CCARDESA

Centre for Coordination of Agricultural Research and Development for Southern Africa

Assessment for the Establishment of New & Strengthening of Current Regional Centres of Leadership in SADC Member States.

Botswana, Democratic Republic of Congo, Eswatini, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe

Draft Report

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Executive Summary

CCARDESA has been facilitating the implementation of the APPSA programme, which is supported by the World Bank in three countries (Malawi, Mozambique, and Zambia) since 2013. **Malawi** was capacitated to be the Centre of Leadership in maize-based farming systems. **Mozambique** was supported to be a leader in rice-based farming systems. On the other hand, **Zambia** was supported in becoming a leader in legume-based farming systems. **Angola** and **Lesotho** joined in later in 2019. The Republic of Angola's RCoL deals with cassava and cassava-based farming systems, while Lesotho deals with some horticulture products. Other SADC countries, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Madagascar, Mauritius, Namibia, Seychelles, South Africa, United Republic of Tanzania and Zimbabwe are yet to establish new Regional Centres of Leadership (RCoLs). In this regard, a study was commissioned by CCARDESA covering the following areas:

i. Identify the priority research and **development commodities** for the National Agriculture Research and Extension Systems (NARES) for each **SADC Member State (**except Angola, Lesotho, Malawi, Mozambique, and Zambia**).** In the process, the study found it necessary to propose at least three priority research and development commodities, ranked in terms of priority, with detailed analysis centred on priority product one research and development commodity.

ii. Assess the regional competitiveness of the selected priority research and Development commodity,

iii. Assess the **gaps or challenges** in terms of (1) **human resources** (2) i**nfrastructure (**3) f**inance** (4) and c**limate-related challenges** and others surrounding the prioritised commodity or commodities. This is done to develop priority interventions to support establishing and operationalising RCoLs.

iv. Assess high-level policies, initiatives, **institutional arrangements, and even budgeting decisions that have cross-cutting relevance to food systems resilience**, including supporting the sustainable management of RCoLs and natural resources.

v. Identify CCARDESA's role in strengthening the RCoLs response to food security and resilience challenges.

Report Structure

Part 1 of this report presents the findings of the Gap Assessment conducted for the Regional Centres of Leadership (RCoLs) in Malawi, Mozambique, and Zambia. Since 2013, these countries have been capacitated to focus on maize-based farming systems in Malawi, rice-based farming systems in Mozambique, and legume-based farming systems in Zambia. The assessment identifies gaps based on literature review, questionnaire responses from focal persons, and field visit outcomes. It details how the gaps were assessed, the magnitude of the challenges, and covers two main components: the level of capacity in agriculture research, knowledge, and technology generation, and the strengthening of regional centres through upgrading facilities, enhancing programs, and training scientists. The report then provides recommendations, key lessons, and strategies for addressing the identified gaps in each country.

Part 2 of the report is dedicated to the Needs Assessment for establishing RCoLs in the remaining SADC Member States, which include Botswana, the Democratic Republic of Congo, Eswatini, Madagascar, Mauritius, Namibia, South Africa, Tanzania, and Zimbabwe. The methodology for need identification in each country involved

secondary and primary data collection, use of a questionnaire, follow-ups, literature review, and analysis of emerging needs. Key variables targeted include the availability of production inputs, supportive infrastructure for production, marketing, and distribution, warehousing and post-harvest logistics, export market potential, access to finance, ease of exporting within the SADC region, growth potential in sales or profitability, commodity governance, attractiveness in terms of the external environment, government support, climate change resistance, research and technology transfer opportunities, and skill levels within the commodity. Part 2 presents the findings on these variables, conclusions, and recommendations for each country, and highlights the implications for CCARDESA in planning, coordinating, monitoring, and evaluating both existing and new RCoLs.

Findings

Part 1: Gap Assessment for Malawi, Mozambique, and Zambia Regional Centres of Leadership (RCoLs)

Malawi: Maize-Based Farming Systems

The gap needs assessment of the Malawi RCoL on maize-based farming systems has highlighted significant achievements in areas such as enhancing germplasm collection and characterization, germplasm improvement, crop management, and post-harvest activities. There has been some improvement in terms of access to technology and knowledge products. Training and capacity-building initiatives have been widened, including farmer-research-extension feedback mechanisms. Furthermore, some improvements have been noted regarding upgrading research infrastructure, including physical infrastructure, farm, laboratory, and office equipment. Capacities of experts have been improved through training. Despite such achievements, some gaps have been identified that are related to the need for further research, infrastructure development, and equipment. Gaps in human resources and financial constraints were identified as factors that limited the optimal performance of the Malawi RCoL to carry out its regional mandate in the maize system.

To address these gaps and needs, the assessment proposes further interventions covering the following areas: Upscaling of research on new varieties of seeds and continued germplasm collection and conservation. There is also a need for further research into technologies that deal with drought and climate change and on seeds and production methods that are tolerant to pests and diseases, including research on how to improve the management of aflatoxin problems in crops such as maize and groundnuts. Other areas recommended include upscaling the dissemination of research outputs, making use of the services of the African Regional Intellectual Property Rights Organization (ARIPO). Furthermore, additional infrastructure support for scaling up is needed, including additional laboratory equipment. There is also a need to address staff turnover and to put in place a robust resource mobilization strategy to address resource predictability challenges. Mainstreaming climate resilience and strengthening monitoring, evaluation, and learning is also key.

Implementing these recommendations will require concerted efforts and investments from the Malawian government, research institutions, development partners, and the private sector. It will also require a shift in mindset and approach, from a project-based and donor-driven model to a more strategic, sustainable, and stakeholder-oriented model of agricultural research and innovation. CCARDESA, as the regional coordinating body for agricultural research and development in the SADC region, has a vital role to play in supporting the implementation of these recommendations and in facilitating greater regional collaboration, learning, and exchange among the RCoLs and other research and innovation actors. By working together and leveraging their comparative advantages, the RCoLs and their partners can create a more resilient, productive, and competitive agricultural sector.

Mozambique: Rice-Based Farming Systems

The National Rice Development Programme (NRDP-2016-27) and the National Rice Programme (PNA 2022) emphasizes the importance of the rice sub-sector for food security in Mozambique. Despite historical and ecological

advantages, the rice sector faces significant challenges such as low adoption of improved technologies, insufficient infrastructure, limited financial services, and the impact of climate change. These issues underscore the critical role of the Rice Leadership Research Center (RCoL) in generating knowledge and solutions to enhance rice production. The Center for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) is conducting a needs assessment to strengthen the existing Regional Centers of Leadership (RCoLs) in the SADC region. Mozambique established the Rice Leadership Research Center (RCoL) in Namacurra, assuming its mandate as a leader in the rice sector and respective production systems in the region. The objective of the assessment is to identify areas for improvement for the full operationalization of the RCoL at the level of human resources, infrastructure, financing, institutional policies, and more.

Although physical infrastructure was built for the RCoL, it remains practically in operational. This is due to several factors: the assembly of the center itself was never completed, with significant parts of the equipment either missing or not yet assembled; statutorily, the RCoL does not exist in the current structure of IIAM, preventing the formalization of autonomous operations with its own budget; and the staff currently assigned to the RCoL is insufficient and requires adequate training to conduct research at the level of a Center of Excellence. Despite not being formally inaugurated, the current facilities need post-cyclone rehabilitation and structural adjustments to meet the needs of the laboratories. Additionally, investments are needed to capitalize on the Center's action and make its operation financially viable, such as alternative energy sources, an irrigation system, and the structuring and leveling of production areas. CCARDESA is called upon to resume its role as an instrument for channeling macro support for the establishment of the Center, mobilizing resources, and lobbying at the government level to address the challenges that currently make the Center practically inactive.

The findings were organized into a SWOT analysis:

Strengths

- The RCoL possesses modern infrastructure, laboratories, and production equipment.
- It has significant scientific and technological capacity.
- A young, trainable, and dedicated team is in place, contributing to increased rice yields.
- The National Rice Program supports the RCoL's mission of identifying and maintaining rice varieties.

Weaknesses

- High energy costs and inadequate energy sources hinder research activities.
- Production fields require significant improvements.
- The official inauguration and formalization of the RCoL have been repeatedly postponed.
- Lack of internal revenue generation mechanisms and an approved organizational structure.
- Insufficient connectivity and interaction with other regional centers.

Opportunities

- The RCoL's location in Zambézia facilitates technological interaction and dissemination.
- Potential to organize regional training and coordinated planning.
- Proximity to the Namacurra rice factory could enhance seed production and revenue generation.
- Opportunity to substitute rice imports with locally produced varieties.
- Training and capacity building during periods of relative inactivity.

Threats

- Cyclones and climate change altering agroecological conditions.
- Lack of institutional coordination with organizations like IRRI and FAO.
- Inadequate market infrastructure for domestic rice.
- Excessive rice imports undermining local production.

Summary of Gaps

- Approval of the RCoL structure and financing model.

- Rehabilitation and equipping of facilities, particularly following Cyclone Fredy.
- Improvement of production fields and installation of necessary infrastructure.
- Enhanced training for human resources.
- Institutionalization of internal revenue generation mechanisms.

Recommendations

- Formal inauguration and operationalization of the RCoL with an appropriate organizational structure.
- Accelerated approval of the new IIAM organizational structure.
- Adoption of a sustainable financial model for the RCoL.
- Active involvement of CCARDESA in mobilizing funding.
- Maximized training efforts for RCoL staff.
- Promotion of exchange programs between RCoLs.
- Ensured readiness and equipping of infrastructure.
- Establishment of internal revenue generation mechanisms.

Key Lessons

- The importance of formalizing and institutionalizing the RCoL to enhance its functionality and sustainability.
- The necessity of coordinated efforts and resource mobilization to support the RCoL's operations.

Conclusions The RCoL in Namacurra faces significant challenges, but with strategic interventions and support, it has the potential to greatly enhance rice production and contribute to food security in Mozambique. Immediate actions are needed to formalize its operations, improve infrastructure, and strengthen the capacity of its staff to ensure its long-term success.

Zambia: Legume-Based Farming Systems

The findings of the assessment indicate that the RCoL has made commendable progress in developing improved legume varieties, with at least 23 varieties released during the implementation of the Agricultural Productivity Programme for Southern Africa (APPSA) project. In terms of disseminating technologies across participating countries, Zambia shared the most legume seed varieties with its neighbors. The RCoL has also enhanced its research infrastructure and built human capacity through training. However, significant challenges remain, including aging infrastructure, inadequate financial resources, limited value addition, and the need for stronger research-extension-private sector linkages. Notably, the development of improved varieties has slowed down since the conclusion of the APPSA project, highlighting the need for sustained support and a clear vision for the RCoL's long-term objectives.

To address these challenges and enhance the RCoL's effectiveness, the assessment proposes a set of key recommendations, which incorporate strategic insights from stakeholders. These recommendations include developing a clear definition and vision for what an RCoL should ideally look like, investing in infrastructure modernization, strengthening value addition and commercialization, enhancing collaboration with regional and international partners, and establishing sustainable funding mechanisms. The assessment also highlights the importance of addressing the concerns raised by private sector stakeholders regarding the need for improved collaboration and the fact that some industry players have set up their own research facilities due to perceived gaps in the RCoL's capacity.

The successful implementation of these recommendations will require concerted efforts from the government, research institutions, development partners, and the private sector, with CCARDESA playing a crucial coordinating role in facilitating collaboration, resource mobilization, and knowledge sharing among the RCoLs and other agricultural research and development actors in the region.

Part 2: Needs Assessment Towards the Establishment of RCOLs in the Remaining SADC Member States

In the remaining SADC Member States, the distribution of priority research and development commodities was fairly spread with no duplications

as follows: South Africa (Citrus), Namibia (Beef), Mauritius (Sugar Cane), Zimbabwe (Horticulture), Democratic Republic of Congo (Green Coffee), Eswatini (Wheat), Botswana (Cowpeas), Madagascar (Sorghum), Tanzania (Rice). By the time of finalising this report, Seychelles had yet to submit her contribution.

The majority of countries identified the following factors as causing moderate to significant challenges to the optimal performance of their chosen priority product from both a need and institutional policy point of view. The details for each country are presented under each country's write-up.

Availability of inputs for production.

Sixty-seven per cent (67%) of countries identified this as a challenge. Furthermore, a review of literature in most countries confirmed the features of this challenge as being both quantitative in the form of shortages of inputs and qualitative in the form of absence of quality inputs. Input challenges ranged from seeds through limited seed multiplication, shortage of pesticides, herbicides, fertilisers and working capital to buy other inputs. At a policy level, policies that facilitate the trading of high-breed seed varieties within the SADC Member States were deemed a significant challenge by 67% of Member States. There needs to be a stronger alignment of national and regional policies to harmonise regional seed systems to facilitate ease of trading and information sharing.

