type of occupation (Figure 21) reveals that most skills gaps are reported in the skilled agriculture occupation, which also includes smallholder farmers and members of cooperatives, followed by machine operators and technicians, reflecting the level of occupations where skills–enhancing interventions need to concentrate.

Figure 21: Number of maize value chain actors reporting skills gaps by occupation type



As an overview of the skills gaps, the most critical ones at the production level are related to proper application of fertilisers and pesticides. Although farmers have experience in general activities such as land preparation, planting, weeding and harvesting, a considerable number of them reported (in the qualitative survey) having issues with knowing the right quantity, safe application methods and routine for pesticides and fertilisers. For processors, skills gaps were reported mainly among technicians, and associated skills gaps exist at two main levels. The first level is related to the skills in operating heavy machinery especially along the production line and the second and most critical level is related to repair of machines once they break down, which often requires processing companies to rely on hired short–term experts, including outsourcing from outsider the country due to limited availability of specialist repair skills in the local labour market. These skills gaps are elaborated in more detail in the qualitative findings of this report.

Regarding the consequences of skills gaps, respondents mainly reported difficulties introducing new technologies, reduced production levels, and stopping to offer some products as the most common consequences. However, other less common effects were reported, such as failure to meet customer expectations, increased operational costs, increased post–harvest losses, and, to a relatively small extent, stopping the offer of some products (Figures 22 & 23). Due to skills gaps, most stakeholders reported reduced quantities and quality of output produced and an inability to maintain reliable supplies to customers.

A disaggregated analysis of the consequences of skills gaps shows diversity along stages of the value chain. While no critical consequences were reported at the input supply stage — partly reflecting the relative concentration of skilled agriculture workers — there are critical gaps in aggregation, processing and marketing. All aggregators claimed skills gaps to be associated with reduced quality and quantity of output, loss of customers due to inability to meet their expectations, difficulty introducing new technologies, and inflating operational costs due to lack of precision. For processors and actors involved in marketing and distribution, skills gaps imply an inability to offer high–quality products that meet customer expectations, leading to loss of clients and challenges in effectively introducing new technologies.

Figure 22: Consequences of skills gaps by respondents

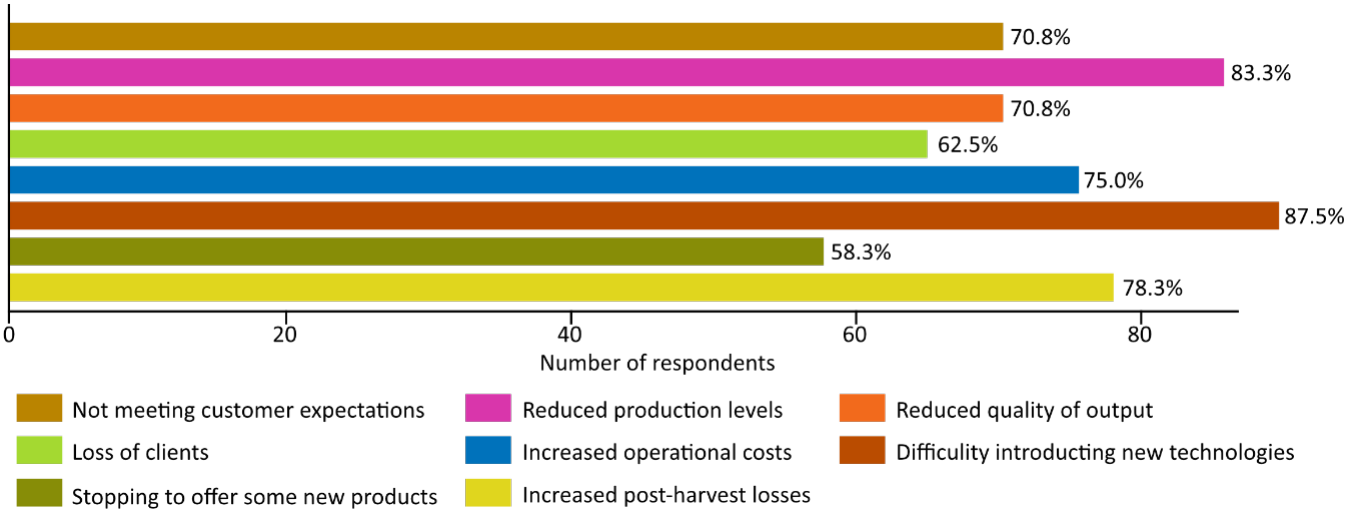
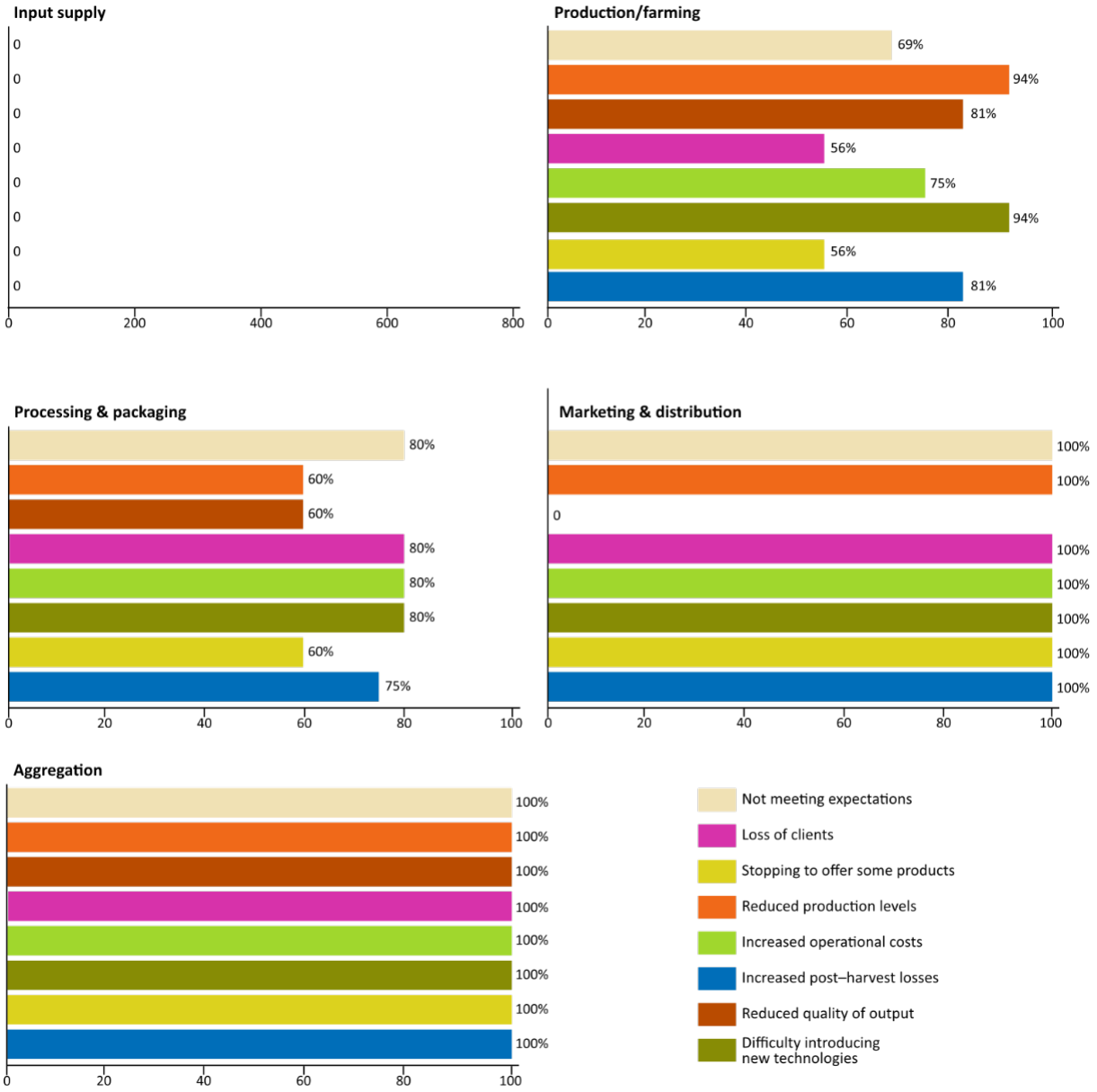


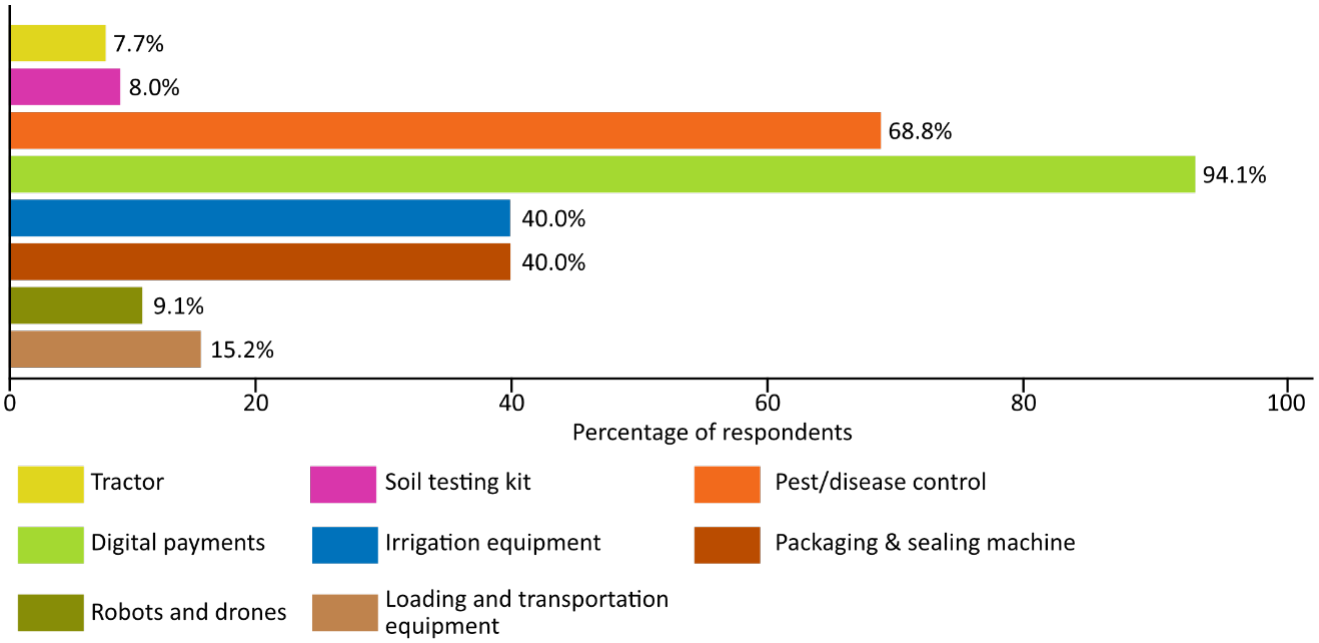
Figure 23: Percentage of respondents who reported consequences of skills gaps



Usage of Technologies

This section assesses the usage level of various agricultural and agro–processing related technologies among maize value chain actors. Generally, farming operations are primarily not mechanised, with almost no usage of tractors in any farming activity (Figure 24). The use of soil testing kits is also still at a very low level. At the same time, disease and pest control equipment are relatively popular, particularly representing hand sprays used in the fight against crop diseases and pests. Digital payments are rather quite popular, with nine in every ten respondents having used any digital payment platform to either receive or make payments, most commonly using mobile money.