Limited Supportive Infrastructure:

Infrastructure as a challenge was mentioned by at least 67% for productive infrastructure. Furthermore at least 78% of Member States for challenges related to distribution infrastructure while 89% of Member States identified marketing infrastructure as a challenge. In terms of production infrastructure, specific challenges included water shortages, electricity challenges, poor industrial buildings, few processing plants, limited irrigation infrastructure, greenhouses, research buildings and others. In terms of infrastructure for distribution, the challenge was characterised by issues such as poor roads and transport facilities and long distances to the market, among others. Regarding the availability of marketing infrastructure, challenges included soft infrastructure in the form of skills and hard infrastructure in the form of selling points. Marketing of products was also affected by weak media engagement and communication infrastructure, especially in remote areas. 78 % of Member States identified policies that favour infrastructure development as weak.

Availability of warehousing, including management of post-harvest/production logistics *(Mentioned by 89% of Member States).*

This challenge featured issues such as the need for more storage facilities to reduce losses throughout the product value chain, from pre-planting to planting, post-harvest, distribution, and marketing.

Export market potential *(Mentioned by 56% of Member States).*

This challenge featured issues such as limited access to SADC and international markets because of poor product standards, poor marketing strategies, and other trade barriers. The private sector also expressed concerns regarding many impediments to trade due to tariff and non-tariff barriers within the SADC region.

Access to finance *(Mentioned by 100% of Member States).*

All SADC Member States highlighted this challenge. Features accompanying it include weak financial inclusion, budget constraints, limited credit creation, and a lack of other innovative financing schemes. At the policy level, 89% of countries identified the ease of access to finance and innovative Public Expenditure review as significant hindrances.

E*ase of exporting across the SADC region* *(Mentioned by 67% of Member States):*

This was accompanied by trade barriers, standards issues, and other regulatory challenges related to export markets in the SADC region. The existence of a regulatory framework that supports production and exports was regarded as weak by 78% of Member States, and trade barriers were identified 67% of Member States.

Potential for growth in sales or profitability *(Mentioned by 56% of Member States):*

Reference was made to challenges such as unpredictable prices that could be so low as to lead to negative returns.

Governance of the commodity *(Mentioned by 89%):*

Factors such as the poor legislative environment in terms of coming up with some incentives were found to be significant, including weak Institutional and Enabling Environment for Technology Adoption

The attractiveness of the commodity in terms of the External environment *(Mentioned by 78%*). Some countries were affected by external environments such as Sanitary and Phytosanitary (SPS) measures and other technical barriers to trade in their attempt to export products globally.

Level of government support for the commodity *(Mentioned by 56%):*

Concerns were raised about limited Government support in terms of research. Policies encouraging investment in agricultural research were weak in 67% of the countries. This extends to policies related to land management and the distribution of water resources.

Research and technology transfer *(Mentioned by 56%):*

Key challenges mentioned included Low technology generation adoption. Furthermore, it has been found that Agricultural research is not optimally funded. Seventy-eight per cent (78%) of the countries added that weak institutional and enabling environment for technology adoption was a significant hindrance. Research laboratory equipment for Research and Development (R&D) needed improvement. At the policy and institutional levels, this challenge included the lack of policy incentives towards the importation of technology and industrial retooling/upgrading (78%)

Climate challenge *(Mentioned by 67%):*

Features highlighted in literature to accompany this included the frequency of droughts, cyclones, desertification, rise in temperature, food insecurity and lack of compliance with Environmental and Social Safeguards (ESS)

The commodity's level of skills and other human resources *(Mentioned by 56%).*

The main challenges included limited skills in various stages of the product value chain. 67% of the countries that indicated weak p**olicies to facilitate training also mentioned this at the policy level**.

Collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders *(Mentioned by 67%).*

Features included areas for improvement among stakeholders regarding linkages with Extension Services, usage of media and other communication tools. There also needs to be more collaboration with out-growers, agro-processors, farmers, advisory service providers and the private sector in the dissemination activities.

Given the above challenges and policy shortfalls, support for new RCOLs should aim to address the identified challenges and needs, including those that are policy related. The specific details and recommendations for each country are in the main finding report and are mainly aligned with all the challenges observed in this Executive Summary.

List of Acronyms and Abbreviations

APPSA	Agricultural Productivity Programme for Southern Africa
ARC	Agriculture Research Council
AU	African Union
BAMB	Botswana Agricultural Marketing Board
BUGD	Unidades Gestoras Beneficiárias Descentralizadas (Decentralized Beneficiary Management Units)
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CGA	Citrus Growers Association
CIAT	International Center for Tropical Agriculture
DARSS	Department of Agricultural Research and Specialist Services
DVS	Directorate of Veterinary Services
EU	European Union
FAO	The Food and Agriculture Organization
FAREI	Food and Agriculture Research and Extension Institute
FSRP	Food Systems Resilience Project
GAP	Good Agricultural Practices
GHG	Greenhouse Gas
GIZ	German Development Cooperation (Deutsche Gesellschaft fur Internationale Zusammenarbeit)
GNP	Gross National Product
HR	Human Resources
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
IIAM	Instituto de Investigação Agrária de Moçambique (Mozambican Institute of Agricultural Research)
IITA	International Institute of Tropical Agriculture
INE	Instituto Nacional de Estatística (National Institute of Statistics)
IRRI	International Rice Research Institute
MAAS	Multi-Annual Adaptation Strategy
MEL	Monitoring, Evaluation, and Learning
MOU	Memorandum of Understanding
MS	Member States
MTS	Medium Term Strategy
NARDI	National Agricultural Research and Development Institute
NARES	National Agriculture Research and Extension Systems
NARS	National Agricultural Research Systems

NDP	National Development Plan
NGO	Non-Governmental Organization
NRDP-2016-27	The National Rice Development Program 2016-27
ODA	Official Development Assistance
OMR	Observatório do Meio Rural (Rural Environment Observatory)
PEDSA	Plano Estratégico de Desenvolvimento do Sector Agrário (Strategic Plan for the Development of the Agrarian Sector)
PES	Plano Económico e Social (Economic and Social Plan)
PHD	Doctor of Philosophy
PNA	Programa Nacional do Arroz (National Rice Program)
PNA 2022	National Rice Program PNA 2022
PNDR	Programa Nacional de Desenvolvimento do Arroz (National Rice Development Program)
PNISA	Plano Nacional de Investimento do Sector Agrário (National Agricultural Sector Investment Plan)
PPPs	Public-Private Partnerships
PQPS	Plant Quarantine and Phytosanitary Service
R&D	Research and Development
RCoL	Regional Centre of Leadership
RG	Resource Gap
RI	Regional Integration
SADC	Southern African Development Community
SCCI	Seed Control and Certification Institute
SDGs	Sustainable Development Goals
SPGRC	SADC Plant Genetic Resources Centre
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TARI	Tanzania Agricultural Research Institute
ToR	Terms of Reference
TVET	Technical and Vocational Education and Training
USAID	United States Agency for International Development
WBG	The World Bank Group
ZARI	Zambia Agricultural Research Institute

1 Introduction

Since 2013, the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) has been facilitating the implementation of the Agricultural Productivity Programme for Southern Africa (APPSA), supported by the World Bank, in Malawi, Mozambique, and Zambia. The primary aim of APPSA is to enhance agricultural productivity and resilience by strengthening research capacities, improving infrastructure, and fostering regional collaboration and in this context, these countries have been designated as Regional Centres of Leadership (RCoLs), focusing on maize-based, rice-based, and legume-based farming systems, respectively. The initiative was later expanded to include Angola and Lesotho in 2019, with Angola concentrating on cassava-based farming systems and Lesotho on horticulture products.

A study, culminating in this report, was initiated to assess the current capacities and needs of the National Agriculture Research and Extension Systems (NARES) to support the establishment of new RCoLs and to strengthen existing ones. The study addresses the diverse challenges faced by the agricultural sector in Southern Africa, such as climate change, inadequate infrastructure, and limited financial resources. It aims to identify specific gaps and opportunities within each country's RCoL. Its scope included identifying priority research and development commodities for NARES across the SADC Member States (excluding Angola, Lesotho, Malawi, Mozambique, and Zambia), assessing the regional competitiveness of these commodities, and examining gaps in human resources, infrastructure, finance, and climate resilience. It also evaluates high-level policies, initiatives, and institutional arrangements relevant to food systems resilience. It identifies actions and resources needed for CCARDESA to strengthen the research system's response to these challenges. The findings from this study will guide CCARDESA and its partners in making informed decisions to enhance agricultural research, technology generation, and overall food systems resilience in the region.

Part 1 of this report presents the findings of the Gap Assessment done for Malawi, Mozambique and Zambia RCoLs. Part 1, therefore provides information on gaps identified for each of the three countries based on literature review, completion of the Questionnaire sent to focal persons and the outcomes of the field visits done in both countries. In presenting each country's gap assessment report, the report also details how the gaps were assessed, the magnitude of the challenges covering the two targeted main components, namely (1) Level of capacity in terms of agriculture research, knowledge, and technology generation and (2) Strengthening RCoLs by upgrading facilities, strengthening programs and training scientists. The report then presents key lessons, and recommendations for addressing the identified gaps in each country.

Part 2 of the report is dedicated to the Needs Assessment for the establishment of RCOLs in the remaining SADC Member States. These countries, including Botswana, the Democratic Republic of Congo, Eswatini, Madagascar, Mauritius, Namibia, South Africa, Tanzania, and Zimbabwe, have not been supported in establishing their RCoLs. The Needs Assessment presented here is therefore of utmost importance.

The report starts by presenting the methodology used in the need identification process under each country, with reference to secondary and primary data collection procedures. It then explains the use of a Questionnaire, the follow-ups made, the literature review, and how various approaches were used to analyse the emerging needs.

The key variables targeted include the following (1) Availability of inputs for production (2) Supportive infrastructure for production, marketing and distribution (3) Availability of warehousing, including management of post-harvest/production logistics (4) the Export market potential (5) Access to finance (6) Ease of exporting across the SADC region (6) Potential for growth in sales or profitability (7) Governance of the commodity (8) Attractiveness of the commodity in terms of the External environmental (9) Level of government support for the commodity (10) Resistance to climate change (11) Availability of opportunities for research and technology transfer and (12) Level of skills and other human resources within the commodity.

Part 2 presents the overall findings on the above variables based on the identified priority products for each member state against the needs identified, touching on the abovementioned variables. The report then presents the conclusions and recommendations for each country. It ends with highlighting the implications for

CARDESSA regarding its role in planning, coordinating, monitoring and evaluating the existing RCoLs and the new ones to emerge.

PART 1

Gap Assessment of Malawi, Mozambique and Zambia RCoLs

Image Source: CCARDESA

2 Gap Assessment of the Malawi RCoL

2.1 Introduction

CCARDESA is a SADC subsidiary organisation with the mandate to harmonise the implementation of agricultural research and development (R&D) in the SADC region. The Centre has a vision of "**a food secure and prosperous Southern** African region with vibrant rural livelihoods. Its mission is "To promote innovative research, technology generation, and adoption for sustainable agricultural development through effective **partnership and capacity building.**

CCARDESA has the mandate to address agricultural research and design issues in the SADC region through the following interventions:

- Coordinating implementation of regional agricultural R&D programmes;
- Facilitating collaboration among stakeholders of the national agricultural research systems (NARS);
- Promoting public–private partnerships in regional agricultural R&D; and
- Improving agricultural technology generation, dissemination, and adoption in the region through collective efforts, training, and capacity building.

The APPSA is a regional project within the SADC region. It is supported by the World Bank Group (WBG). It initially covered 3 countries namely Malawi, Mozambique, and Zambia. However, in 2019, Lesotho and Angola were added as direct beneficiaries. Needs assessment studies are on-going to include the remaining SADC Member States. The APSSA project was designed to support and promote the following in the SADC region:

- Collaboration among the participating countries in agricultural research, technology dissemination, and training;
- The generation and dissemination of technologies, innovations, and management practices across national borders of participating countries;
- The establishment of RCoLs on commodities of regional importance;
- Sharing of agricultural information, knowledge, and technology among participating countries; and
- Platforms for information sharing and assisting the countries in improving the capacity of the national research and extension systems through various activities.

The NARES are knowledge generation and sharing centres. On the other hand, a RCoL in the SADC region generally refers to a leading agricultural technology centre or programme characterised by an established capacity to become a leader in the region and beyond. A well well-functioning RCoLs should by nature have the following characteristics:

- Ability to provide guidance and leadership in research, technology dissemination, and training to the best of its capacity for the benefit of the host country and other SADC Member States;
- Ability to establish a critical mass of qualified staff for training and capacity building;
- Appropriate infrastructure for research, design, and management of complex projects;
- Ability to tap into global research approaches through partnerships; and

- Ability to generate and share knowledge across the region.
- APSSA was designed to support the establishment of RCoLs that are crop-specific in their approach towards enhancing research and productivity.

In Malawi, the Department of Agricultural Research Services (DARS), was selected as the home of the RCoL on maize-based farming systems. It is located at the premises of its major research station at Chitedze, Lilongwe. DARs primarily focuses maize and other legume crops within the maize farming system. It also incorporates other associated nutrient, soil and water management research issues. As an RCoL, DARs was designed to contribute to the following APPSA:

- Lead in the knowledge generation and sharing on agricultural information, knowledge and technology across boundaries of participating countries;
- Improve regional specialization in agricultural research;
- Improve regional collaboration in agricultural training and dissemination;
- Spearhead the resolution of other regional production challenges in the SADC; and
- Establishing and maintaining strategic linkages with partners and stakeholders.

CCARDESA has commissioned a study that aims at making an assessment the gaps that exist within the NARES and RCoLs in Malawi, Mozambique and Zambia with the aim of strengthening them to perform optimal.

The Gap Assessment targeted the following two components of APSSA support:

i. Technology generation and dissemination covering (research and dissemination)

ii. Strengthening Regional centres through Upgrading facilities, strengthening programs and training scientists

Image Source: Consultants – taken during site visit

2.2 Methodology

The first step of the needs assessment involved a comprehensive document review. This step was crucial to understand the existing body of knowledge, the context of the RCoL's operations, and the historical developments in the rice sub-sector in Malawi. The document review focused on key policy instruments, strategic plans, project reports, and relevant research studies. This included documents such as the APPSA Project Appraisal Document, APPSA Progress Reports, APPSA End-of-Project Evaluation Report, National Agricultural Policy, National Agricultural Research Policy, and the National Agricultural Investment Plan.

The document review provided a solid foundation for identifying gaps and informing subsequent stages of the assessment. For a complete list of documents reviewed, please refer to **Annex 1: List of Documents Consulted**.

The gap assessment of the RCoL was carried out using a combined approach for collecting and processing information that included the following tools:. **Completion of Questionnaires**: This involved designing and submission of a Questionnaire the contained unstructured, semi structured, and structured questions for completion by the focal person in consultation with other relevant stakeholders involved in the project. The questions were formulated based on a review of several documents, such as the programme design documents, the annual reports, and the mid- and end-of-project reports.

Guided by literature review, the interview questions comprised variables indicated below:

i. Level of capacity in terms of agriculture research, knowledge, and technology generation

ii. Infrastructure adequecy for production, marketing and distribution

iii. Potential for increased value addition

iv. Potential for increased Exports

v. Level of importation of agricultural technologies to support production activities

vi. Level of training & dissemination of agricultural technologies status

vii. Management styles used in dealing with the product

viii. Institutional arrangements supporting the commodity

ix. Human Resources, leadership, and Governance supporting the product

x. Level of collaboration among stakeholders to share knowledge.

xi. Level of ability to deal with climate change and other natural disasters

Following the completion of the Questionnaire by Malawi, results were analysed to inform the gap assessment process as reported in the findings section. The data collected through the Questionnaire was analysed alongside with site vists observations and other secondary as a way of triangulating the findings.

Field mission: A mission to Malawi was under taken by one of the Consultant between between 28 May to 31 May (inclusive of travel). The mission started with a kick off meeting that was held in the morning on 29 May at the DARS Conference Room, followed by field visits at Chitedze and DARs accompanied by interviews and consltations with stakeholders. The following day there was a mission to to Lifuwu and field visist at Lifuwu Agriculture Research Station and rice fields. Observations were made accompanied by inteviews. Thereafter, a debriefing meeting was made during the late hours of 30 May 2024 at the DARES Board Room in Lilongwe. Given that the APSSA project phase 1 closed more than 5 years ago, institutional memory remained a

challenge. However, efforts were made towards targeting key informants who well versed with the National Agriculture Research and Extension Systems (NARES) and the work at the Regional centres of Leadership (RCoLs). For a detailed record of the entities and stakeholders consulted during this assessment, please refer to **Annex 2: List of Entities and Stakeholders Consulted.**

Gap and SWOT analysis: The Study focussed on identfying what was on the ground as supported by APSSA and the missing links to make the RCoL work well. This covered the current strengths in terms of Malawi's capacity to continue doing agriculture research, knowledge, and technology generation. The available infrastructure and other facilities were assessed for adequecy in delivering research and training of sciencintist. The weaknesses and gaps they may be facing to date considering the desired state in terms of capacity. In the analysis special attaention was taken at identfying emerging opportunities and challanges that require further support to sustain the work of RCoLs. This included generating lessons for use in supporting the establishment of new RCoLs in other countries.

The mixture of various appraoches helped to ensure that one source is validated against another source and hence increasing the validity and reliability of the findings, conclusions and recommendations.

Image Source: Consultants – taken during site visit

2.3 Findings

2.3.1 Findings on Component 1: Level of Capacity in Terms of Agriculture research, Knowledge, and Technology Generation

Asked to indicate their overall view on the level of existing capacity in terms of research, knowledge, and technology generation, Malawi indicated that they have witnessed some moderate to significant improvement in this area. This shows a mixed bag that is characterised by some achievements and some notable gaps. There was an indication of significant improvements in the Level of collaboration among stakeholders in terms of sharing knowledge accompanied by an increased commitment by the Government of Malawi to increase the Level of investment in agricultural research. Furthermore, interviews with stakeholders showed that the Government is also committed to increase the Human Resources and to enhance leadership and Governance structures that support research.

As per the design of Component 1 of the APSSA, the study also sort to infer the extent to which Malawi managed to (1) enhance germplasm collection and characterization, germplasm improvement (plant breeding), crop management, and post-harvest activities (2) improve the content and accessibility of technology messages and knowledge products (3) Provide capacity building for advisory service providers (4) To enhance dialogue and consultation around technology priorities (5) To improve in farmer-research-extension feedback mechanisms; and (6) To research on technology dissemination methods.

In terms of **enhancing germplasm collection and characterization, crop management, and post-harvest activities**, thrrough the APSSA support, Malawi managed to produce a number of outputs. The total number of technologies made available to farmers and other stakeholders reached 95, a figure above the target of 87. Of these technologies, 44 were legumes, 3 rice, 36 maize seed varieties, 8 agronomic practices, 1 post-harvest, and 3 labor-saving technologies. 95 percent of the targeted farners became aware of the improved technologies.

The filed mission also confirmed that **coordination systems for research and knowledge and accessibility of knowledge products were improved.** Stakeholders confirmed that there has been an enhanced scaling up of knowledge generation and sharing using demonstrations, field days, Lead farmers, On-farm field days, agriculture shows, print and electronic media etc. The informants in Malawi also confirmed that a total of 30 new technologies developed were being used in Mozambique and/or Zambia as part of regional sharing.

Malawi was able to release about 27 new technologies distributed to include: 2 rice crop varieties, 13 maize hybrids, 6 bean varieties, 6 agronomic practices (4 rice agronomic practices, 1 on irrigation water re-use and 1 water use efficiency.

The National APPSA Secretariats, Regional and Technical committees were also established to improve coordination. However, concern was raised that after the closure of the project, the frequency of meetings has been reduced due to resource constraints. While the national monitoring system is still working well in Malawi, during the interviews, it was reported that some gaps exist in terms of Regional M&E systems. Malawi has qualified lead Commodity experts that help in spearheading R&D and peer reviews.

The capcaity for research in Malawi was enhanced by the invetsments made in the **Provision of post-harvest storage facilities such as small scale metal silo testing/fabrication**, R&D on storage pest and introduction of integrated Crop Management (ICM) technologiess. This was complimented by increased research in dealing with some pest/disease threats. Malawi also indicated a significant potential for increased value addition. This has been because of commitment towards enhancing agro-processing facilitaies for use in value addition.

Through interviews and review of several end of project reports around agriculture research, it was observed that there are still gaps that compromised productivity. This has been worsened by incidences of persistence pests and diseases. The other problem relates to low access to improved seeds and production methods that are adaptable to climate changes, droughts, extreme high temperatures and nutrition requirements.

Key Gaps identified under component 1

i. **Gaps in Research on new varieties of seeds and continued Germplasm collection and conservation**. While notable progress was made in this area, the Malawi stakeholders confirmed that gaps still remain in this area and that by the end of APSSA 1, dissemination of the research outputs had not reached other users within Malawi and other SADC Member States.

ii. **Persistent Drought and climate change**: Research into technologies that deal with drought and heat continue to be a challenge in Malawi. In this regard it was suggested that more investments are needed to come up with genotypes/varieties that are tolerant to drought. There is a need to also explore rresearch into strategies that assist in breeding for climate change resilience and measures to deal with water management

iii. **Pests and Diseases**: Pests and Diseases are still a big menace in Malawi. In this regard it was suggested that further research is required to come up with seeds and production methods that are tolerant to pests and diseases.

iv. **Problem of Aflatoxin**: It was observed that in Malawi maize and other crops are prone to fungi that cause Aflatoxin and hence the need to continue enhancing Research into how to improve the management of aflatoxin problems in crops such as maize and groundnuts.

v. **Challenges of Post harvest losses**: It was noted that many farmers in Malawi especially maize producers still face significant post-harvest losses due to distance from the fields and the markets. In this regard further research on improving post-harvest losses in grain legumes is necessary.

vi. **Low utilization of the provision of the Intellectual Property Rights (IPR):** It was noted that due to low utilization of IPR principles there was limited improvement in research in plant varieties, hence the need for Malawi to work with organizations such as the African Regional Intellectual Property Rights Organization (ARIPO) that is based in Harare Zimbabwe to explore how research and innovation can be protected and rewarded.

2.3.2 Findings on Component 2: Strengthening Regional Centres through Upgrading Facilities, Strengthening Programs and Training Scientists.

Component 2 of APSSA project support to Malawi was meant to strengthen Regional Centres of Leadership (RCoLs). For Malawi, the Department of Agricultural Research Services (DARS), was the target Regional Centre of Leadership (RCoL) that concentrated on maize-based farming systems at its location at Chitedze Research Station in Lilongwe and other research satellite stations under Ministry of Agriculture and Food Security. For the full transcript of the data collection questionnaire used in this assessment, please refer to **Annex 3: Transcript of the RCoL Data Collection Questionnaire.**

The support included:

(i) Upgrading of research infrastructure including physical infrastructure; farm, laboratory, and office equipment; and information technology and knowledge management systems;

(ii) Improving administration and performance management systems;

(iii) Developing human capital including providing scientific training at the post graduate level and by upgrading skills through short courses and/or targeted training; and

(iv) Strengthening seed production capacity, seed regulatory functions, and related services.

In terms of **upgrading infrastructure**, Malawi was asked 2 questions related to strengthening Regional centres through Upgrading facilities, strengthening programs and training scientists. The responses pointed towards moderate to significant improvement**s.** Moderate improvements were observed with respcet to the Level of infrastructure for marketing and distribution and some significant improvements were noted with regards to levels of infrastructure for marketing and distribution

In support of the RCoL, the APSSA project supported a number of infarstructure works at Bvumbwe, Kasinthula, and Chitedze Research Stations for Research and production. Main ones are indicated in the table below:

Table 1: Infrastructure Support for RCoL under the APSSA Project

Nature of Infrastructure	Places
Offices/houses/sheds/hostels rehabilitation	Bvumbwe, Chitedze & Kasinthula
New construction works	Bvumbwe, Chitedze & Kasinthula
Rehabilitated Irrigation systems	Kasinthula
Rehabilitated & equipped laboratories	Bvumbwe,

The above infrastructure were complimented by construction of road networks to the research stations. In additioon, at least eighteen vehicles, four tractors and associated implements were procured by APSSA. The building below is one of the office complex constructured by APSSA.

These infrastructure projects were regarded as valueble by Malawi Government.

Some scientific equipment for crop breeding, entomology, plant pathology, mycotoxin, soil and plant analysis, and food technology were also procured.

In terms of **improvement of skills** Malawi indicated some significant improvement in Human Resources, leadership, and Governance system. It was observed that a total of 44 scientists were offered either PhD, MSc or BSc scholarships. Out of 44 students supported, 11 were at PhD level (27% female), 23 MSc (35% female) and 11 BSc (45% female) degrees. Training programmes covered critical subjects such as plant breeding, biotechnology, social science, irrigation engineering, agronomy, environmental science, general agriculture and management disciplines.

Image Source: Consultants – taken during site visit

Malawi also reported significant improvement in terms of Management styles used in dealing with the targeted products as indicated by the training that were provided towards imparting knowledge on performance

management. Stakeholders reported significant training in management and leadership training and in administrative processes

The strengthening of Seed, Regulatory and Related services was also part of the notable achievement of APSSA 1 in Malawi. APPSA, supported the development of the seed policy. As part of this, there has been high appreciation of the policies that facilitated the trading of high breed seed varieties within Malawi and the SADC region.