Figure 24: Percentage of maize value chain actors who reported using various technologies



The above findings based on the mini survey mirror national averages, which reflect generally low levels of agriculture technology adoption, including utilisation of mechanisation, related modern farming practices as well as adoption of improved seeds, organic and inorganic fertilisers (Table 3). According to Seasonal Agriculture Survey of 2023, less than two percent of households used any form of mechanisation across seasons A, B and C. During the same period, the use of irrigation varied by season, averaging 10.3%, 9.6% and 64.6% in seasons A, B and C, respectively. Application of erosion control measures was rather quite high, estimated at over 90% in each of the three seasons.

Table 3: Percentage of farmers using mechanisation, irrigation and erosion control measures

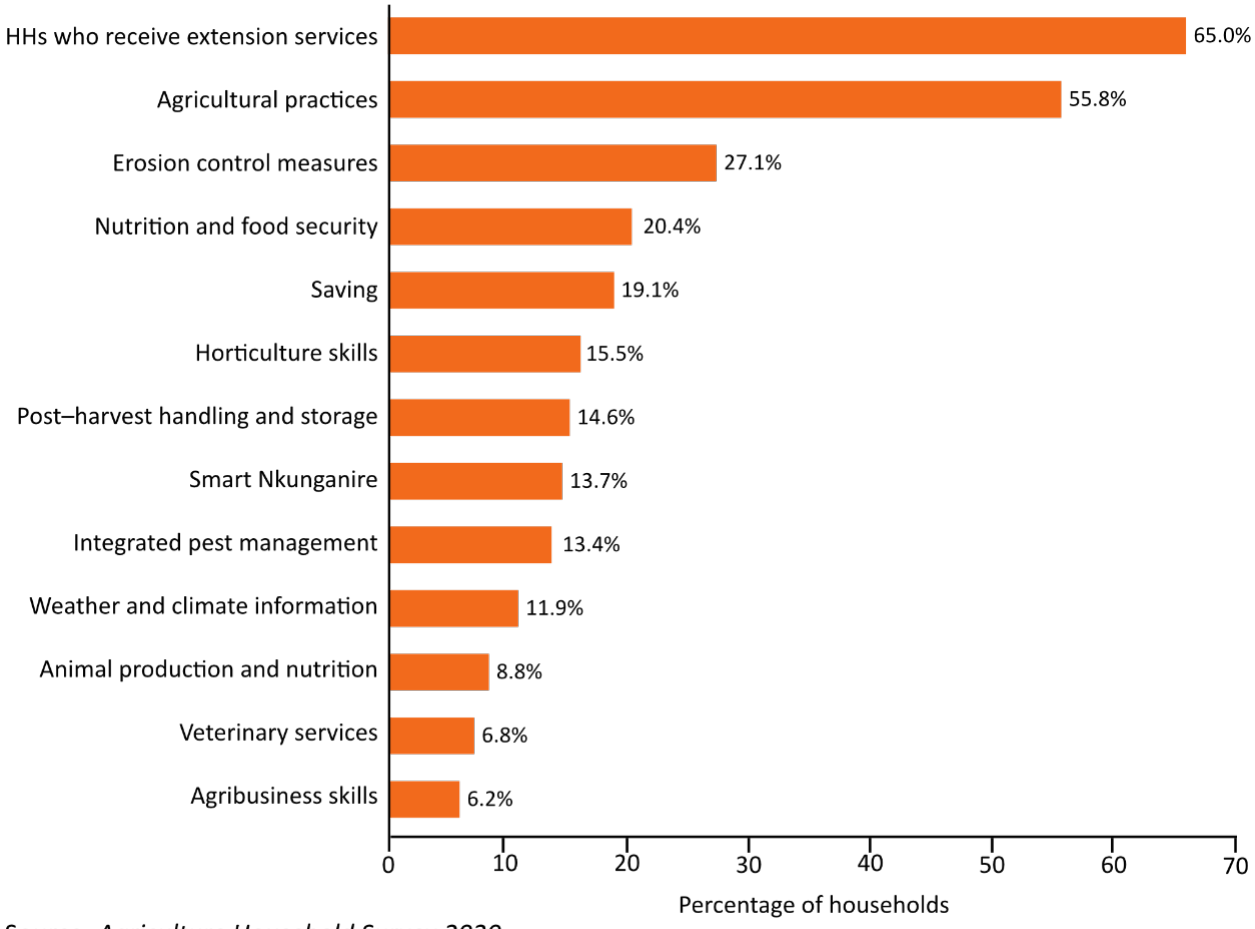
Technology	Season A	Season B	Season C
Irrigation	10.3%	9.6%	64.6%
Mechanisation	1.2%	0.7%	0.2%
Erosion control	92.1%	91.6%	94.8%
Improved seeds	37.1%	20.9%	20.7%
Organic fertiliser	87.9%	83.4%	83.7%
Inorganic fertiliser	59.6%	51.6%	74.2%

Source: *NISR (2023): Seasonal Agricultural Survey 2023 Annual report*

Extension Services

According to the Agricultural Household Survey (AHS) of 2020, access to agricultural extension services is moderate. Overall, nearly two-thirds (65%) of agricultural households accessed some form of extension services in 2020, covering various agricultural practices including but not limited to soil erosion control measures, food and nutrition security, saving, horticulture skills, post–harvest handling and storage, Smart Nkunganire, integrated pest management, weather and climate information, animal production and nutrition, veterinary services and agribusiness skills (Figure 25). By source, extension services are mainly acquired through media communication with agricultural technical information (accounting for 32.3% of farmers accessing extension services); local government officials at the District, Sector and Cell levels (21.2%); meetings and community works (14.0%); farmer/livestock promoters (11.4%); NGOs and companies (8.4%); central government officials (3.0%), among other sources.

Figure 25: Percentage of agricultural households accessing extension services (AHS, 2020)

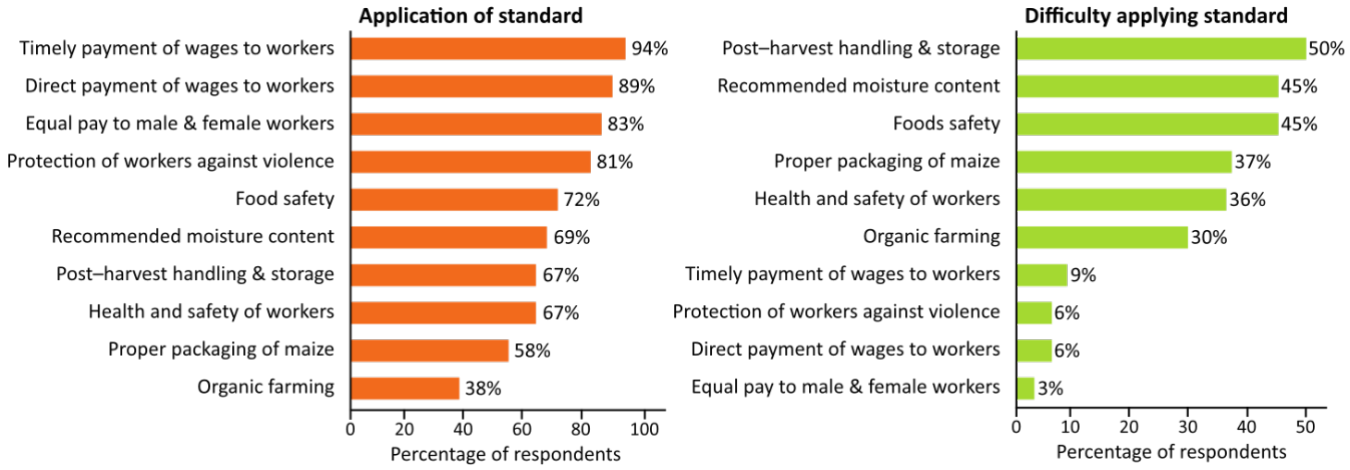


Source: *Agriculture Household Survey 2020*

Compliance with Standards

This section examines the extent to which maize value chain actors comply with various standards and the reported difficulty related to compliance. The most commonly applied standards are related to the regulation of workers, including timely payment of wages, payment of wages directly to workers who have done the work, equal payment of wages to male and female workers having done similar work, and protection of workers against violence and harassment (Figure 26). Food safety and recommended moisture content are mostly complied with among the non–employment related standards, while proper packaging and organic farming have relatively lower compliance rates. In terms of difficulty applying the standards, maize value chain actors reported challenges complying with appropriate post–harvest handling and storage recommended moisture content and food safety. At the same time, applying most of the employment–related standards seems to be relatively easy.

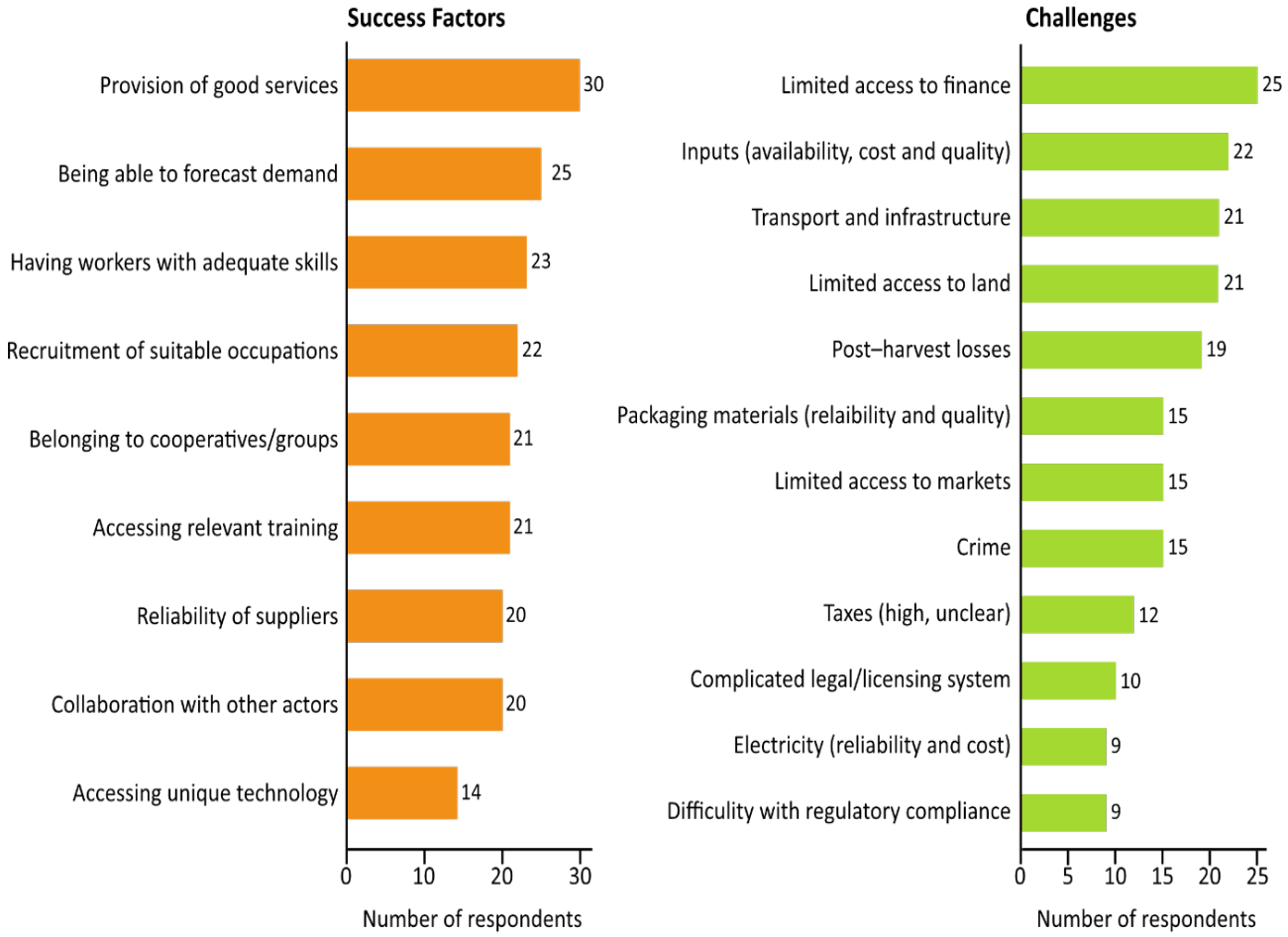
Figure 26: Extent and level of difficulty of complying with various standards



Success Factors and Challenges to Business Growth for Maize Value Chain Actors

Promoting business growth along the maize value chain requires first understanding the factors influencing success and constraints to business survival and performance as reported by value chain actors (Figure 27). These success factors include the ability to forecast demand accurately, provision of good quality services to customers, recruitment of suitable occupations, having adequately skilled workers, reliability of suppliers and belonging to a cooperative or association. On the other hand, accessing unique technology was largely reported to have a high influence among a small number of stakeholders, which partly reflects the generally low levels of adoption of advanced technology, especially at the production stage. As far as challenges are concerned, commonly reported concerns of maize value chain actors are limited access to finance, issues with inputs — unavailability, high cost and/or low quality — inadequate transportation or infrastructure, limited access to land, post–harvest losses, limited market and crime.