Key Gaps identifies under Component 2:

With regards to Component 2, some gaps were noted that still hinder Malawi to be the most sort out Centre by other SADC countries when it comes to maize research. The main gaps identified include the following:

i. Infrastructure requirements for scaling up: Discussion with stakeholders indicated the need for additional infrastructure for scaling up operations considering the regional mandate dimension of the RCoL in maize farming systems. The type of infrastructure that was advocated for include (1) Extra room space for use in training and capacity building purposes (2) Guest Houses or accommodation and catering facilities for regional stakeholders who visit the RCoL (3) Infrastructure for virtually meetings including communication and networking infrastructure. (4) At lifuwu Research Station, it was found ideal to construct a laboratory for rice research. The whole idea is to ensure that Malawi becomes a true hub for innovative research in maize systems and related crops and is able to generate knowledge, facilitate regional exchange, collaboration, networking and knowledge-sharing by bringing together SADC experts from the farming community, the academia, industry associations and the public sector.

ii. **Poorly equipped laboratories:** While Chitedze was supported with a state-of-the-art laboratory building, the main concern that was discovered relates to acute shortage of laboratory equipment that do hinder the RCoL to carry out its work optimally. Other donors such as the EU managed to chip in but still, the support fell short of what was required for the RCoL to perform optimally in its research work.

The mission observed that a state-of-the-art laboratory at Chitedze was accompanied by relatively empty shelves in terms of equipment. With the changing technologies, stakeholders believe Malawi could do better with acquisition of latest laboratory technologies. The technologies should bring with it cutting-edge infrastructure, technologies, hardware, software and systems integration, and high-speed data processing capabilities that is consistent with modern technologies.

iii. **Water Pumping Technology:** One of the gaps that was observed especially at Lifuwu Research Station was the lack of affordable water pumping technologies. It was found that the current dependence on electricity instead of solar energy was costly. This was worsened by the persistent shortage of energy due to power cuts.

iv. **Human Resources Challenges due to high Staff Turnover:** One of the gaps identified was that of high staff turnover. This has necessitated the need to ensure the existence of trained staff retention schemes in order to ensure sustainability of the capacity building programmes. Interviews with stakeholders indicated that most trained staff have since moved to other Government services and other organisations outside Government thereby compromising the training programmes and institutional

memory. As part of addressing this, the Government indicated that it is putting in place a staff bonding mechanism to deal with this issue.

Image Source: Consultants – taken during site visit

v. **Adequacy of Policy and Institutional Configuration:** Malawi was asked to also indicate the adequacy of supportive regional policies for the optimal operations of the RCoL. The following were identified as areas that had improved slightly and will require further improvements (1) Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders (2) Policies that reduce trade barriers (3) Policies that ensure ease access to finance and innovative Public Expenditure review and (4) Policies on Importation of Technology and industrial retooling/upgrading

vi. **Financial Constraints:** It was evident during the mission that apart from World Bank funding and other donors such as the EU, there was limited work in terms of implementation of a robust resources' mobilisation strategy needed to ensure the support received under APSSA remains sustainable beyond the World Bank support. Exploring other innovative sources of finance including the private sector was going to go a long way in ensuring the continuity of work. While Government has continued to allocate resources to the RCoLs, the scope of work that encroaches into the region requires additional resources. Limited financial resources led to other challenges that include:

- Failure to fund rec-current expenditure related to vehicle maintenance, office consumables and running cost, fuel for use in monitoring of works.
- Failure to rollout the management Information System (MIS) that was developed by APSSA.

2.4 Recommendations

Based on the findings of the needs assessment, the following recommendations are proposed for strengthening the Malawi RCoL on maize based farming systems:

i. **Upscaling of Research**: Given that research in technologies is the Cornerstone of the Malawi RCoL in terms of the realization of its regional mandate. It is recommended that research should continue to be a priority, in particular covering areas that have been observed to be weak. These areas include:

- Research on new varieties of seeds and continued Germplasm collection and conservation.
- Research into technologies that deal with drought and h climate change and the need to come up with genotypes/varieties that are tolerant to drought.
- Research around seeds and production methods that are tolerant to pests and diseases.
- Research into how to improve the management of aflatoxin problems in crops such as maize and ground nuts.
- Research on improving post-harvest losses in grain legumes is necessary including investing in new storage technologies.

ii. **Upscaling of dissemination of the research outputs.** Given the regional nature of the Malawi RCoL in maize systems, it is recommended that there should be more efforts on ensuring that stakeholders within Malawi and other SADC Member States are able to get access of the new variates of maize farming systems and varieties that are tolerant to drought, can resist diseases and other negative conditions.

iii. **Make use of the services of the African Regional Intellectual Property Rights Organization (ARIPO):** Given that Malawi is a member of ARIPO, efforts should be made to collaborate more with ARIPO on Plant Varieties Protection that involves the protection of breeders' rights and applies to all plant genera and species. By collaborating with ARIPO farmers will have access to a wide range of improved varieties to contribute to the attainment of food security and economic development. ARIPO is based in Harare Zimbabwe.\

iv. **Additional infrastructure support for scaling up:** Consider additional infrastructure support to include: (1) Extra room space for use in training and capacity building purposes (2) Guest Houses or accommodation and catering facilities for regional stakeholders who visit the RCoL (3) Infrastructure for virtually meetings including communication and networking infrastructure and (4) additional laboratories. The additional infrastructure should be accompanied by a continuous process of modernising the existing infrastructure at Chitedze and other research stations.

v. Improve **on laboratory equipment**: Well-equipped laboratories are needed for the optimal performance of the Malawi RCoI. Pursuant to this, it is recommended that resources be mobilised to procure state of the art laboratory equipment.

vi. **Address Staff Turnover**: Given the critical role human resources play in the success of RCoL, it is critical that future assistance be designed in way that ensures that staff that receive training are motivated to stay longer with the RCoL for institutional memory and sustainability of the training programmes. Retention of staff should continue to be accompanied by continuous training to improve performance.

vii. **Put in place a robust Resource Mobilisation Strategy to address resource predictability challenges.** In order to sustain the RCoL activities, beyond donor support, it is important that future designs be accompanied by a robust Resource Mobilisation Strategy (RMS). This will ensure continuity of activities beyond the donor support period. If well designed and implemented, the RMS will reduce incidences of high dependence on a single source of funding by ensuring multiple sources of resources that may include private sector support, fees for services, training fees, support from philanthropic organisations and foundations, special research grants etc.

viii. **Mainstreaming climate resilience:** It has been noted that if not addressed climate change may lead to huge losses and as such future design should mainstream climate resilience strategies through use of Smart agriculture technologies.

ix. **Strengthen monitoring, evaluation, and learning:** To ensure accountability, adaptability, and continuous improvement, the RCoL should strengthen its monitoring, evaluation, and learning (MEL) systems and the Malawi MEL should work in harmony with the Regional Monitoring systems.

x. **Support the improvement of supportive policies:** Given the importance of supportive policies, it is recommended that efforts be made to ensure existence of policies that will enable the Malawi RCoL to perform optimally.

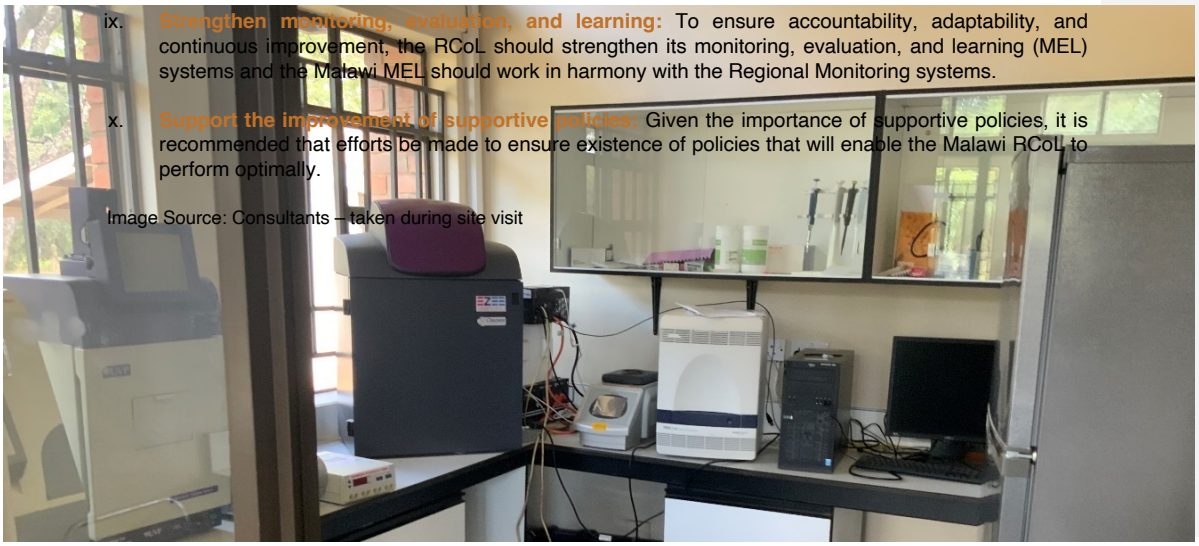


Image Source: Consultants – taken during site visit

2.5 Key Lessons

From the way the RCoL for Malawi has been designed and implemented a number of lessons emerge that could feed into the design of other RCoL within the SADC region. These lessons can be summarised as follows:

i. **Supportive physical and soft infrastructure is important**: It is important to ensure that the design of RCoL consider the existence of appropriate infrastructure (both physical and soft infrastructure).

ii. **Partnership**: Given the Regional nature of RCoL, it is important at the onset to ensure a but in by other countries for a success Collaboration / Partnerships and commitment towards interdependence on research and knowledge generation and sharing. This will make it easier for R&D projects to benefit from Regional Networks across borders that include Agricultural extension agencies.

iii. **Coordination, Monitoring & Evaluation**: The design of the RCoL should be accompanied by a robust national and Regional M&E system including coordination structures.

iv. Robust Resource Mobilisation Strategy.

Image Source: Consultants – taken during site visit

2.6 Conclusions

The gap needs assessment of the Malawi RCoL on maize based farming systems has highlighted that there have been significant achievements in the areas such as enhancing germplasm collection and characterization, germplasm improvement crop management, and post-harvest activities. There has been some improvement in terms of access to technology and knowledge products. Training and capacity building initiatives have been widened inclding in farmer-research-extension feedback mechanisms. Furthermore some improvement have been noted regartding upgrading of research infrastructure including physical infrastructure; farm, laboratory, and office equipment. Capcities of experts have been imp[roved through training. Despite such achievements some gaps have been identified that are related to the need for further research, infrastructure development and equipment. Gaps in human resources, and financial constraints were identified as factors that limited the optimally performance of the Malawi RCoL to carry out its regional mandate in maize system.

To address these gaps and needs, the assessment proposes further interventions covering the following areas: Upscaling of Research on new varieties of seeds and continued Germplasm collection and conservation. There is also a need for further research into technologies that deal with drought and climate change and on seeds and production methods that are tolerant to pests and diseases including research on how to improve the management of aflatoxin problems in crops such as maize and groundnuts. Other areas recommended include upscaling of dissemination of the research outputs, making use of the services of the African Regional Intellectual Property Rights Organization (ARIPO). Furthermore, additional infrastructure support for scaling up is needed including additional laboratory equipment. There is also the need to address Staff Turnover and to put in place a robust Resource Mobilisation Strategy to address resource predictability challenges. Mainstreaming climate resilience and strengthening monitoring, evaluation, and learning is also key.

Implementing these recommendations will require concerted efforts and investments from the Malawian government, research institutions, development partners, and the private sector. It will also require a shift in mindset and approach, from a project-based and donor-driven model to a more strategic, sustainable, and stakeholder-oriented model of agricultural research and innovation.

CCARDESA, as the regional coordinating body for agricultural research and development in the SADC region, has a vital role to play in supporting the implementation of these recommendations and in facilitating greater regional collaboration, learning, and exchange among the RCoLs and other research and innovation actors. By working together and leveraging their comparative advantages, the RCoLs and their partners can create a more resilient, productive, and competitive legume value chain that contributes to improved food security, nutrition and income.

2.7 Gap Assessment of the Mozambique RCoL

2.7.1 Introduction

The National Rice Development Program (NRDP-2016-27) recognizes that the development of the rice sub-sector is imperative to ensure food security in Mozambique and, in line with the strategic lines of PNISA, defines as the main strategy of this program the intensification of the use of agricultural inputs and appropriate technologies for rice production by small producers. On the other hand, more recently, according to the National Rice Program (PNA 2022), approved by the Ministry of Agriculture and Rural Development, it is assumed that "unlike other Southern African countries, Mozambique has a long history of rice cultivation through missions of the Portuguese and Chinese. With its abundant rivers and tributaries, several deltaic landscapes along the coast provide large tracts of arable land, suitable for rice cultivation. Rice production (paddy) in Mozambique has doubled in the last 10 years, from 206,385 tons in 2007-2008 to 412,552 tons in 2017-2018 (PES 2019)." As detailed in **Annex 4: List of Documents Consulted**, the foundational documents and policies shaping the NRDP-2016-27 and PNA 2022 have been comprehensively reviewed to inform this assessment.

In the diagnosis presented in the same policy instrument, citing the National Institute of Statistics (INE, 2020), the main constraints of the rice subsector include: low use of improved technologies, namely: (i) certified seed (8.7%); (ii) fertilizers (2.8%); (iii) pesticides (6.3%); (iv) machinery (4.2%); (v) irrigation (4.3%); (vi) credit (2.0%); low access to infrastructure and support services for commercialization that burden transaction costs (access roads, warehouses, electricity); insufficient and limited access to financial services and technical assistance; weak water management capacity; deficient land/soil leveling; high levels of post-harvest losses and waste; pests and diseases and climate change. This scenario reinforces the importance of the RCoL in implementing practical actions for the generation of knowledge and solutions for the country and the region that will contribute to the growth of the contribution of this sector in achieving national and regional objectives and goals in the context of ensuring food and nutritional security and beyond.

In this context, and within the scope of the APPSA Project, the foundations for the creation of the RCoL were launched, namely developing the concept of the RCoL, building infrastructure, allocating some assets and contributing to the training of staff for the Centre. Although this process was not completed within the scope of the APPSA project, additional contributions were mobilized for the acquisition of laboratory and production equipment through the National Sustainable Development Fund, a process that has experienced delays and the need for adjustments throughout the course, consequently delaying the full operationalization of the RCoL. Meanwhile, the RCoL still suffered the effects of Cyclone Fredy in part of its facilities, requiring, at this point, not only the completion of the process of equipping laboratories and work rooms/offices, but also the repair of the damage suffered.

Finally, while the process of revising the Organic Statute is underway at the IIAM level, which will ensure the formal framework of the RCoL in the institutional structure allowing a clear definition of the mechanisms for financing its activities, the Center continues to be inaugurated, faces financial challenges for basic operation, its workforce is made up of researchers and technicians informally displaced from existing units in the current IIAM structure and is unable to generate its own revenue, either through production and/or provision of services, or through research projects with possible funding via international entities' funds that finance research activities.

Despite these constraints, the partnership with IRRI in research initiatives for the release of new varieties, the activities carried out by the units that lend their staff to the RCoL (in particular the "Ceramic" Research Unit) and individual initiatives made with the researchers' own resources, have contributed to give life to the centre and some operational routine, although far from what would be desirable within the scope of what was expected to be achieved with the creation of the Centre.

2.7.2 Methodology

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) is conducting a gap assessment to strengthen the existing Regional Centres of Leadership (RCoLs) in the SADC region. Mozambique has established the RCoL in Namacurra in discharging its mandate as a leader in rice and rice-based farming systems for the region. The objective of this assessment is to identify the capacity gaps (human, infrastructure, financial, institutional policies, etc.) of the Mozambican RCoL.

The gap assessment of the RCoL was carried out using a combined approach for collecting and processing information that included the following tools: (i) literature review, with particular focus on sector policy instruments; (ii) administration of a base questionnaire intended to obtain an institutional perspective on the gap for the operationalization of the RCoL in view of the fulfillment of its mandate; (iii) individual interviews with RCoL managers and researchers, supervisory entities at the provincial, regional-center and central levels, including the focal points and directors of relevant areas at IIAM; (iv) holding a brainstorming session in a focus group discussion with the RCoL team (in person and online); (v) conducting field visits to trial sites and material and equipment storage sites. he full list of entities and stakeholders consulted can be found in **Annex 5: List of Entities and Stakeholders Consulted**.

These tools were carried out interchangeably, allowing the triangulation of information and the collection of complements, revalidation of information through direct and documentary sources, including the inclusion of written contributions from the target groups.

Figure 3: Lemamic Experimental Unit: Conservation Status of Equipment

2.7.3 Findings

2.7.3.1 Literature Review

From the literature review, the creation of the RCoL by the Government of Mozambique stands out in the context of the implementation on the ground of the National Rice Development Program (NRDP-2016-27). This programme recognises the crucial importance of the development of the rice subsector as a national imperative to ensure food security in Mozambique and, in line with the strategic lines of PNISA, defines the main strategy as the intensification of the use of agricultural inputs and appropriate technologies for rice production by small producers.

More recently, the Government of Mozambique approved the National Rice Programme (PNA 2022), which emphasises capitalising on its long history in rice cultivation and consumption. Mozambique is endowed with favourable conditions, such as abundant rivers and tributaries and several deltaic landscapes along the coast with large tracts of arable land suitable for rice cultivation. Rice production (paddy) in Mozambique has doubled in the last 10 years, from 206,385 tons in 2007-2008 to 412,552 tons in 2017-2018 (PES 2019).

2.7.3.2 Constraints of the Rice Subsector

The main constraints of the rice subsector, as identified by the National Institute of Statistics (INE, 2020), include:

- Low use of improved technologies: certified seed (8.7%), fertilisers (2.8%), pesticides (6.3%), machinery (4.2%), irrigation (4.3%), and credit (2.0%).
- Low access to infrastructure and support services for commercialisation that burdens transaction costs (access roads, warehouses, electricity).
- Insufficient and limited access to financial services and technical assistance.
- Weak water management capacity, deficient land/soil levelling, high post-harvest losses and waste levels, pests and diseases, and climate change.

2.7.3.3 Relevence to the National Rice Development Programme (PNDR 2016-2027)

The construction of the RCoL was intended to address challenges related to increasing production and productivity, improving income, and ensuring food and nutrition security. The specific objectives include:

- Increasing the yield of producers in rainfed systems from 1.2 to 2.6 tons/ha and from 3.5 to 5 tons/hectare in irrigated systems (until 2019).
- Reducing post-harvest losses from 40% to less than 10%.
- Increasing the use of irrigation infrastructure in rice production from 20% to at least 80%.
- Motivating and inducing the use of agricultural mechanisation by producers to improve efficiency and effectiveness in the production chain.

2.7.3.4 APPSA Project Collaboration

The APPSA project collaborated in this endeavour by establishing Regional Centres of Leadership (RCoL) on products of regional importance to improve productivity in key crops for food security in the region. Mozambique was assigned the rice crop due to its adequate natural conditions and demonstrated leadership in the sector. The expectation was that the RCoL would lead the implementation of practical research actions for the generation of knowledge and solutions for the country and the region within the scope of this crop (rice).

2.7.3.5 Institutional Perspective from the Baseline Questionnaire

The responses to the baseline questionnaire indicated significant challenges to the full operationalisation of the RCoL. They particularly highlighted the infrastructure's inoperability and the human structure's inadequacy, which hinder the Centre's ability to fulfil its mandate. A detailed transcript of the RCoL Data Collection Questionnaire is provided in **Annex 6: Transcript of the RCoL Data Collection Questionnaire**.

2.7.4 Insights from the Stakeholder Engagements

Interviews with RCoL managers, researchers, and supervisory entities revealed several key issues:

- The human capacity at IAM consists of a team of poorly qualified researchers, mostly young and insufficient in number, to address all the necessary research and innovation challenges. Only 7% of the researchers have a doctoral degree, and most are nearing retirement. In 2018, the RCoL had 11 researchers and 22 technicians working on first-generation seed classes.
- Infrastructure resources were exhausted during construction, leaving insufficient funds for acquiring field equipment and laboratory outfitting. This issue is not unique to Mozambique but is also observed in Angola and Lesotho.
- The revision of the IIAM Organic Statute is underway to ensure the formal framework of the RCoL within the institutional structure, allowing for a clear definition of financing mechanisms. However, financial challenges for basic operations persist.

A brainstorming session with the RCoL team (in person and online) highlighted financing as the critical factor for the Centre's operation. It was recognised that until the IIAM Organic Statute is revised to grant the RCoL some operational autonomy, little progress can be made institutionally, affecting infrastructure and human resources.

Field visits to trial sites and material and equipment storage sites demonstrated the team's efforts in implementing activities within the scope of the RCoL's mandate.

2.7.4.1 Identified Needs

For a specific needs list, refer to **Annex 7: CLiPA Specific Needs List**. From the interactions carried out and the information collected, the following needs were identified:

- Approval of the RCoL Structure and Financing Model (investments and operation), including mechanisms for the authorised generation of internal revenues and an adjusted and decent remuneration framework.
- Rehabilitation of damage from Cyclone Fredy, equipping, assembly, testing, and commissioning of laboratory and production and processing equipment, general maintenance, and correction of recorded areas for improvement.
- Soil levelling, installation of an irrigation system, establishment of a meteorological park, and installation of equipment for other operational aspects, including transportation and laboratory needs, as well as alternative energy sources (solar and wind) to reduce energy costs and ensure continuous operation.
- Training of Human Resources in short and long-term courses, rehabilitation and acquisition of means of transport, documentation instruments (including cameras and drones for observation and spraying), and allocation of decent housing for researchers at the Centre's facilities.
- The official inauguration and formalisation of the RCoL, preferably at the highest level, will include the performance of traditional rituals (Mukhutu) and corresponding legal procedures, defining the operational framework and model for command lines and resource allocation.
- Institutionalisation of internal revenue generation mechanisms through the utilisation of existing human, technological, infrastructural, and material resources in the Centre.
- Establishing connectivity and interaction with other regional Centers to enhance the RCoL's relevance as a leader in rice research for Southern Africa.

2.7.4.2 SWOT Analysis

Strengths

- The RCoL has infrastructures that include laboratories (soils, seeds, biotechnology, plant health, among others), production equipment, a production field, and office and housing areas.
- The RCoL is equipped with tangible and intangible assets (including knowledge) that place it among the most modern, prepared to address scientific gaps for the country and the region.
- There is capacity for technological/technical and scientific adaptation and adoption.
- The team is young, trainable, available, and dedicated. Despite limited resources, they conduct trials, produce knowledge, make crosses, release varieties, and contribute to the training of producers, extension workers, and other actors in the Rice Value Chain.

- The RCoL has conditions to accelerate the variety-release processes (laboratories, greenhouses for three seasons per year), increasing the average yield per hectare from 1.2 to 1.8 tons/hectare (including irrigated and rainfed lowlands).
- The National Rice Program, a policy instrument approved in 2022, assigns to IIAM the mission of identifying rice varieties that can better adapt to different agroecological zones, ensuring the maintenance and production of pre-basic and basic seed varieties, and coordinating with relevant institutions on soil and plant analysis actions.

Weaknesses

- The company cannot bear energy costs, specifically the energy power rate (25 to 30 thousand per month), and there is a lack of alternative energy sources to guarantee continuous electricity for research activities.
- Inadequate production fields require interventions such as soil levelling, drainage, and establishing an irrigation system and greenhouses.
- Delays in the official inauguration and formalisation of the RCoL, affecting the operational framework and resource allocation.
- Lack of internal revenue generation mechanisms utilising the Centre's resources.
- Absence of an organisational chart and approved organic structure/statute to ensure the sustainability of the RCoL's actions.
- Need to adjust remuneration according to position to enhance team commitment.
- Lack of connectivity and interaction with other regional centres is diminishing the RCoL's relevance as a leader in rice research for Southern Africa.

Opportunities

- The location in Zambézia supports technological interaction and dissemination with producers.
- Practical exposure to pests, diseases, and soil levelling gaps in production areas.
- Potential for organising training on the design and functioning of Centres of Excellence at the CCARDESA level, enhancing visibility and experience exchange among RCoLs.
- Possibility of coordinated regional planning on programs, promoting institutional coordination among Centres in various countries.
- Feasibility of the Namacurra rice factory could generate revenue and promote partnerships with seed companies, enhancing practical improvement of the team and infrastructure.
- Rice represents a foreign exchange cost to the country, so substituting imports with varieties released by the Centre presents an opportunity.
- Active involvement of CCARDESA in resuming support to regional Centres of Excellence, ensuring necessary lobbying with governments and donors.
- Utilising the period of relative inactivity of the RCoL for team training, aiming to strengthen human capacity to train a minimum of 100 PhDs in the next ten years.

Threats

- Cyclones altering agroecological conditions.
- Lack of institutional coordination, particularly with IRRI and other organisations, causing destabilisation of the RCoL.
- Insufficient factories to guarantee a market for rice, reducing the need for technological intensification.
- Excess rice imports making domestic rice uncompetitive.

Figure 2: Ongoing Experiments in the Field of the Ceramica Experimental Unit for the Release of New Varieties

2.7.5 Recommendations

The following recommendations are proposed to address the challenges faced by the RCoL and ensure its effective operationalization and sustainability. These recommendations aim to strengthen the RCoL's institutional framework, financial sustainability, infrastructure readiness, and human capacity.

Formal Inauguration and Effective Action

- Formally inaugurate the RCoL and ensure it enters into effective action with an organic structure aligned with the requirements of its mandate.
- Accelerate the process of approving IIAM's new organizational structure, ensuring the legal and institutional formalization of the RCoL and other similar centres.