Figure 27: Number of actors reporting success factors and challenges to business growth



Qualitative Case Studies on Perceptions and Experiences of the Maize Value Chain Actors

Introduction

Understanding how the maize value chain operates requires gathering comprehensive information from actors, including but not limited to their perceptions and experiences regarding the organisation of the value chain, as well as the opportunities and challenges therein. In this regard, qualitative information was collected to supplement the mini–quantitative survey, where the former covered ten actors operating at different stages of the value chain (Table 4). The actors were drawn from six districts across three provinces: Eastern Province, Southern Province and Kigali City Province.

Table 4: General characteristics of maize value chain actors profiled

Actor name	Province	District	Years in operation	Main activity/activities	No. of employees*
Impabaruta Cooperative	Southern	Kamonyi	14	Seed multiplication	878
Indatwa za Kamonyi	Southern	Kamonyi	7	Maize farming	1,442
CODPCUM Cooperative	Eastern	Nyagatare		Maize farming	62
KOHIKA Cooperative	Eastern	Nyagatare	17	Maize farming; processing.	52
IZGM Cooperative	Eastern	Bugesera	15	Maize farming; input supply.	380
Rebero Grain Millers Limited	Kigali	Gasabo	9	Maize farming; aggregation; processing.	26
African Improved Foods (AIF)	Kigali	Gasabo	8	Maize processing	600
Minimex Limited	Kigali	Kicukiro	18	Maize processing	124
East Africa Exchange Limited (EAX)	Kigali	Nyarugenge	11	Maize grain aggregation and trade/marketing	152
Sosoma Industries Limited	Kigali	Kicukiro	16	Maize processing	80
Average/typical actor	**N/A**	**N/A**	**12.7**	**N/A**	**380**

*Includes members of cooperatives as these also perform daily duties similar to those of hired workers

The qualitative information collected from value chain actors was organised and presented around four common themes: employment and skills, blockages to the value chain, the role of technology, and the influence of government policies, regulations and infrastructure.

Employment and Skills

In terms of numbers, employment in the maize value chain is concentrated around the production stage, where the most significant number of workers employed is casual, involved in land preparation, planting,

weeding and harvesting of maize. Generally, most actors recruit their workers from the local communities in which they operate. This is mainly because operations for which workers are sought — particularly for the production stage — don't require sophisticated skills. Only a handful of relatively larger–scale value chain actors manage to employ or hire services of professional agriculture workers such as agronomists.

Discussions with value chain actors revealed several skills gaps, mainly reported among farmers and cooperatives. The commonly reported skills gaps are related to the work of skilled agricultural workers, with specific difficulties found ineffective pest and disease control, including knowing the timing and mixing of pesticides and herbicides, and fertiliser application — including knowing the right type and quantity of fertiliser to apply. For processors, the main skills gaps are among technicians. As one actor mentioned, *"Operating machines is relatively easy as someone can be easily shown how to do the job and they perfect it. However, getting experienced technicians to repair the machines is difficult once the machines break down, and we often rely on regional specialists".*

Overall, skills gaps in the maize value chain result mainly from the fact that workers hired generally have low skill levels, and many actors cannot afford the services of highly skilled workers. Some actors resort to hiring underqualified workers, hoping to provide on–the–job training, albeit a slow learning process sometimes. This issue was illustrated by one cooperative representative who mentioned, *"We have an accountant who is not qualified to the level we want because she only has a high school diploma. We know that there are many accounting techniques that she does not know, but hiring a degree holder would be quite expensive for us. We have therefore accepted our fate and instead try to support her through coaching and guidance to acquire some techniques gradually".* The same Cooperative representative expressed the need to hire a manager and an agronomist to boost the knowledge base of the Cooperative and expand production, adding that, *"We also need an agronomist because we had a partnership with RYAF [*Rwanda Youth in Agriculture Forum*] who used to pay half of the salary of the agronomist. We paid the remaining half. However, when RYAF stopped the support, we had to let the agronomist go because we could not afford his salary from cooperative income alone".*

For some cooperatives, the desire to improve and expand operations outweighs the perceived high cost of hiring qualified and experienced staff. One cooperative representative highlighted during discussions that, *"Through RCA [*Rwanda Cooperative Agency*], the agriculture cooperatives were encouraged to hire skilled workers, and that is how our cooperative hired a professional accountant and a manager who helped the cooperative to survive bankruptcy and pay its debts to the level where we currently have positive savings".* This observation reflects the need for guidance and knowledge transfer to cooperatives and farmers to adopt a business mindset and proactively address some skills gaps without relying on external support. The same Cooperative further stressed its employment vision banked upon the need to streamline its operations, as mentioned by its representative, *"We also grow crops with the technical support of a company that is also our client, but we now need an agronomist who specializes in seed multiplication and can help us to improve our activities. We also need a salesperson who is skilled in agro–products because we want to expand our agro–dealer business. Finally, we need a skilled person who can help customers understand the purpose and functionality of our products".* A like–minded cooperative shared the same recruitment vision amidst funding constraints, mentioning, *"In the future, we anticipate hiring more workers in marketing. Many cooperatives sell their produce at a low price on the available market without conducting market research. We need marketers to help expand our market share. Although we currently can't afford to hire them, we keep them in our future plans".*

Some actors attribute skills gaps to limited cooperation and knowledge sharing. While capacity–building programmes offered by the government and non–governmental stakeholders are clearly needed for such actors, value chain actors can address some skills gaps through effective knowledge sharing and peer learning, which have not been utilised adequately so far. One actor mentioned that *"Every actor in the value chain should endeavour to share knowledge. For example, Rumbuka trains us and supports us in getting inputs in time, which helps us produce quality seeds in enough quantity. Likewise, buyers should support farmers to minimise post–harvest losses resulting partly from inadequate post–harvest handling skills."*

Building upon the suggestion of knowledge sharing and capacity building among value chain actors, some actors have proactively engaged farmers to enhance their capacity to produce high–quality maize. A success story in this regard is a processor who routinely trains farmers on how to dry maize properly and handle maize grain after harvest to reduce the risk of aflatoxin infestation and high moisture content. The actor showed the benefits of this arrangement, saying, *"We used to reject 95% of maize from farmers and cooperatives due to improper drying and handling, but after training them, the rejection rate reduced to below five per cent".*

Another proactive measure to address skills gaps within the value chain is through training of workers. As one processor mentioned, *"We realized that some technical skills cannot be easily obtained on the local market, so we undertook comprehensive training of all our workers before the commencement of operations, and we continue to offer them on–job training to hone their skills".*

Some actors, however, hold a pessimistic view about the training of workers, as one processor mentioned that, *"After training workers, they work for a short time and leave for other jobs…retaining workers is a serious challenge".* Other actors heavily rely on trainings from the government, development partners and non–governmental organisations (NGOs) to augment the skills of their workers. One cooperative reiterated, *"When the cooperative started cultivating maize, members had inadequate skills in maize cultivation and very little interest, which limited their efforts. Luckily, throughout the years, we have received much training and support, which have enabled us to increase productivity from 2.5 tons per hectare to 7.3 tons per hectare".*

Another key driver of skills gaps in the maize value chain is limited knowledge and awareness, especially among cooperative members, which limits hiring skilled workers even when they can afford it. One cooperative representative stressed, *"Many farmers are uneducated, and they need more sensitization to understand that hiring skilled labour does not reduce the cooperative's income but rather increases its productivity, which in turn raises income".* For several cooperatives, hiring one person to handle multiple duties is seen as a cost–saving mechanism, which, however, reduces concentration and effective performance and contributes to endless skills gaps. An example from one cooperative representative stressed the gravity of this challenge: *"You can be a manager in a cooperative but also be in charge of secretarial services, accounting and finance, human resource management, sensitization and mobilization, and many other activities. Eventually, you find yourself unable to perform productively with all those responsibilities".*

Another cooperative managed to hire a specialised agronomist. Still, he often delays reaching out to farmers due to many responsibilities. According to the cooperative's representative, *"The most important employee we need is an agronomist to guide farmers on the right strategies for planting seeds, taking care of the plants and following up on productivity. We have one agronomist, but he is not enough because of his many respon-*

sibilities. Sometimes, he is in charge of distributing seeds to farmers, and it may take him more than three days to visit a field. This can be late for farmers because, by the time the agronomist reaches their fields, their crops are already damaged by pests and/or diseases".

In some cooperatives, members assume management roles and multi–task them with their traditional farming tasks and often end up underperforming, further exacerbating skills gaps. This often results into a combination of technical skills gaps as well as soft skills gaps especially with regards to effective leadership of cooperatives, communication skills required for market purposes and customer care, among others. One member of a cooperative highlighted this challenge, mentioning, *"We need workers to manage our cooperatives because many cooperatives are being managed by cooperative committee members who are unpaid volunteers. The voluntary nature of their roles makes committee members accountable for the cooperative's successes and failures, meaning that we need professional and consistent workers who can manage our cooperatives and produce tangible results".*

Blockages to the Value Chain

Several blockages or challenges exist in the maize value chain, preventing actors from raising production/productivity levels and expanding the scope and scale of operations, including moving up the value chain. Understanding these blockages' nature, extent, and causes is a crucial first step in devising measures to address them.

Limited access to finance — Making technological improvements and investing in several productivity–enhancing and value–adding activities requires considerable capital, which most micro, small and medium–scale actors often lack. According to one actor, *"Financial institutions doubt the ability of farmers to pay loans and, as such, are unwilling to offer credit to us even when we provide all the necessary loan application documents".* Another actor highlighted the implications of inadequate finance, saying that *"Due to lack of adequate finance, we are unable to invest in modern farming technologies to boost production. We can't hire or buy tractors, construct drying shelters or install modern irrigation systems. Failure to make all these investments results in reduced productivity and low income for our cooperative"*. This observation reflects the country-wide picture, as the Annual Household Survey of 2020 reported that only 38.7% of agricultural households had requested a loan and lack of collateral was cited among the top reasons for loan rejection (NISR, 2021). Receipt of grants is also uncommon, as only 2.8% of agricultural households had received any grant from various sources for agricultural purposes. The limited access to credit and grants indeed portrays difficulties faced by value chain actors in making substantial investments in value addition and expansion of farming and post-harvest activities in the maize value chain.

Low quality of maize due to poor drying and post–harvest handling — The effective functioning of the maize value chain requires that systems are systematically interlinked and complementary. Increasing production is, however, often hampered by the risk of post–harvest losses due to inadequate drying facilities. Drying is one key challenge; as one processor mentioned, *"This season, the maize harvest has been quite good, but we are likely to reject about half of the maize from cooperatives because of improper drying mainly due to unexpected rains. As a newly established processing plant, we don't have enough dryers to help all farmers dry their maize, yet accepting half–dried maize increases the chances of developing aflatoxins before*

processing. The wise decision under these circumstances is to reject the maize grain from farmers because currently, we can't afford to construct enough drying facilities due to financial constraints".

One cooperative mentioned, *"We don't have enough drying shelters and modern dryers, and quite often, our maize is rejected by processors".* Another actor added, *"Due to a lack of enough funds, we have not started to use dryers. We only use drying shelters, but they are slow and ineffective during the rainy season".* This indeed reduces the ability of farmers and cooperatives to supply reliable quantities and quality of maize to processors and other large–scale buyers, ultimately failing to sustain market opportunities and losing customers to more sophisticated farmers within the country, if not abroad. The high moisture content of maize produced by Rwandan farmers due to poor drying facilities is the main reason why processors reject maize grain and resort to importation. As a representative from one milling company stressed, *"When farmers and cooperatives bring maize with high moisture content and/or aflatoxin infestation, we have no option but to import from countries like Zambia".*

Inconsistency in quantity and quality of seeds supplied — Some actors expressed concerns over the supply of seeds from multipliers and distributors, with commonly reported issues being delays in supply, failure to supply required quantities and inconsistency in seed quality, which often leads to variations in their productivity. One cooperative stressed this concern, *"We face a challenge of delayed seeds, which are sometimes of poor quality. For example, we received the WH 403 variety in the past season, which our member farmers liked. Still, available quantities were very low, and the supplier started to distribute a different variety, which many people disliked because it was unproductive. Some people ended up growing traditional seeds, which negatively affected their yields".*

Limited access to information — Effective communication among actors is necessary for the smooth functioning of the maize value chain. However, information asymmetries exist among actors at different levels, and there is limited access to general–source information. For one actor, information related to irrigation was the main issue, mentioning that *"Sometimes we want to try alternative sources of irrigation equipment or technology, but we don't have enough information about them".*

Unreliable power supply — For processors particularly, the unreliability of electricity exacerbates its high cost, affecting production and profitability. As for one actor, *"Given that our main plant is located in a residential area, electricity is quite weak, and sometimes the production cycle is ineffective, resulting in under–production on some days".* Another processor highlighted *"Unreliable electricity which reduces the quantity of maize processed per hour and raises the per–unit cost of production".*

Low prices — It is clear from discussions with value chain actors that low prices offered by buyers are quite discouraging. Low prices stem from two issues reported by the actors: low prices of maize recommended by MINICOM and the influence of middlemen who sometimes cheat farmers by offering unreasonably low prices for their grain. Illustrating the issues of prices set by MINICOM, one cooperative representative mentioned that *"The maize prices recommended by MINICOM are sometimes too low even to cover the cost incurred in growing the maize, which sometimes causes losses among farmers".* There is also a third factor that explains low prices, which stems from the farmers themselves: some farmers make advance supply arrangements with traders and end up selling their maize on the farm before maturity in search of quick income.

Issues with contract enforcement and payments — Some farmers sign supply contracts with traders, processors and aggregators to supply specific quantities of maize grain in predetermined periods. However, some buyers expressed concern that *"Some farmers and cooperatives don't respect their supply contracts and often sell maize to other buyers who offer higher prices upon harvest".* Such contractual failures threaten marketing systems for maize, hurting suppliers and buyers. For suppliers, on the other hand, delayed payments from some clients constrain operations. One cooperative mentioned that *"When customers delay paying for our maize grain, it limits our ability to pay for essential inputs, and this reduces our profitability".*

The Role Of Technology

The use of technology is at a quite low scale among the maize value chain actors, driven mainly by two factors: lack of adequate finance and limited scale of operations. One cooperative mentioned, *"We are unable to use tractors because our farming operations are too small for mechanisation".* Another cooperative finds limited funds to be the key inhibitor to technology adoption, emphasizing that *"We would definitely like to use modern technology, but we lack adequate funds to purchase machines like tractors, harvesters and threshers and yet financial institutions are unwilling to extend credit to us".* Some actors like cooperatives, aggregators and small–scale processors use manual moisture testing kits, which are mostly acquired from donors. As one cooperative involved in farming and aggregation mentioned, *"We can't afford enough moisture testing kits, but thanks to our partners, we recently acquired both mobile and fixed–point testing machines".*

Pest and disease control remains quite rudimentary, with manual spray pumps being the most common appliance. Another driver of low technology adoption is limited knowledge among value chain actors. As one cooperative representative emphasized, *"We hear about certain technologies like soil testing kits, and we would like to try them, but we lack adequate information on where to get them from and how to use them".* One farmer added, *"The fact that we don't get adequate information about irrigation systems and methods renders us unable to use them. Perhaps if we could get reliable information about alternative irrigation methods, we would consider using them".* The inhibitive cost of irrigation systems indeed keeps many individual farmers and cooperatives away from using them, even when they are fully aware of the benefits that accrue to farmers who use irrigation. One cooperative mentioned, *"Our main reason for not using irrigation is the lack of enough funds. In areas like the Kagitumba Valley, farmers have managed to grow maize and harvest three times in a season because they have advanced irrigation machines. It is hard for us to acquire those machines because they are very expensive".*

The usage of digital platforms is relatively low but growing. Digital payments are quite popular among the actors, mainly dominated by mobile money used by most actors to receive payments from clients and pay for supplies. Individual farmers and cooperatives use the Smart Nkunganire System (SNS), registering their details and making requisitions for subsidised fertilisers and improved seeds via mobile phones with agro–dealers' help. While some farmers are coping well with this digital platform, others expressed concern: *"The low digital literacy skills among our members make it hard for some of them to navigate the system and access crucial inputs".* Another cooperative representative was concerned that *"A farmer cannot easily obtain additional inputs for newly acquired plots of land after submitting the requisition in the system".* Several cooperatives also use digital platforms to make quick and accurate orders for their supplies.

One cooperative representative shared the benefits realized from the use of digital platforms, saying, *"We are able to order inputs online from Kigali while I am here at the office without having to travel. The supplier has not yet started delivering to customers, but I can send anyone to pick my order without worrying that they might misuse the money or buy poor–quality supplies because I am the one who bought them online".* The usage of digital platforms remains low despite the clear benefits, partly owing to limited skills and a lack of awareness of how to use them and the range of marketing benefits that can be supported. According to one cooperative representative, *"We lack access to e–commerce; not only us but many cooperatives do not know how to use e–commerce. This is due to lacking skills and confidence to use online marketing. Even when you consider commonly accessed social media platforms such as WhatsApp and Facebook, which can support online marketing without requiring sophisticated skills, many farmers and cooperatives still haven't embraced them for marketing. The common challenge is not knowing how to trade online, but marketing is possible. Perhaps we need sensitization to improve our confidence to use digital platforms for marketing purposes or hire people who can do that on our behalf".*

One aggregator has established an innovative electronic warehouse system where farmers who store their grain in the aggregator warehouses are provided with a receipt that they can use to access formal credit from financial institutions. Maize drying remains largely rudimentary, as one actor mentioned, *"We lack modern drying facilities and machines and hence rely on natural sunshine which sometimes doesn't dry maize adequately and fast enough".* Technologies for processors vary by scale of operations: small–scale millers use either diesel–powered or electric–motor millers whose parts are imported mainly from China, and the milling line is assembled in Rwanda, while for large–scale operators, almost the entire processing chain is imported.

Packaging and storage have been considerably improved over the years, with innovative materials being introduced in the market. Appreciative of these innovations, one cooperative representative mentioned, *"We also use eco–sacs and eco tanks for safe storage of our maize produce to match the needed quality levels on the market."* However, these new and environmentally friendly technologies have not spread among many farmers, and support for scaling up access among more farmers would improve post–harvest handling.

Influence of Government Policies

The government has been instrumental in shaping the operation and functioning of the maize value chain. From prioritization of the crop in the Crop Intensification Programme (CIP) to provision of subsidized fertilisers and improved seeds, to land–use consolidation, extension services and training of farmers, among other interventions. Considerable policy efforts have been put into reducing post–harvest losses, as one cooperative attested, *"The government has supported us in constructing drying shelters which have helped to reduce post–harvest losses."* In terms of contractual arrangements, one cooperative appreciated government support rendered to farmers in terms of enhancing access to drying facilities to improve and quicken maize drying to comply with the required moisture content. One cooperative representative said, *"The government has supported us in constructing drying shelters, and this has helped to reduce post–harvest losses."* This compliment was shared by another farmer, saying, *"Another policy was to promote post–harvest handling skills and management where they supported different cooperatives in constructing drying shelters, stores and offices for cooperative operations by connecting cooperatives with funders to help train them in improving post–handling skills".* Overall, addressing post–harvest losses is indeed an incentive for value chain actors to raise production and increase market access and profitability, as reported by the respondents.

Farmers have commended the SNS for promoting access to improved seeds and fertilisers. As one farmer mentioned, *"The government policy that influenced us was Smart Nkunganire, which had incentives for inputs that helped farmers to afford them. Many of us were beginners who had little income to invest in farming. Indeed, the subsidization of improved maize seeds and fertilisers eased the financial constraints that had limited some farmers from adopting them".* According to one cooperative, *"The government programme of Smart Nkunganire has reduced prices of inputs; it is now affordable for us to get fertilisers and pesticides at low prices, which helped to increase the quantity and quality of our produce".*

Some value chain actors have reservations about some policies, claiming that they have introduced difficulties in how the actors used to do business. The Smart Nkungaire System was highlighted as an initiative with challenges amidst benefits and positive intentions, mainly regarding the lack of flexibility, the choice of seeds provided via the platform and issues with digital literacy among user farmers. According to one farmer, *"The Smart Nkunganire System prioritised made–in–Rwanda seeds, which are unproductive like foreign seeds. We had foreign seeds in the system, but they were removed to promote the use of local seeds. However, the foreign seeds output would produce yields of 4–5 tons per hectare for a poor farmer and 6–7 tons per hectare for a rich farmer. However, productivity has reduced since we are now using local seeds. The government has even decided to expand the land size to cover the loss".* This sentiment points to the need to reconsider the type of seeds offered via the system, mainly based on feedback from farmers and cooperatives.