Financial Model and Operationality

- Adopt a financial model for the RCoL that guarantees its operationality, preferably placing it at the level of a BUGD (Decentralized Beneficiary Management Units).
- Establish a mechanism at the CCARDESA level to support the RCoLs in mobilizing financing via the African Development Bank or other donors. This mechanism should aim to recover CCARDESA's leadership role in creating these centres, opening doors and sponsoring initiatives to seek funding for the RCoLs.

Training and Capacity Building

- Maximize efforts in training RCoL staff and other potential candidates, ensuring the team is prepared and improved to meet the needs of the research processes to be developed.
- Take advantage of the RCoL's period of relative inactivity to train the team. In the next 10 years, aim to strengthen the Center's human capacity through the training of a minimum of 100 Ph. Ds.
- Promote exchange programs between RCoLs to gather experience on the modus operandi of such centres and to train staff at the doctoral level in a possible regional exchange program.
-

Infrastructure Readiness and Equipping

- Ensure the infrastructure's readiness and equipping with the necessary assets for full functioning, including replacing parts affected by extreme weather events, such as Cyclone Fredy.
- Ensure soil levelling, install an irrigation system, establish a meteorological park, and install equipment for various operational aspects, including alternative energy sources (solar and wind) to reduce energy costs and ensure continuous operation.

Revenue Generation and Institutionalization

- Institutionalize an internal revenue generation mechanism with a formula that allows the RCoL to ensure its regular functioning. This could be achieved by producing and selling pre-basic and basic seeds of released varieties, training, and consultancies.
- Promote the possible feasibility of the Namacurra rice factory (next to the RCoL), which could bring more excellent dynamics to the centre by producing seed, enabling its seed processing unit to generate revenue, promoting interaction and partnerships with seed companies, launching new varieties and respective technologies, and contributing to a faster practical improvement of the team and infrastructure.

Research Support and Programme Coordination

- Share links to research support programs to enhance the RCoL's research capabilities.
- Organize training on the design and functioning of Centres of Excellence at the SARDESA level, giving visibility and promoting the exchange of experience among the RCoLs.
- Promote coordinated planning at the regional level on programs in each country, foster institutional coordination between centres in various countries, and support each other in their process of institutional and operational growth.

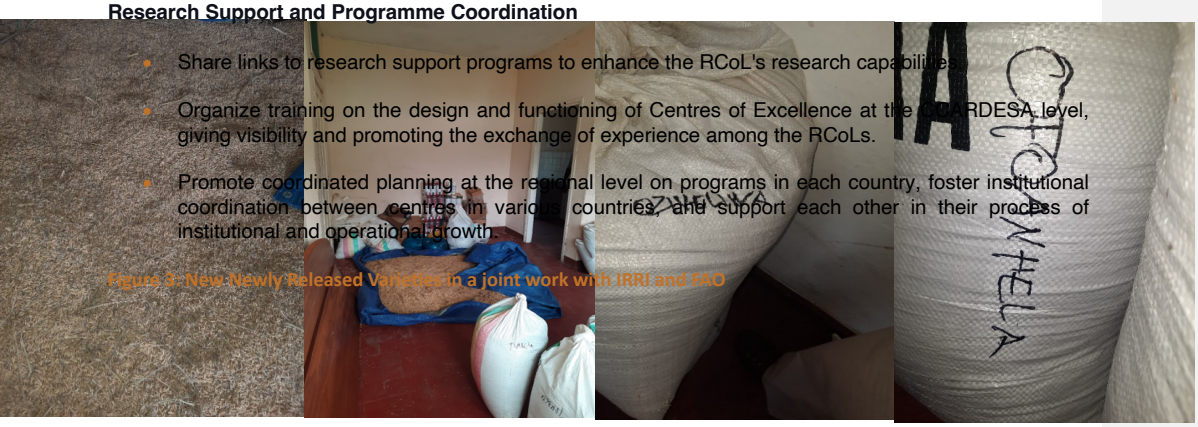


Figure 3- New Newly Released Varieties in a joint work with IRRI and FAO

2.8 Key Lessons

The assessment highlighted several key lessons and identified gaps that need to be addressed for the successful operationalization and sustainability of the RCoL:

Approval of Structure and Financing Model

The RCoL requires an approved structure and a comprehensive financing model that includes mechanisms for authorized internal revenue generation and a decent remuneration framework for staff. This would ensure financial sustainability and motivate the workforce.

Rehabilitation and Equipping

Rehabilitation of the RCoL is necessary, particularly addressing the damage caused by Cyclone Fredy. This includes equipping and commissioning laboratories and production equipment, along with general maintenance to ensure all facilities are operational.

Infrastructure Development

There is a need for infrastructure improvements such as soil levelling, installation of an irrigation system, establishment of a meteorological park, and installation of equipment for various operational aspects. Additionally, the integration of alternative energy sources (solar and wind) is essential to reduce current energy costs and ensure continuous operation.

Training and Capacity Building

Training of human resources through both short-term and long-term courses is crucial. This should be complemented by acquiring necessary means of transport and documentation instruments (including cameras and drones for observation and spraying) and providing decent housing for researchers at the Centre's facilities.

Official Inauguration and Formalization

The RCoL should undergo an official inauguration and formalization at the highest level. This involves performing traditional rituals (Mukhutu) and corresponding legal procedures, which will define the operational framework and resource allocation mechanisms, ensuring the Centre's formal integration within the institutional structure.

Institutionalization of Revenue Generation

The RCoL needs to institutionalize mechanisms for internal revenue generation by leveraging existing human, technological, infrastructural, and material resources. This will enhance the Centre's financial independence and operational capabilities.

Connectivity and Interaction

Establishing strong connectivity and interaction with other regional Centres is vital. This would enable the RCoL to fulfil its mandate as a leader in rice research for Southern Africa, fostering collaboration, knowledge sharing, and standardized protocols across the region.

Further insights and detailed observations can be found in **Annex 8: Transcript of the CLiPA Data Collection Questionnaire**

2.9 . Conclusions

While awaiting the approval and entry into force of the new IIAM Strategic Plan 2024-2034 and the IIAM Organic Statute that advances profound structural changes to adapt the institution to the changes that have taken place in the organizational environment of the agrarian sector over the last 10 years, a process that conditions part of the efforts for the institutionalization of the RCoL, staff training could be a strong bet so that the necessary skills are built in the team. On the other hand, the same apparent obstacle can also be capitalized to complete the development of infrastructures, test Protocols and Portfolios and establish research process management routines within current conditions.

The prolonged state of indefiniteness, even with the efforts to minimize it through the institution of the current team displaced from other IIAM units, is not only eroding the team's motivation but also conveying a sense of the Centre's perceived lack of material usefulness. This has led to the current overall gloomy state of the institution, both in terms of infrastructure and staff. We understand that this situation is challenging for our staff, who are seeing time pass in a sea of uncertainties that do little to help consolidate the team.

Therefore, it is urgent to enable actions that bring back the dynamics of the APPSA implementation period, which, with the same backdrop, represented a motivating dynamic phase in the installation of the Centre.

3 Gap Assessment of the Zambia RCoL

3.1 Introduction

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) is mandated to coordinate agricultural research and development in the Southern African Development Community (SADC) region. As part of its efforts to promote sustainable agricultural growth and food security, CCARDESA has been actively supporting the establishment and strengthening of Regional Centres of Leadership (RCoLs) in various member countries. These RCoLs serve as hubs of expertise and innovation in specific commodity value chains, providing leadership in research, technology dissemination, and capacity building.

In Zambia, the RCoL focuses on legume-based farming systems, with the Zambia Agricultural Research Institute (ZARI) serving as the lead institution. The RCoL was established under the Agricultural Productivity Programme for Southern Africa (APPSA), a World Bank-funded project implemented from 2013 to 2019.

The needs assessment of the Zambian RCoL was conducted with three main objectives in mind. Firstly, it sought to identify the capacity gaps in terms of human resources, infrastructure, financial resources, and institutional policies that may hinder the RCoL's effectiveness and sustainability. Secondly, the assessment aimed to document lessons learned and best practices from the establishment and operation of the RCoL, which could inform future interventions and support mechanisms. Finally, the assessment sought to provide practical and actionable recommendations for strengthening the RCoL and enhancing its impact and sustainability in the long term.

The findings and recommendations of this assessment will contribute significantly to CCARDESA's broader efforts to promote agricultural transformation, food security, and sustainable development in Southern Africa. By providing evidence-based insights and a roadmap for strategic investments and interventions, the assessment will support CCARDESA in its mission to strengthen the Zambian RCoL and other RCoLs in the region, ultimately contributing to improved livelihoods and resilience of smallholder farmers.

Image Source: Consultants – taken during site visit

3.2 Methodology

The needs assessment of the Zambian RCoL employed a mixed methods approach to gather comprehensive and triangulated data from multiple sources. This approach combined extensive document review, in-depth stakeholder interviews, site visits, and the administration of a questionnaire to key informants.

The document review phase involved a systematic analysis of relevant documents related to the establishment, operation, and performance of the RCoL. These documents included project appraisal documents, progress reports, end-of-project evaluations, and strategic plans of ZARI and other relevant institutions. The review aimed to gather background information, assess the RCoL's progress and achievements, and identify key lessons learned and challenges faced during the implementation of the APPSA project and other related initiatives - see **Annex 9: List of Documents Consulted.**

To complement the document review, semi-structured interviews were conducted with a diverse range of stakeholders involved in or affected by the RCoL's activities. These stakeholders included ZARI management and research staff, beneficiaries of long-term training programs supported by the APPSA project, private sector partners, and collaborating institutions. The interviews sought to gather stakeholders' perspectives on the RCoL's strengths, weaknesses, opportunities, and threats, as well as to identify specific capacity gaps and needs in terms of human resources, infrastructure, financial resources, and institutional policies. The interviews also aimed to document stakeholders' experiences, lessons learned, and recommendations for strengthening the RCoL's performance and impact.

Image Source: Consultants – taken during site visit

In addition to the document review and stakeholder interviews, the needs assessment involved site visits to key research stations and facilities associated with the RCoL. The site visits provided an opportunity for direct observation of the RCoL's infrastructure, facilities, and ongoing research activities. They also allowed for informal interactions with research staff, technicians, and other personnel involved in the day-to-day operations of the RCoL, providing valuable insights into the challenges and opportunities faced by the centre – see **Annex 10: List of Entities and Stakeholders Consulted**.

To further enrich the data collected, a questionnaire was administered to key informants to assess the RCoL's capacity, achievements, challenges, and needs. The questionnaire covered various aspects such as human resources, infrastructure, financial resources, institutional policies, and research outputs and outcomes. The

questionnaire responses provided quantitative and qualitative data that complemented the information gathered through document review, interviews, and site visits.

The data collected through these multiple methods were analysed using a combination of qualitative and quantitative techniques. The assessment team conducted a thorough review of the interview transcripts, observation notes, questionnaire responses, and document summaries to identify key themes, patterns, and issues related to the RCoL's capacity, performance, and sustainability. The findings were triangulated across different data sources to ensure the validity and reliability of the conclusions and recommendations.

Overall, the mixed-methods approach employed in this needs assessment allowed for a comprehensive and nuanced understanding of the Zambian RCoL's capacity gaps, challenges, and opportunities. By combining multiple data sources and analytical techniques, the assessment generated robust and actionable findings and recommendations to inform CCARDESA's future interventions and support mechanisms for the RCoL and other similar initiatives in the region.

Image Source: Consultants – taken during site

3.3 Findings

The needs assessment of the Zambian RCoL on legume-based farming systems revealed a range of achievements, challenges, and opportunities for strengthening the centre's capacity and impact.

3.3.1 Achievements and Strengths

In terms of achievements and strengths, the RCoL has made significant progress in developing improved legume varieties, particularly during the implementation of the APPSA project. The assessment found that at least 23 improved legume varieties were released during this period, covering crops such as cowpea, groundnut, common bean, and soybean.[1] In terms of disseminating of technologies across participating countries, Zambia shared the most legume seed varieties with its neighbours. Zambia also demonstrated a high adoption rate of legume technology emanating from the APPSA programme. These varieties have demonstrated superior traits such as higher yields, better disease resistance, and improved cooking quality compared to local varieties, and have been widely adopted by farmers in Zambia and beyond.

Image Source: Consultants – taken during site visit

Since the conclusion of the APPSA project, ZARI has continued to develop crop varieties as seen for example in the fact that in 2023, 16 crop varieties were developed of which 4 were sorghum, two cassava, two pearl millet, two maize, one pigeon pea, and two groundnuts. There has been a larger emphasis on other crops in this regard, however, beyond ZARI, actors such as Goodnature Agro and the University of Zambia have also been developing legume varieties. This highlights the need for sustained support and a clear vision for the RCoL's long-term objectives to ensure continuous innovation and impact in the legume sector.