Government policy has also been influential when it comes to the promotion of locally–made inputs like seeds. One seed multiplier appreciated the Made–in–Rwanda policy, mentioning that *"We used to multiply seeds and sell them at a low price until the government decided to promote local seeds, after which our market share increased, and we were able to sell at a reasonable price. Our cooperative income has increased due to this programme. We have a stable market as we harvest the seeds and send them to the government".* Another cooperative, however, had a conflicting view: *"The challenge we faced was the policy of promoting made–in–Rwanda seeds, which resulted in removing foreign seeds from the Smart Nkunganire programme where farmers are limited to accessing locally produced seeds that are not as productive as the foreign seeds we used to grow".*

Government interventions have been instrumental in skills development, especially in training through local government agronomists at the District and Sector levels. As one farmer mentioned, *"The government did good by increasing skills for farmers and other agricultural workers".* Through various interventions, capacity–building programmes offered to farmers are also gradually building a skills base and professionalizing farmers, changing the traditional way of growing maize. One cooperative representative who appreciated such capacity–building initiatives mentioned, *"The government sent advisors who helped us understand cultivation techniques through multiple trainings. Many farmers used to grow crops without knowing how to take care of them, wrongly thinking it was a matter of planting seeds and waiting for weeding and harvesting. However, after several trainings, farmers' mindsets and practices are changing, and now many have learnt good practices such as using pesticides and applying fertilisers for the second time, as well as post–handling".*

However, for one actor, *"the trainings are mostly theoretically and yet agriculture requires practical skills".* Another actor mentioned the limited number and skills of service providers: *"We only have one agronomist per sector who is supposed to train all farmers in the sector about farming practices. When there is a disease, agronomists sometimes send the SEDOs (*Socio–Economic Development Officers*) to alert farmers in Cells. How-*

ever, this strategy is not effective because SEDOs are not skilled in agriculture practices. The only information a farmer will receive through that channel is the existence of the disease, without knowing how to handle it in case their crops are infected. We do not have enough skilled personnel to guide farmers in our area". These two observations point to the need for targeted and practical training sessions that reflect the realities of farmers and cooperatives and address their skills gaps in handling components of farming, such as caring for maize plants and fighting against pests and diseases.

In the fight against climate change and extreme weather events, government support towards agriculture insurance is gradually promoting resilience. One cooperative member mentioned, *"The most important and useful policy is crop insurance, where the government supports us by paying 40% of the insurance fees".* Agriculture insurance uptake is generally low, driven in part by a combination of limited income — amidst farmers' perceptions about the high costs involved — and limited information about how insurance works. Current subsidization programmes by the government would indeed promote uptake and, if coupled with adequate sensitisation and mobilisation of farmers, have the potential to contribute to agriculture's adaptation to climate change through safeguarding production and farm incomes.

The Africa Maize Market size is estimated at USD 41.40 billion in 2024, and is expected to reach USD 57.26 billion by 2029, growing at a CAGR of 6.70% during the forecast period (2024-2029).

https://www.mordorintelligence.com/industry-reports/african-maize-market

Review of International Experience and Best Practice for the Maize Sector

Introduction

The international comparison aims to see how countries have developed their value chain for maize and to consider the implications for Rwanda, especially in terms of how they might develop skills and employment opportunities. The selection of case studies was based on a number of criteria. The first is what lessons can be gained from the other countries' experiences. In practice, this meant selecting countries that have successfully grown their maize industry and have similar development characteristics. There is no point in selecting country case studies where the lessons are not applicable. The second criterion for selecting case studies was the availability of data. Unless the data was available, it is difficult to understand how other countries' value chains operate, the effectiveness of their policy rules or the support provided by the government.

Our approach focuses upon five related parts to comprehensively understand the maize value chain in different countries. The first is how the value chain developed and what factors made it successful in the three countries selected. The second part is the various stakeholders involved in the value chain and their corresponding relationship. The third part turns to the rule and supportive environment, including the roles played by the government and how they are facilitating the success of the three different value chains. The fourth part turns to employment and skill issues. It should be noted that there was limited data on this topic in some cases. Finally, the challenges facing the value chain and the implications for Rwanda are tackled.

International Case Studies on the Maize Value Chain

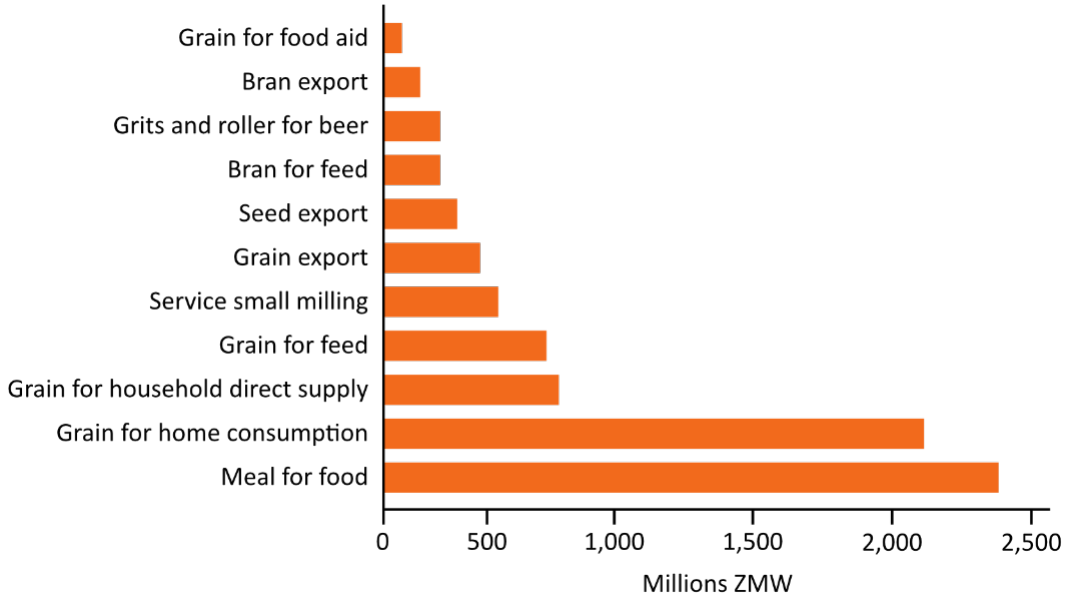
An overview of the case studies selected for the analysis is outlined in Table 5. A total of three different case studies were chosen. The first case study, Zambia, was selected due to learning from its long experience and attempts to commercialise its maize sector and the large numbers working in the sector. The other second case study, Uganda, was selected due to its next–door location to Rwanda and its predominance of small–scale and informal sector producers. Finally, South Africa was chosen because it is the largest producer of maize in Africa and has an established foundation for agricultural skills development. Each country has a slightly different value chain, and their approaches to the industry can offer lessons for Rwanda.

Case study 1: The Zambia — Could do Better?

Zambia's economic development is intricately tied to the advancement of productivity in agriculture and the sustainable administration of farming systems (IAPRI 2020). Maize is Zambia's primary food source, accounting for around 60% of the nation's caloric needs. The majority of this produce is derived from small–scale farms and relies predominantly on rainfall for irrigation. Due to favourable precipitation and consistent government subsidies in both production and marketing, the country has consistently generated excess maize yields over the past twenty years (see Figure 28).

Country	Key Markets for Maize	Structure of Value Chain	Contribution to GDP	No. Employed	Rules	Supportive Functions	Key Challenges
Zambia	Food consumption, animal feed (poultry, pigs and dairy sector).	• Over 3,000 commercial farmers and numerous small-scale farmers contribute to maize production, contributing over 80% of total output. • There is a also a large informal market, characterised by small traders and local aggregation points whilst formal markets also exist, involving larger traders and millers, often concentrated in urban areas.	3% of total GDP	70% of the labour force are working in agriculture, without 40% in maize.	• The sector is guided by the National Maize Policy (NMP), and the Seed Act. • The government controls the price by buying the maize when the price is dropped.	• The government provides subsidies for inputs like fertilisers and improved seeds. • Trained outreach officer offers technical advice, training, and demonstrations on improved farming practices. • The government supports research institute to conduct research on maize breeding, pest and disease control.	• Heavy reliance on government and this can disrupt the private sector. • Low productivity and limited rural poverty reduction. • Affect of climate change.
Uganda	Mainly staple food, animal feed (mostly for poultry and pigs), processed food ingredients.	• Smallholder farmers, who cultivate more than 80% of the land controlled 70% of the total maize production. • Informal markets dominate, with limited access to formal channels. • Large-scale industrial mills exist but operate below capacity due to inconsistent supply.	10 % of the country's GDP	47% of the workforce directly employed in agriculture, and mostly in maize cultivation.	• The government has a new agricultural policy. • The government regulated most of the value chain components and quality standards, but it only applies to all formal sector.	The government supporting farmers with input subsidies and infrastructure development, as well as research on applied farming techniques.	• Low productivity. • Limited access to markets, weak infrastructure, and limited value addition.
South Africa	Staple food, ingredients for pap, grits, various processed foods, livestock feed and Industrial uses.	• 98% of maize comes from commercial farms, while developing agriculture contributes the remaining 2%. • Utilise advanced technology and mechanisation for large-scale production only available on commercial farms. • Both commercial and informal markets play a role in maize marketing.	2.2 % of the country's GDP	956,000 people were employed in primary agriculture in Q3 2023.	The government regulates the framework for establishing quality standards for agricultural products, including maize, prohibits anti-competitive control the price, and the labour market.	The government supports the production through input subsidies, infrastructure development and research for new technologies, price stabilisation scheme, & support to farmers affected by disasters.	• Access to quality inputs. • Inefficiencies in processing and distribution. • Unequal land distribution. • Competition.

Figure 28: Value of the production of maize in Zambia in million Zambian Kwacha (ZMW)



The Role Played by the Government Partners In Supporting the Maize Value Chain

The government plays a crucial role in supporting the maize value chain by coordinating the operations of various stakeholders and partners. The Food Reserve Agency (FRA) promotes maize production by buying maize from farmers at predetermined rates, providing incentives to allocate resources towards maize cultivation, stabilising corn prices, and offering farmers access to markets and storage facilities. The Ministry of Agriculture supports maize through the Farmer Input Support Programme (FISP), targeting small farmers who can't afford inputs.

The FISP aims to cut farmers' input costs, stimulate food production, meet national security concerns, and boost farmer and family incomes. It provides subsidized or free fertilisers, seeds, training, and extension services. The Ministry of Agriculture has also started supporting innovations in the maize value chain, such as the National Advisory Committee for the Approvements of Technology, which improved three new systems for better yields and soil maintenance.

The Sustainable Intensification of Smallholder Farming Systems in Zambia (SIFAZ) project, a collaboration between the Food and Agriculture Organisation (FAO) of the United Nations, Zambia's Ministry of Agriculture (MoA), and the International Maize and Wheat Improvement Centre (CIMMYT), has led to enhanced techniques for cultivating maize. Each category of maize farmers faces distinct markets and limitations. Largescale farms primarily engage in the maize value chain to produce seeds and supply grain to the poultry, pig, and dairy sectors. At the same time, small and medium–scale farmers face similar market uncertainties and fluctuations in agroclimatic conditions. Remote regions with lower pricing and underdeveloped markets for maize grain face higher levels of risk.

Key Stakeholders and Industry Structure

Zambia's maize sector relies on various stakeholders, including companies that supply high–quality seeds and agrochemicals to protect crops from diseases and pests. The Zambia Seed Company (Zamseed) is a notable national company that provides hybrid maize varieties suitable for Zambia's varied climatic and soil requirements. Other key stakeholders include the government through the Food Reserve Agency (FRA), milling companies like Zambezi Milling, National Milling, and Unga Limited, traders like Cargill, Afgri, and Dunavant, small–scale buyers like smaller businesses and stalls, and the Millers Association of Zambia (MAZ).

The Business Environment and Supportive Infrastructure

The Zambian government's "Vision 2030" policy aims to establish an efficient, competitive, sustainable, and export–focused agriculture industry by 2030. This vision focuses on increasing crop productivity, extending cultivated acreage, and enhancing the maize value chain to generate employment. However, the business environment for maize cultivation is subject to debate. Approximately 50% of small–scale farmers receive subsidized fertiliser and hybrid seed supplies, reducing their production expenses. The Food and Agriculture Organisation (FAO) ensures a secure market for excess produce from small–scale farmers in isolated regions.