The RCoL has also made substantial investments in enhancing its research infrastructure through the APPSA project. These investments include the establishment of irrigation facilities, rehabilitation of laboratories, and procurement of advanced research equipment. These infrastructure improvements have strengthened the RCoL's capacity to conduct high-quality research and respond to the needs of the legume value chain.

Another key achievement of the RCoL has been the building of human capacity through long-term training programs supported by the APPSA project. A significant number of staff members were trained at various levels, including diploma, bachelor's, master's, and doctoral degrees, in fields relevant to legume research and development. This capacity building has contributed to the development of a skilled and competent workforce that can drive innovation and impact in the legume sector.

The RCoL also benefits from collaborations with regional and international research networks, which facilitate germplasm exchange, knowledge sharing, and capacity building, enhancing the RCoL's ability to develop and disseminate improved legume technologies. Collaborations amongst scientists within the country have also been catalysed by APPSA's sub-projects research design, in areas where these were hitherto non-existent.

[1] See the World Bank, 2020. Agricultural Productivity Program for Southern Africa (APPSA) Implementation, Completion and Results Report.

3.3.2 Challenges and Weaknesses

Despite these achievements, the needs assessment also identified several challenges and weaknesses that limit the RCoL's effectiveness and sustainability. One major challenge is the aging research infrastructure and equipment, with some facilities remaining unutilized due to lack of installation, maintenance, or training. Examples provided by key informants include inadequate nitrogen analysis equipment. It is also noted that ICT infrastructure (and requisite expertise to operationalise it) has proven to be inadequate throughout the ZARI system. This issue hinders the RCoL's ability to conduct cutting-edge research and respond to emerging challenges and opportunities in the legume sector. It further hinders the RCoL's ability to ensure robust knowledge management and communication with stakeholders, thereby limiting the effective dissemination/sharing of data collected, as well as ensuring the visibility of research outcomes. Low communication and visibility levels also led to the underutilisation of programme resources by targeted groups. There is a need for better communication channels, including invitations to networks and more structured interactions between universities and research institutions which will aid in maximising the impact of trained researchers in the region.

In terms of capacity development, key informants interviewed, lamented that there was a lack of structured follow-up or further capacity development post-training, which could have long-term negative impacts on the trainees' careers and research outputs. It was further noted that there was an absence of mentorship or guidance during the training, which could have enhanced the learning experience and application of the training to real-world scenarios.

Another significant challenge is the inadequate financial resources for sustaining research activities beyond project funding. The RCoL has relied heavily on donor support, particularly from the APPSA project, and faces difficulties in securing adequate and predictable funding from the government and other sources. Low government funding has impacted ZARI's research activities and as long as ZARI remains a department within the Ministry of Agriculture, securing increased and ongoing investment in agricultural research will remain

challenging. This financial constraint limits the RCoL's ability to maintain and upgrade its infrastructure, attract and retain qualified staff, and implement long-term research programs. This is further exacerbated by the fact that there is no follow-up project for the APPSA to ensure the sustainability of project outcomes within Zambia.

Image Source: Consultants – taken during site viisit

The assessment also revealed limited value addition and commercialization of legume products, with weak linkages between research, extension, and private sector actors. This disconnect hinders the translation of research outputs into tangible benefits for farmers and other stakeholders in the legume value chain. Private sector stakeholders raised concerns about the inadequate collaboration between the RCoL and industry players, noting that some companies have set up their own research facilities due to perceived gaps in the RCoL's capacity and responsiveness to market needs.

Human resource challenges were also identified, including high staff turnover and limited succession planning, particularly for senior researchers approaching retirement. Furthermore, the Institutional Assessment Report on ZARI pointed to a critical shortage of researchers and technicians, as well as insufficient training in management and leadership among research managers. The report also notes that the capacity of the RCoL to carry out research and development programs and activities has been somewhat hindered by a lack of sufficiently qualified and experienced personnel. This lag in research experience was occasioned by recruitment restrictions that came about in the past, owing to a Structural Adjustment Programme that the country went through. When recruitment was subsequently resumed, it created a situation in which there were more newly recruited staff versus staff that had more experience carrying out RCoL activities.

There are also gaps in knowledge transfer between older and newer staff members at research institutions, which exacerbates the situation and affects the effectiveness of ongoing research. These issues that are flagged above pose risks to the continuity and institutional memory of the RCoL's research programs.

Image Source: Consultants – taken during site visit

Furthermore, the assessment found weak institutional arrangements for collaboration with universities, private sector partners, and other stakeholders. This also falls short of specific guidance in the Food Legumes Farming Systems Science Plan which encourages robust collaborations and partnerships across various sectors including public, private, and civil society to enhance the impact of research outputs. While the RCoL has some formal agreements and memoranda of understanding (MOUs) with partners, these collaborations are often project-based and do not provide a framework for long-term, strategic engagement. Such collaborations were also stifled in the recent past by disruptions such as the Covid-19 lockdowns, limiting

interactions amongst researchers. This also underscores a limitation in relation to the widespread use of technological platforms to overcome physical meeting limitations.

3.3.3 Opportunities

With regard to institutional development and programme management, it is noted that the Comprehensive Agricultural Transformation Support Programme (CATSP) discusses enhancing the coordination, efficiency, and accountability of the public sector in delivering critical enabling results. This involves establishing a dedicated agency for coordination under a presidential initiative, enhancing accountability systems, and streamlining planning and monitoring processes. The RCoL can leverage this approach by enhancing its own institutional frameworks to improve coordination and management efficiency. This includes adopting similar accountability and performance measurement systems to ensure that research and development activities are aligned with strategic goals and are effectively executed.

During the assessment, stakeholders emphasized the importance of defining what an RCoL should ideally look like in terms of its vision, objectives, and operational model. This insight highlights the need for a clear and shared understanding of the RCoL's role and purpose among all stakeholders, including researchers, policymakers, development partners, and the private sector. There is an opportunity in this regard to align the RCoL's initiatives to the ZARI Strategic Plan 2019-2024. Specific areas of alignment include the following:

- **Technological and Innovation Development**: The ZARI Strategic Plan emphasizes the generation and promotion of technologies and innovations for agricultural productivity (KRA 1), which aligns with the RCoL's focus on developing improved legume varieties. This includes climate change adaptation technologies and agricultural machinery, which can support RCoL's objectives of developing climate-smart legume varieties and technologies.

- **Knowledge and Information Sharing**: The ZARI Strategic Plan includes objectives related to promoting knowledge and information sharing on agricultural value chains (KRA 2). This aligns with the RCoL's need for enhanced collaboration and linkages with other research and extension services, particularly in commercialising legume products.

- **Socioeconomic, Market, and Policy Support**: The ZARI Strategic Plan also outlines objectives to utilise socioeconomic and cultural information to support agricultural product value chains (KRA 3). This could help address RCoL's challenges related to market access, value addition, and policy support.

- **Institutional Capacity and Resource Management**: The strategic plan seeks to improve human resource capacity and manage financial resources more effectively (KRA 4). This aligns with RCoL's needs for strengthening human resources, improving funding stability, and modernizing research infrastructure.

- **Monitoring, Evaluation, and Learning**: The implementation of the strategic plan includes robust Monitoring and Evaluation (M&E) mechanisms, which can support RCoL's need to strengthen its monitoring, evaluation, and learning systems. This can help the RCoL track progress towards its goals more effectively and make informed adjustments to its strategies.

It is also noted that in the draft CATSP, a clear framework for M&E is proposed to track progress against strategic objectives, which include improvements in food security, economic growth, and other developmental goals. This rigorous M&E framework could also be drawn upon to address gaps related to quantifying achievements related to improved legume varieties, as well as ensuring a systematic approach to evaluating the outcomes and impact of research and interventions brought about by activities under the RCoL.

The RCoL in Zambia also has the opportunity to enhance its alignment with the strategic direction under the Ministry of Agriculture's Strategic Plan 2022-2026 by focusing on several key areas. First, it could integrate its legume research and development with national priorities for agricultural technology and innovation. This involves promoting the dissemination of improved legume varieties and ensuring these are in line with market and climatic needs. The RCoL can also bolster its contribution by enhancing knowledge sharing and information dissemination on agricultural value chains, particularly through stronger collaborations with extension services. Additionally, there is an opportunity for the centre to leverage socioeconomic data to support market-driven research and policy advocacy that benefits legume value chains. Placing an emphasis on climate change adaptation and mitigation through the development of climate-smart legume varieties will align the RCoL's efforts with national climate strategies. Furthermore, enhancing public-private partnerships will aid in the commercialization of legume products and attract necessary investments.

Beyond these strategic frameworks, other opportunities for the RCoL to enhance its impact and sustainability have also been identified. One key opportunity is the growing demand for legume products in domestic and regional markets, driven by population growth, urbanization, and changing consumer preferences. This trend creates opportunities for the RCoL to develop and disseminate improved varieties and technologies that can meet the evolving needs of the market.

Another opportunity lies in the increasing recognition of the role of legumes in sustainable intensification, climate change adaptation, and nutrition security. Legumes are known for their ability to fix nitrogen, improve soil fertility, and enhance the productivity and resilience of cropping systems. They also play a crucial role in diversifying diets and addressing malnutrition, particularly among women and children. The RCoL can capitalize on this growing interest and support for legumes to attract investment, partnerships, and policy support for its research and development activities.

The RCoL also has opportunities for strengthening regional collaboration and germplasm exchange through existing SADC frameworks and networks. These regional initiatives provide platforms for sharing knowledge, resources, and best practices related to the conservation, development, and dissemination of improved crop varieties and technologies. It is worth noting that the national seed regulations of Zambia are now aligned with the SADC seed policy regulations. This represents a significant step forward in achieving the SADC goal of aligning key elements of seed regulation, such as variety release, quality assurance, and sanitary and phytosanitary (SPS) measures. It enhances the national variety release system by ensuring that varieties are evaluated based on the established regional variety release standards. This enhancement will facilitate the introduction and distribution of advanced technologies across other nations within the SADC region.

Furthermore, the RCoL can explore opportunities for developing public-private partnerships (PPPs) in seed systems development, value addition, and commercialization. Collaborating with private seed companies, agro-dealers, and processors can help ensure that the RCoL's research outputs are demand-driven, commercially viable, and accessible to farmers and other end-users.

Image Source: Consultants – taken during site

3.3.4 Threats

However, the needs assessment also identified potential threats to the RCoL's performance and sustainability. One major threat is the impact of climate change, which is already affecting legume production and productivity in Zambia and the broader SADC region. Legumes are particularly vulnerable to climate-related stresses, such as drought, heat, and pests and diseases, which can reduce yields, quality, and profitability. While the RCoL has been developing climate-smart legume varieties and technologies, the scale and pace of adoption remain limited, and more needs to be done to enhance the resilience and adaptability of legume production systems.

Another threat is the increasing competition from other crops, particularly maize and soybeans, which have been attracting more research and investment due to their commercial potential. This is partly linked to the fact that historically, the focus of Zambia's agricultural policies has been on maize production. Furthermore, policy shifts related to the focus of specific types of crops over others, has been influenced by regime changes and the priorities of incumbent governments. The current Government's focus is on growing the maize, wheat and soybeans crop sectors. This shift in focus and resources may divert attention away from other important legume crops, such as cowpea, pigeon pea, and groundnut, which are crucial for food security and nutrition.

Moreover, the RCoL faces the challenge of limited policy support and public investment in agricultural research and extension systems. Inadequate government funding and prioritization of agricultural research and development can hinder the RCoL's ability to generate and disseminate innovations and respond to the needs of farmers and other stakeholders in the legume value chain. As such, there is a need for clearer research prioritization aligned with national and regional demands.

3.3.5 Capacity Gaps and Needs

One key gap that was identified is that delays in research, particularly in breeding and release processes for new crop varieties, does not neatly align with the typical three-year project cycle. Breeding programs, which involve crossing plants, growing multiple generations, and selecting the best performers under various conditions, can take several years to yield reliable and marketable new varieties. It is also noted that the

process of releasing a new agricultural variety often involves not just agricultural research and development but also regulatory reviews, field testing across different regions, and compliance with both local and international standards, which can be time-consuming.

The needs assessment also identified several capacity gaps and needs that require attention to enhance the RCoL's performance and impact. One critical gap is the need for continuous training and capacity building of research staff, particularly in the use of advanced equipment and modern breeding techniques. Related to the latter, the ZARI Institutional Assessment report observed that only a small number of research programs/teams have incorporated Innovation Systems approaches like the Innovation Platform that is housed under ZARI. With the rapid advancement of science and technology, it is essential for researchers to keep abreast of the latest tools and methods to drive innovation and efficiency in legume research. The continuous training element should also include the building of capacities in specific scientific areas such as taxonomy and methodologies for climate adaptation, in line with guidance contained in the Food Legumes Farming Systems Science Plan. It should, however, be noted that the attrition rate among trained staff is high, partly because returning scholars find limited resources to apply their new skills effectively within their home institutions. This is further exacerbated by dynamics such as outdated facilities (compared to those that staff may have trained with), the lack of a strategic vision to advance institutional support for innovative projects, and a competitive global job market, leading to the attraction of trained individuals towards better career prospects. To address high staff attrition, institutions and governments should increase Research and Development (R&D) investment, create incentives for researchers to remain, and foster a culture that supports innovation and reduces bureaucratic barriers.