Over 50% of public funding administered by the Ministry of Agriculture is allocated to the maize value chain, but the efficacy of the subsidy scheme appears constrained. The primary complaints of the existing maize policy are disparities between actors who receive subsidies and those who do not, low productivity, and uncertain sustainability of smallholders' cropping systems.

The extent to which infrastructure facilitates maize production is also subject to discussion. Rural roads in Zambia experience inadequate upkeep and limited connectivity, leading to higher transportation expenses and impeding the timely delivery of goods and resources. Insufficient irrigation infrastructure also limits farmers' ability to utilise sophisticated machinery and irrigation pumps, hindering productivity.

Skills and Employment

The substantial surge in maize production since 2000, primarily driven by small–scale farmers and the growing number of participants engaged in input supply and value–addition activities, has resulted in expanded employment and income generation prospects in both rural and urban regions. The proliferation of small–scale operations in the supply of agricultural inputs and trade of maize has created valuable income–generating prospects, especially for young men residing in rural regions with limited paid job alternatives. Small and micro–scale commerce offers substantial revenue opportunities for individuals who are unable to participate in formal employment markets due to the absence of schooling or skills requirements.

The government has not prioritised skills development for the agriculture industry, specifically in relation to maize. Education programmes are structured and offered at several levels within the education system. These include degree and certificate programmes in higher education and agricultural instruction at the school level. Nevertheless, similar to many African nations, the provision has faced criticism about the cur-

riculum's content, the lack of practical training, and its failure to establish connections with the labour market and farmers.

Nevertheless, informal training has proven more effective in addressing the demands of the job market. An example of such training is being offered by Cargill. Zambia's smallholder farmers are acquiring contemporary farming methods and obtaining superior crop inputs through the company's extensive network of 1,600 training schools, benefiting approximately 70,000 individuals. Cargill assists farmers in improving crop quality, increasing yields, and ultimately, earning higher incomes by educating them on the significance of appropriate soil preparation, sowing, and weed and pest control.

Cargill has formed over 800 Cargill Women's Clubs throughout the country, granting these women access to much needed resources that enhance their skills and strengthen their farm operations. By offering lines of credit, better seeds and improved harvesting methods, Cargill helps increase what female farmers take to market. Then, tailored marketing support helps them sell what they grow. In addition, the clubs' education on gender issues helps women navigate inequality in Zambian culture — a major push for social change.

Challenges Facing the Sector

The main challenges facing the value chain include limited productivity and the potential for unsustainability of smallholder farming systems. The FRA faces obstacles such as budgetary sustainability, logistics, and a disproportionate number of benefits given to larger farmers that sell more maize.

Lessons for Rwanda

Rwanda could learn from these challenges and implement targeted subsidies or support programmes to enhance productivity in its agricultural sector. Zambia's maize value chain includes domestic consumption and export, and diversifying its agricultural products and markets can improve resilience against market fluctuations. Informal training programmes like those offered by Cargill highlight the importance of practical skills development. Rwanda could focus on enhancing agricultural education and training programmes that align with market needs and create policies ensuring inclusivity in the agricultural sector, supporting small– and large–scale farmers.

Case Study 2: Uganda — From Subsistence Production to the Expansion of the Commercial Market

Uganda's maize industry has evolved from subsistence production to the expansion of the commercial market, with over 3 million farmers growing the crop for subsistence needs. The government prioritised maize production after gaining independence in 1962 by implementing programmes such as better seed types and extension services. However, economic sanctions and political unrest impeded development.

The 1990s saw economic liberalization encouraging private sector growth in processing and trading maize. Large–scale commercial farms also started to appear, enhancing output, with production mainly concentrated in the Eastern Region. However, obstacles to further growth included inadequate market information systems, weak rural transportation networks, and poor storage infrastructure.

Uganda's rich soils are ideal for maize growth, but the industry faces challenges such as reliance on rain–fed agriculture, low input use, and little mechanisation. About half of the country's maize is produced in the Eastern area, which leads the industry. Regional differences in yields and resource availability emphasise the need for focused measures to close the gap.

Stakeholder and Industry Structure

Uganda's maize value chain comprises various stakeholders, including smallholder farmers, large–scale commercial farms, and financial institutions. The government agencies like the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and research institutions like the National Crops Resources Research Institute (NaCRRI) are important stakeholders in policies, regulations, and research initiatives.

There are approximately 2,000 registered businesses in Uganda's maize value chain, most involved in milling and trade. Over 4 million tons of maize were produced annually in 2020, contributing to an estimated 10% GDP contribution. The major driver of demand is the local market, with maize flour being a staple diet for many people. Export markets are becoming more significant, with South Sudan and Kenya emerging as crucial locations.

The Role Played by the Government

The government's activities for the maize industry are led by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), which creates programmes such as the National Agricultural Policy (NAP) 2013. The Uganda Bureau of Statistics (UBOS) gathers and disseminates essential statistics on maize prices, consumption, and output. Regulatory organisations like the Uganda National Bureau of Standards uphold standards for maize and its products.

The Business Environment and Infrastructure

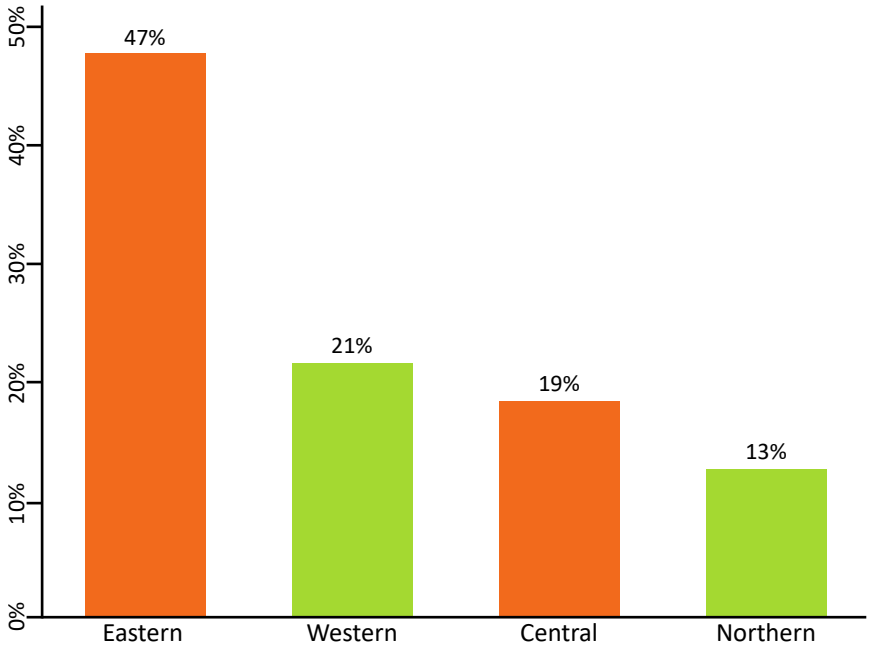
The regulatory framework in Uganda is multi–layered and fragmented, with organisations like the Uganda Grain Trade Association (UGTA), the Uganda National Bureau of Standards (UNBS), the National Agricultural Advisory Services (NAADS), and the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF). This complexity often results in conflicting requirements, red tape, and uneven enforcement. Inconsistency in policy has also been a challenge, with the government's policy of export prohibitions and price restrictions stifling investment and skewing market signals, impeding the industry's expansion.

The maize industry is a complex ecosystem with various players, each with their own goals and areas of interest. Farmers seek increased yields, steady pricing, and easy access to markets and inputs, while traders and millers seek stable supply chains, effective marketplaces, and high–quality grains. The government aims to boost export revenue, create jobs, and ensure food security.

To ensure quality maize, Uganda needs to implement globally recognised standards such as Codex Alimentarius, which includes initiatives like the maize grading system developed by the Ugandan National Bureau of Standards. A comprehensive strategy requires funding farmer training programmes on best

practices, encouraging the use of improved fertilisers and seeds, and bolstering quality control measures along the value chain.

Figure 29: Maize production by region in Uganda (2020)



Skills Development and Employment Issues

Agricultural education is where formal channels for skill development are established. Specialised programmes in agronomy, food science, and agricultural business management are offered by universities like Makerere and Gulu, which provide graduates with both academic and practical understanding.[6] To close the knowledge gap between theory and practice, vocational training institutes and farmer field schools — which are frequently funded by NGOs and government agencies — offer practical instruction in enhanced farming techniques, post–harvest management, and value addition. Despite their importance, these programmes often suffer from accessibility and funding issues, which keeps many people out of the loop, especially women and young people.

Networks of informal learning emerge naturally from farmer–to–farmer interactions. Experienced farmers impart their expertise and insights to their peers through farmer groups, field demonstrations, and community knowledge hubs, enabling them to develop practical skills and modify innovations for specific local settings.[7] The informal learning environment is being enhanced by digital technologies such as online platforms and smartphone applications, which provide people access to market data, best practices, and extension services — even in remote locations.[8]

[6] MAAIF. (2020). Agricultural Sector Development Strategy 2020–2030. Ministry of Agriculture, Animal Industry and Fisheries, Uganda.

[7] Otim, M., Namuwonge, A., Mwesigye, F. K., & Sserunkuuma, J. (2020). Farmer Learning and Field Extension Systems in the Context of Agricultural Transformation in Uganda. Journal of Agricultural Extension and Rural Development, 12(2), 109–121.

[8] Akram, A., Sserunkuuma, J., Mugabi, P., & Otim, M. (2021). Digital Technologies for Agricultural Value Chain Development in Uganda. Journal of African Studies and Development, 9(3), 156–165.

In addition, the private sector is essential for developing skills. Seed firms provide training programmes on hybrid seed types and appropriate agronomic methods to optimise yields and market value.[9] Processing firms help small and medium–sized enterprises (SMEs) throughout the maize value chain become more efficient and competitive by providing them with business skills training and technical support through collaborations with NGOs and government agencies.

A startling 47% of the workforce is employed in agriculture, especially maize cultivation, which continues to be the mainstay of the Ugandan economy and contributes considerably to GDP.[10] More than 80% of rural families work with maize, with small–scale farmers being the majority of the industry's producers.[11] Since millions of Ugandans depend on maize for their lives, employment statistics in this industry are a crucial gauge of the country's health.

Navigating this data, though, is a difficult task. One major challenge is the absence of thorough and standardized techniques for gathering data. Even though the Uganda Bureau of Statistics (UBOS) carries out surveys such as the Annual Agricultural Survey (AAS), they frequently prioritise output data over comprehensive employment statistics. Significant gaps remain, especially in the area of informal employment, which is common in the maize industry since small–scale farming predominates.[12]

Another degree of intricacy is added by the variety of jobs associated with maize. A wide range of operations are included in this sector, including cultivation, harvesting, processing, marketing, and value–adding. It is difficult to capture the entire range of employment across these many occupations and areas. Research such as the *Determinants of Maize Production Income in Western Uganda* shows how data must be disaggregated in order to appropriately depict employment trends and income inequalities among various maize value chain sectors.[13]

Key Challenges Facing the Sector

The sector's key challenges include the fundamental difference between smallholder farmers and larger–scale entities. Smallholder farmers often face obstacles such as small landholdings, heavy reliance on rain–fed agriculture, and lack of access to better inputs and technology, which reduce productivity and yields, leading to significant income differences. Larger commercial farms often have enhanced seeds, automated procedures, and irrigation systems, enabling them to produce greater yields and generate sizable profit margins.

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[9] Mutenga, B., Asea, D., Byamukama, E., Nankunda, N., & Kashaija, F. (2018). Adoption of Hybrid Maize Seed Varieties and Their Impact on Household Income in Eastern Uganda. African Journal of Agricultural and Resource Economics, 13(4), 217–233.

[10] UBOS. (2022). Annual Agricultural Survey (AAS) 2019 – Statistical Release. https://www.ubos.org/wp–content/uploads/publications/04_2022AAS2019_Report.pdf

[11] FAO. (2017). Rural youth employment and agri–food systems in Uganda. https://openknowledge.fao.org/server/api/core/bitstreams/db527da5-a0bf-431f-9a08-8052ac9e5dc6/content

[12] EPRC. (2007). Improved Inputs Use and Productivity in Uganda's Maize Sub–sector. https://elibrary.acbfpact.org/acbf/collect/acbf/index/assoc/HASH15c7/72a92463/20cdfff9/a3.dir/EPRCseries69.pdf

[13] Atuhaire, G., & Kasirye, G. (2018). Determinants of Maize Production Income in Western Uganda. ResearchGate, 12(3).

Within the value chain, employment patterns also differ significantly. Family–run smallholder farms usually produce only enough food to meet their own needs and have little surplus to sell. On the other hand, larger farms and processing plants provide prospects for earning a living income but are often associated with informality and unstable working conditions.

Implications for Rwanda

The implications for Rwanda are clear. Improving smallholders' access to land, loans, and agricultural extension services through policy interventions is essential to raise their output and competitiveness in the market. Encouraging group efforts and farmer cooperatives can strengthen smallholders' position through market diversity and collective bargaining. Formalising employment within the value chain is equally important, providing workers with the skills they need to land stable, well–paying employment while enacting and upholding labour laws will protect them from exploitative practices and ensure acceptable working conditions.

Case Study 3: South Africa — Leading Producer of Maize In Africa & Champion of Skills Development

South Africa, a leading producer of maize in Africa, has been a key component of the country's agricultural economy since the 17th century. Maize's drought tolerance, hardiness, and large yields have made it popular in African societies. However, the introduction of apartheid in 1948 significantly impacted the industry, leading to racial segregation laws and limited access to markets and resources. South Africa has produced an average of over 15 million tons of maize annually, covering 75% of the land used for farming.

The production of maize in South Africa meets domestic and international demand, with almost half of the crop being used for human consumption, particularly in the form of maize meal. The export market offers both advantages and disadvantages, with South Africa contributing only 2% of world maize exports. Diversifying export destinations and reducing price volatility are essential for diversifying the market. The maize value chain is complex, with government initiatives to combine farmer income with consumer affordability and land ownership issues, particularly for small–scale farmers.

Stakeholder and Industry Structure

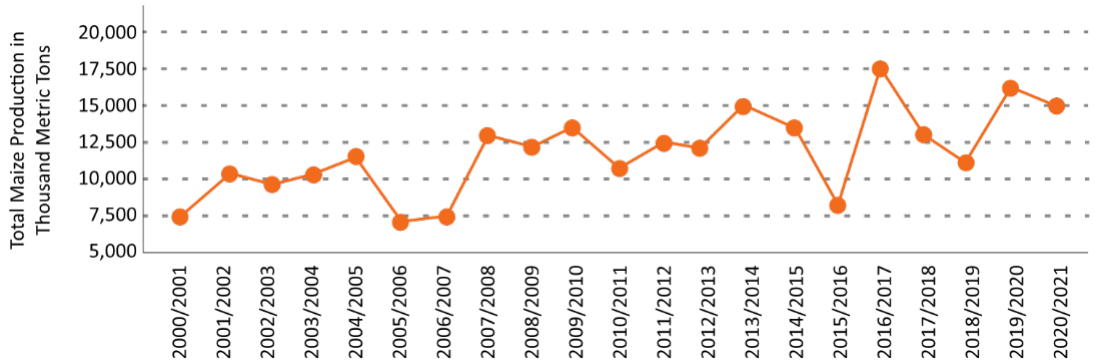
South Africa's maize industry is diverse and complex, with commercial farmers accounting for 80% of production and small– and developing–scale farmers making up a smaller portion. The sector also includes businesses providing inputs, dealers, merchants, and processing facilities for flour, animal feed, and other goods. The Department of Agriculture, Land Reform and Rural Development estimates that South Africa has around 32,000 commercial agricultural units, with 5,000–7,000 significantly contributing to the country's maize output.

Government Policy

The maize policy in South Africa is a patchwork of policies, with the National Agricultural Policy Framework (NAPF) 2012–2030 focusing on transformation, food security, and poverty reduction. The Strategic Plan for the Maize Industry (2018–2023) focuses on value chain growth, market access, and production efficiency.

Trade agreements like the African Continental Free Trade Area (AfCFTA) and the Southern African Development Community (SADC) provide access to markets for maize exports and expose the industry to competition from other nations. Regulatory organisations play a vital role in the industry, addressing internal issues, simplifying procedures, and valuing diversity.

Figure 30: Production of maize in South Africa from 2000 to 2022 (in 1,000 metric tons)



The Business Environment and Infrastructure

Bureaucratic inefficiencies, fragmentation, and lack of cooperation among government bodies often hinder policy and institutional frameworks. Small–scale farmers' limited access to capital and unequal land ownership also limit their potential. To address these issues, Rwanda can learn from the historical context of South Africa's maize industry, promoting inclusivity and equal access to resources. The structural composition of the industry, including both commercial and small–scale producers, can benefit from a diverse agricultural sector.

The maize industry in South Africa is governed by various regulatory bodies, including the National Department of Agriculture, Food and Rural Development (DAFF), which regulates the quality of maize grains, input safety, and crop traceability. The Agricultural Product Standards Act allows DAFF to control genetically modified organisms (GMOs), a controversial topic. Regulatory agencies also promote fair market practices, competitiveness, and environmental sustainability. However, challenges exist in monitoring and enforcing legislation, particularly in the face of market concentration and dominance by major firms.

The South African maize market operates within a complex business environment, with 75% consumed domestically and 25% exported. Price volatility, climate change, and resource constraints impact market dynamics and farmer profitability. Genetically modified maize has enhanced yields and insect resistance, but concerns about long–term effects on the environment and society persist. Investments in drought–resistant cultivars, water management techniques, and sustainable agricultural methods are essential for long–term resilience.

Transportation infrastructure is crucial for the maize sector, with deteriorating roads, outdated rail stock, and ineffective logistics affecting grain movement. The Free State's disproportionate number of silos also contributes to bottlenecks and inefficiencies. Skills development and employment issues are also significant challenges in the industry.

Skills Development and Employment Issues

The maize industry in South Africa paints a complicated picture. Initiatives to address skills gaps and promote best practices are highlighted by the Agricultural Sector Education Training Authority (AgriSETA) Sector Skills Plan (SSP). AgriSETA is the primary organisation in charge of the sector's skills development. It establishes national certification frameworks, sponsors training initiatives, and manages the levies that employers collect and distribute. Precision farming, post–harvest management, and value chain growth are among the topics that are prioritised in its Sector Skills Plan for Agriculture, which offers a roadmap for focused interventions.[14]

Governmental organisations are essential in promoting and aiding in the development of skills. Initiatives like the Youth in Agriculture and Agro-processing Programme are carried out by the Department of Agriculture, Land Reform and Rural Development (DALRRD), which promotes entrepreneurship and offers hands-on training. Universities and research organisations like the Agricultural Research Council (ARC) provide contributions through knowledge transfer initiatives, extension services, and applied research that guides the creation of training materials and curricula.

An essential driver for the development of skills is the business sector. Prominent agribusinesses, input providers, and farmers' associations make training investments for their staff members, collaborate with academic institutions to provide internship opportunities, and fund pertinent research initiatives. Their hands-on engagement guarantees that training curricula reflect the demands of the industry and new technology.[15]

Farmer cooperatives and non–governmental organisations (NGOs) are examples of civil society organisations that are essential in reaching marginalised areas and advancing inclusive skill development. They provide youth and women with specialised training programmes that frequently include business management and financial literacy components.[16] Through their efforts, disadvantaged populations are empowered to actively engage in the maize value chain and the skills gap is bridged.

With an anticipated 128,000 people directly employed by commercial maize growers, on–farm operations make up the majority of the maize sector's employment.[17] In the larger agricultural, forestry, and fisheries sector, this represents around 15% of the labour force.[18] On–farm employment has fluctuated over the last ten years; in 2021, it saw a noteworthy increase because of favourable harvest conditions and improved financial situations.[19] But worries about some of these vocations being replaced by automation and mechanisation in the future still exist.

[14] AgriSETA (2023). Sector Skills Plan — AGRICULTURE. https://www.agriseta.co.za/wp-content/uploads/2023/03/AgriSETA-Sector-Skills-Plan-FIN.pdf

[15] De Klerk, J. (2020, June 19). Finding a solution to agriculture's skills gaps. Farmer's Weekly. https://www.linkedin.com/pulse/improving-agricultural-sector-south-africa-through?trk=article-ssr-frontend-pulse_more-articles_related-content-card

[16] Magara, A. & Makhubele, M. (2012). The Role of Agricultural Skills Development in Transforming African Agriculture. The African Centre for Economic Transformation. https://acetforafrica.org/?smd_process_download=1&download_id=16812

[17] Department of Agriculture, Land Reform and Rural Development. (2021). Maize profile. https://www.dalrrd.gov.za/

[18] Statista. (2023). South Africa: employment agricultural sectors. https://www.statista.com/statistics/1134712/employment-in-agriculture-hunting-forestry-and-fishing-in-south-africa/

[19] Food For Mzansi. (2022). Job stats: Mzansi's agri sector has a healthy heartbeat. https://www.foodformzansi.co.za/

The employment footprint of the maize industry is broad and includes a variety of activities outside of the fields. According to estimates, the transportation, storage, and processing industries support up to 250,000 more employment. These industries create a large number of work possibilities.[20] Furthermore, the downstream sectors that use maize as a raw material — such as the manufacture of food and animal feed — also help to create jobs. This complex web of linked companies emphasises how the maize industry multiplies its impact on the whole economy.

The employment in South Africa's maize sector is facing several issues. One of the most urgent issues is the loss of jobs as a result of the fast replacement of manual labour by mechanised farming practices, especially in harvesting. Although this boosts productivity, fewer personnel are required as a result.[21] Opportunities for employment in rural areas are further reduced by this trend and land consolidation that benefits large–scale commercial farms. This is especially striking in light of South Africa's existing high unemployment rate, which disproportionately affects rural areas.[22]

The difficulty is made worse by the erratic nature of work. A large number of farm–workers work on seasonal or temporary contracts, which means they don't have fundamental job security, benefits, or enough pay. The historical legacy of labour laws from the apartheid era and the lax implementation of safety laws are the causes of this vulnerability. These circumstances lock workers in a cycle of exploitation and poverty together with limited access to possibilities for alternative livelihoods and skill development.

A further aggravating factor is the precarious socioeconomic environment. The allocation of land is still incredibly uneven, with a tiny group of white commercial farmers owning a sizeable share of the arable land.[23] Investment in labour–intensive farming methods is hampered by this historical injustice and continuing land reform initiatives. Furthermore, there are significant threats to agricultural income and job stability from outside variables including fluctuating input costs and climate change.

Key Challenges Facing the Sector

The industry faces challenges such as job loss due to mechanised farming practices, erratic work conditions, and a precarious socioeconomic environment. Policy interventions can help achieve a more equitable and sustainable maize industry by fortifying labour laws, encouraging small–scale farming, and making it easier for people to access capital and technology. Investments in rural infrastructure and skill development can increase workers' access to markets and value chains while providing them with employable skills.

The South African maize industry faces several challenges, including climate change, resource scarcity, input costs, market dynamics, infrastructure, technological adoption, and policy and institutional frameworks. Climate change increases drought frequency and severity, limiting production and yield. Input costs and market dynamics also pose a challenge for small–scale farmers, who rely heavily on consistent rainfall. Poor in-

[20] Ibid.
[21] Vink, N., & Kirsten, J. (2004). A Descriptive Analysis of Employment Trends in South African Agriculture. https://www.mdpi.com/2071-1050/13/5/2645
[22] Tips. (2000). Agricultural Employment Crisis in South Africa. https://www.tips.org.za/
[23] IIAP. (2021, October). The challenges for small enterprises in the South African maize processing industry: Innovation and inclusion in agro–processing. https://iiap.info/wp-content/uploads/2021/11/IIAP_South-Africa-Maize-Working-Paper_October-2021.pdf

frastructure hinders market access and transportation, especially in rural areas. Technological adoption and research gaps also hinder production and climate change adaptation.

Implications for Rwanda

In conclusion, the key challenges facing the South African maize sector, such as climate change impacts, input costs, and market dynamics, offer Rwanda an opportunity to address these issues proactively. Skills development and employment highlighted in the South African maize industry provide important insights for Rwanda's agricultural workforce. Implementing targeted skill development programmes fostering collaborations between government, businesses, and educational institutions, can contribute to a skilled and resilient workforce. Additionally, Rwanda should anticipate and address potential challenges associated with the mechanisation of farming practices, ensuring a just transition for workers.

The global maize area (for dry grain) amounts to 197 M ha, including substantive areas in sub–Saharan Africa, Asia and Latin America (FAOStat, 2021). It is an established and important human food crop in a number of countries.

Recommendations for Policy Reform and Concluding Comments

The analysis of employment and skills in the Rwandan maize value chain reveals a promising sector with significant potential for growth and contribution to the national economy, including possible export opportunities. The study highlights critical areas where policy interventions could bolster employment opportunities, address skills gaps, and enhance the sector's overall competitiveness.

Key Issues for Policy Reform

Based on the analysis, the following areas emerge as priorities for policy reform.

Skills and Employment

- **Vocational Education and Training** — Strengthening vocational training institutions and agricultural colleges can provide a steady stream of skilled workers to meet the growing demand for specialised skills in the maize value chain. While designing education curricula for agriculture and mechanical TVET schools, a comprehensive skills needs assessment ought to be made in order for training institutions to provide practical skills, including those identified in this study as critically lacking. At the production level, targeted training programmes could focus on operation and maintenance of irrigation systems, proper fertiliser application and integrated pest management. Beyond production, training institutions ought to work with the private sector and other actors — especially processors — to identify training needs among technicians to build a skills set of people capable of operating and maintaining sophisticated machinery along various stages of the production line.
- **Other Targeted Skills Development Initiatives** — Building the technical capacity and professionalism of individual farmers and cooperatives though not only training in mainstream farming activities but also in financial and agri–business management to ensure they operate maize enterprises profitably. Rwanda Cooperative Agency (RCA) ought to design capacity building initiatives in collaboration with various training institutions to make tailored training programmes covering entrepreneurship, financial management, record keeping, marketing, value addition, among other modules.

Removing Blockages

- **Reduce Post–Harvest Losses** — Promote investment in drying, storage, and processing technologies to minimise spoilage. This could be done partly though establishment of a post–harvest handling facility in each major maize producing sector or district. The facility could act as a one–stop centre for maize handling, with modern warehouse, storage, drying and other post–harvest handling services. This could be a joint initiative or public–private partnership between the relevant government institutions and the private sector — including cooperatives — with the financial and technical support of development partners.
- **Streamline Regulations and Permits** — Compliance with regulations requires that regulators work together with farmers, cooperatives and the private sector to ensure they understand the details of reg-

ulations and what it takes to comply with them. Training sessions and information sharing by the regulatory agencies coupled with practical step–by–step guidance on how to meet regulatory requirements would help to boost compliance with various standards and regulations especially among small–scale businesses.

- **Facilitate Access to Credit and Financial Services** — There is merit in designing targeted financial products for smallholder farmers and cooperatives to invest in improved inputs and technologies. RCA and other governmental and non–governmental organisations could support cooperatives and small–scale companies with skills in business proposal writing to increase their capacity and chances of obtaining funds from both private financial institutions and grant providers.

Technology and Digitalisation

- **Support Research and Development** — A joint programme bringing together government institutions (led by RAB, MINICOM and RCA), private sector companies and academic would help to boost investment in research on improved maize varieties, climate–smart practices, and efficient maize processing technologies. The programme could be implemented in the form of a centre of excellence and one–stop centre for critical skills and modern technologies where value chain actors can get access to the latest equipment and skills in maize production, post–harvest handling and processing.
- **Promote Digital Literacy and Extension Services** — There is need to scale up training sessions among farmers and other value chain actors regarding the use of digital tools to access market information, weather forecasts, and best practices. For the Smart Nkunganire system, local agro–dealers could receive training of trainers (ToT) on how to use the system, and these could in turn train the farmers they serve, during their input supply encounters.

Women, Youth and Inclusiveness

- **Targeted Youth and Women Initiatives** — It is important to design programmes that address women's and young people's specific needs and aspirations to encourage their participation in the maize sector. Among others, government guarantee schemes to de–risk lending to agricultural and agri–business enterprises by financial institutions could boost credit access and induce investment in value chains as well as movement from production to upper stages of the value chain, particularly small–scale processing and milling.

Concluding Comments

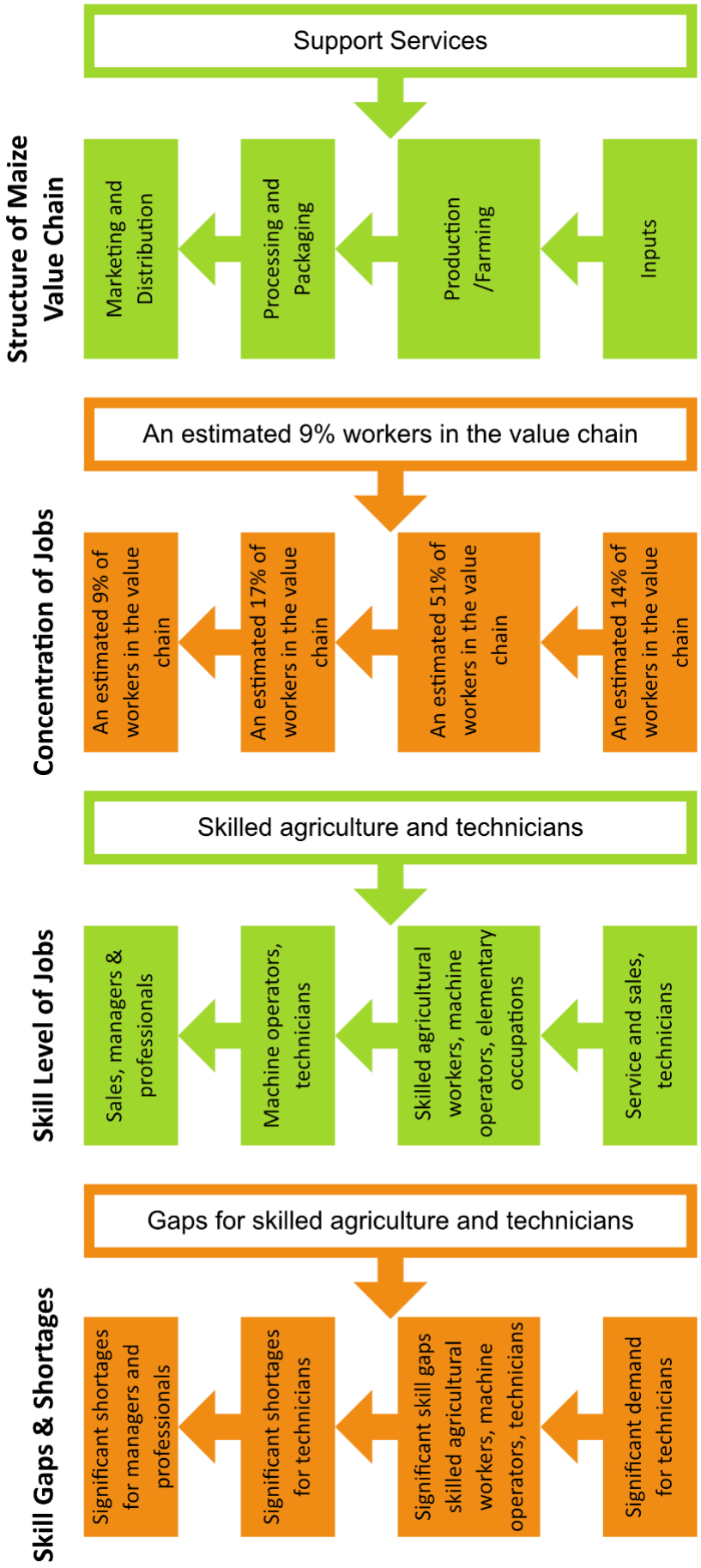
Limited research has been conducted on the relationship between value chain and their impact on skills and employment, especially in the maize sector. The current study has attempted to shed light on this subject and unpack the complex relationship between the two (see Figure 31). From the policymakers' perspective, the following skills and employment messages need to be taken on board:

- The structure and performance of a value chain can have both positive and negative impacts on skills development and employment opportunities. Governments, in collaboration with stakeholders such as businesses and educational institutions, can help ensure that this relationship is more positive.

- The maize value chain offers a significant concentration of jobs in the production stage, primarily requiring skilled or semi–skilled labour. This presents a substantial opportunity for unemployed youth and individuals with minimal skills, particularly those residing in rural areas where maize operations are often located. By focusing on targeted upskilling initiatives for this demographic, the sector could achieve significant gains in productivity and overall efficiency. Strategic investment in workforce training programmes would not only improve the livelihoods of these individuals but also bolster the competitiveness of the maize industry as a whole.
- The maize value chain offers a wide range of skilled and fulfilling career paths beyond the traditional focus on production. Highly skilled jobs can be found in areas like marketing, distribution, research and development, and support services such as logistics and technical expertise. Career guidance officers and schools should actively promote these diverse opportunities to young people, highlighting the potential for growth and innovation within the maize sector.

Finally, to unlock the full potential of the maize value chain, it's imperative to strategically target resources towards addressing critical skill shortages. Our current study reveals alarming occupational shortages in managers and professionals, technicians, skilled agricultural workers and operators. These deficiencies are undoubtedly hindering the value chain's performance, stifling innovation, and limiting growth. Prioritising investment in training programmes, educational partnerships, and targeted recruitment initiatives to fill these skill gaps is essential for the long–term health and competitiveness of the sector.

Figure 31: Relationship between skills and employment in the maize value chain



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Annex

Table 6: Number of actors interviewed

Province/District	No. of Actors
Eastern Province	20
Bugesera	6
Kayonza	5
Nyagatare	7
Rwamagana	2
Kigali City	10
Gasabo	6
Kicukiro	3
Nyarugenge	1
Southern Province	6
Kamonyi	6
Grand Total	**36**

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