As well, an important need, which is also emphasised in the Food Legumes Farming Systems Science Plan, is the adoption of digital technologies in agricultural research that have a transformative impact. The Science Plan emphasises the necessity of digitalising resources such as soil samples and maps, which is crucial for enhancing precision in research activities. By using digital tools, researchers can more accurately analyse soil conditions, optimize resource allocation, and tailor agronomic practices to specific environmental conditions. This approach not only improves the efficiency of research but also ensures that findings and recommendations are based on precise and comprehensive data.

Another capacity need is the upgrading and modernization of research facilities, such as laboratories, greenhouses, and irrigation systems. Many of the RCoL's facilities are aging and require significant investment to support cutting-edge research and development activities. Modernizing these facilities will enhance the RCoL's ability to conduct high-quality research, attract and retain top talent, and respond to emerging challenges and opportunities in the legume sector. Furthermore, in line with the Food Legumes Farming Systems Science Plan, there is a need to enhance scientific quality through the use of modern scientific tools and specialised skills.

The RCoL also faces the challenge of frequent power outages and load shedding, which can disrupt research activities and damage sensitive equipment. Establishing a stable and reliable power supply is crucial for the smooth functioning of the RCoL's research facilities and the efficient use of advanced technologies.

Furthermore, the RCoL needs to diversify and sustain its funding sources beyond project-based support. This requires exploring innovative financing mechanisms, such as competitive grants, partnerships with the private sector, and endowment funds, to ensure long-term financial stability and reduce dependence on external donors. There is a sense that resources were spread too thinly over too many projects, which diluted the effectiveness of the research efforts.

In summary, the needs assessment of the Zambian RCoL on legume-based farming systems has revealed significant achievements, challenges, and opportunities for strengthening the center's capacity and impact. While the RCoL has made commendable progress in developing improved legume varieties and enhancing its research infrastructure, it faces several constraints that limit its effectiveness and sustainability. These

include inadequate financial resources, limited value addition and commercialization, weak institutional arrangements, and the need for continuous capacity building and modernization of research facilities.

To address these challenges and capitalize on the opportunities identified, the RCoL will require strategic investments, institutional strengthening, and stakeholder collaboration. The recommendations outlined in the subsequent section provide a roadmap for action, focusing on key areas such as defining a clear vision for the RCoL, modernizing infrastructure, strengthening value addition and commercialization, enhancing regional and international collaboration, and establishing sustainable funding mechanisms. Implementing these recommendations will require concerted efforts and commitment from all stakeholders, including the government, research institutions, development partners, and the private sector, with CCARDESA playing a crucial coordinating and facilitating role. Comprehensive recommendations based on the findings are outlined in **Annex 11: List of Specific Gap of the RCoL**

3.4 Recommendations

The recommendations and conclusions drawn are supported by detailed data and analyses, which are available in the annexes, specifically **Annex 12: Transcript of the RCoL Data Collection Questionnaire**. The following recommendations are proposed for strengthening the Zambian RCoL on legume-based farming systems:

1) **Develop a clear vision and strategic plan for the RCoL:** In consultation with key stakeholders, CCARDESA and ZARI should work towards developing a clear definition and vision for what an RCoL should ideally look like. This should include a shared understanding of the RCoL's objectives, functions, and operational model, as well as its role in the broader agricultural research and development landscape. The plan should align with national and regional agricultural priorities, ensuring targeted and impactful research. The strategic plan should outline short-term, medium-term, and long-term goals, as well as the resources and partnerships required to achieve them.

2) **CCARDESA's coordination role beyond APPSA:** CCARDESA should play a pivotal role in coordinating agricultural research across Southern Africa by facilitating collaborations between countries, leveraging resources and expertise, and enhancing research impacts. CCARDESA should support capacity building through training programs and initiatives, crucial for advancing agricultural practices and technologies. It should also assist in resource mobilization, connecting Member States with donors to secure funding for research and development. Additionally, CCARDESA must take the lead in documenting research findings and disseminating this information throughout the region, promoting regional integration and efficient use of collective resources. It is also expected that the organisation should advocate for agriculture at regional and international platforms, participating in policy dialogues and ensuring agriculture remains a priority in development agendas.

3) **Invest in infrastructure modernisation:** The RCoL should prioritize the upgrading and modernisation of its research facilities, including laboratories, greenhouses, irrigation systems, ICT and advanced research equipment. The infrastructure priorities should also look to alternative and sustainable sources of power, such as solar, to off-set potential loadshedding disruptions. This will require a combination of government support, partnerships with the private sector, and external funding. Modernising the RCoL's infrastructure will enhance its capacity to conduct cutting-edge research, generate high-quality data, and develop improved legume varieties and technologies that meet the needs of farmers and other stakeholders.

4) **Adopt the use of digital technologies:** The RCoL should integrate digital technologies into R&D processes, which could include the use of geographic information systems, remote sensing, and other digital data management tools. These technologies can facilitate better data collection, analysis, and

sharing across various stakeholders in the agricultural sector. This should also be accompanied by concomitant training for staff on the use of such technologies.

5) **Strengthen value addition and commercialisation:** The RCoL should focus on enhancing value addition and commercialisation of legume products, through improved collaboration with extension services, private sector actors, and other stakeholders along the value chain. This may involve the development of clear policies and guidelines for technology transfer, market linkages, and public-private partnerships. The RCoL should also invest in research on post-harvest handling, storage, and processing technologies to reduce losses, improve quality, and increase the competitiveness of legume products in domestic and regional markets.

6) **Enhance regional and international collaboration:** The RCoL should actively participate in regional and international research networks and platforms, such as the SADC Plant Genetic Resources Centre and the SADC Seed Centre. This will enable the RCoL to leverage expertise, resources, and technologies from other countries and institutions, avoid duplication of efforts, and achieve economies of scale in research and development activities. The RCoL should also explore opportunities for collaboration with international research centers to access advanced tools, technologies, and germ plasm for legume improvement.

7) **Establish sustainable funding mechanisms:** To reduce dependence on project-based funding and ensure long-term financial stability, the RCoL should develop a comprehensive resource mobilisation strategy. This strategy should identify potential funding sources, such as competitive grants, endowment funds, and public-private partnerships, and articulate the value proposition and impact of the RCoL's research activities. The RCoL should also advocate for increased government support for agricultural research and development, highlighting the critical role of legumes in achieving national and regional food security, nutrition, and economic development goals. Furthermore, the RCoL could leverage innovative financial and risk-sharing facilities designed to enhance private sector engagement and investment in agriculture, as envisaged under the CATSP. The RCoL can align with this by developing or participating in financial instruments that mitigate risks associated with agricultural research and development, such as crop failure risks due to pests or climate variability. This could help in securing more stable funding and encourage more aggressive innovation in legume-based systems.

8) **Strengthen human resource capacity:** The RCoL should invest in continuous training and capacity building of its research staff, focusing on advanced research methods, data management, and soft skills. This can be achieved through a combination of short-term courses, workshops, seminars, and long-term degree training programs. The RCoL should also establish a mentorship program to facilitate knowledge transfer and succession planning, ensuring that the next generation of researchers is well-equipped to take on leadership roles and drive innovation in the legume sector. Furthermore, the RCoL should seek to strengthen its leadership faculties, particularly in project management and cross-sector collaboration, to enhance its role as a leader in legume-based agricultural research.

9) **Improve institutional arrangements and partnerships:** The RCoL should strengthen its institutional arrangements for collaboration with universities, private sector partners, and other stakeholders. This can be achieved through the development of clear policies, guidelines, and incentives for partnership, intellectual property management, and technology transfer. The RCoL should also establish a stakeholder engagement plan that identifies key partners, their roles and responsibilities, and the mechanisms for communication, feedback, and mutual accountability.

10) **Enhance research-extension-private sector linkages:** To address the concerns raised by private sector stakeholders regarding the need for improved collaboration, the RCoL should prioritize the strengthening of research-extension-private sector linkages. This may involve the establishment of multi-stakeholder platforms, joint research and development projects, and innovative partnerships and business models that leverage the complementary strengths of the public and private sectors. The RCoL could leverage the CATSP in this regard, as the latter emphasises the importance of policy dialogue at multiple levels (district, provincial, and national) to ensure the effectiveness of policy measures and their alignment with stakeholder needs and priorities.

11) **Mainstream climate resilience and sustainability:** Given the increasing impact of climate change on legume production systems, the RCoL should mainstream climate resilience and sustainability into its research and development activities. This may involve the development and dissemination of climate-smart legume varieties and technologies, as well as the integration of climate risk management strategies into the RCoL's research agenda and partnerships. This approach would align with the Food Legumes Farming Systems Science Plan, which calls for regular updates to research priorities to adapt to emerging challenges such as climate change and new pests and diseases.

12) **Strengthen monitoring, evaluation, and learning:** To ensure accountability, adaptability, and continuous improvement, the RCoL should strengthen its monitoring, evaluation, and learning (MEL) systems. This may involve the development of clear performance indicators, the regular collection and analysis of data on research outputs and outcomes, and the establishment of feedback loops and learning mechanisms to inform decision-making and strategy refinement.

13) **Improve communication and Knowledge Management:** It is important to increase awareness of professional networks and support robust knowledge management systems. Additionally, leveraging modern technology is recommended to ensure efficient preservation and accessibility of information, enhancing the overall efficiency and effectiveness of knowledge dissemination and management practices. To this end, it is important for the RCoL to improve ICT capabilities, establishing a comprehensive agricultural information system, and enhancing staff training in basic and advanced communication skills.

14) **Institutionalising research activities in Member State implementation plans:** It is crucial to ensure the institutionalisation of research activities in the implementation plans of member countries. This process involves the establishment of structured training programs with clear goals, as well as the introduction of mentorship schemes for ongoing professional guidance. Forming collaborative networks with universities and stakeholders can enhance resource sharing and focus on practical applications relevant to local needs. Transparent resource allocation is crucial for effective project execution. Regular monitoring and evaluation will assess the impact of these initiatives and ensure they adapt to changing requirements, ultimately contributing to sustainable agricultural development and economic growth in member countries.

Implementing these recommendations will require a phased approach, based on the RCoL's priorities, capacities, and available resources. CCARDESA can play a critical role in supporting the implementation process, by facilitating dialogue, coordination, and knowledge sharing among the RCoL, government, development partners, and other stakeholders. CCARDESA can also assist in mobilizing resources, providing technical assistance, and monitoring progress towards the achievement of the RCoL's goals and objectives.

3.5 Key Lessons

The key lessons learned from the implementation of the APPSA project which can inform the RCoL's needs are as follows:

- **Regional Collaboration Strengthens Research and Development:** Establishing Regional Centers of Leadership (RCoLs) in each participating country proved effective for sharing knowledge and technologies, allowing for specialization in specific crops which enhanced overall regional expertise.

- **Capacity Building is Critical:** Significant investments in building the human and institutional capacity of national agricultural research systems paid off. Training and upgrading infrastructure helped enhance the technical capacity to lead national and regional research agendas.

- **Focus on Both Technology Generation and Dissemination:** Initially, the project put more emphasis on generating new technologies rather than disseminating existing ones. The mid-term review corrected this by increasing focus on dissemination, which is critical for the practical application of research findings.

Image Source: Consultants – taken during site visit

- **Linkages with Extension Services**: The project highlighted the need for stronger linkages between research and extension services to ensure that new technologies reach the farmers effectively. This area had been relatively underfunded, suggesting a gap between technology development and its application on the ground.

- **M&E Needs**: Robust M&E frameworks are essential from the start. The project faced challenges due to some indicators not being clearly defined, which led to adjustments mid-project. Continuous and effective M&E helps in timely corrections and ensures project targets are met.

- **Policy Harmonisation:** The project facilitated the harmonization of seed policies across participating countries, which is expected to speed up the release and sharing of new crop varieties and technologies, thus enhancing agricultural productivity across borders.

- **Private Sector Engagement:** Engagement with the private sector, particularly in seed multiplication and distribution, was recognised as crucial for the sustainability of project impacts. Strengthening partnerships with private entities is essential for the effective dissemination and commercialization of agricultural technologies.

3.6 Conclusions

The needs assessment of the Zambian RCoL on legume-based farming systems has highlighted the significant achievements, challenges, and opportunities facing the center in its efforts to generate and disseminate improved legume technologies and innovations for the benefit of smallholder farmers and other stakeholders in the legume value chain. The assessment has identified several capacity gaps and needs related to infrastructure, human resources, financial resources, and institutional arrangements, which are limiting the RCoL's ability to effectively and sustainably deliver on its mandate and realize its full potential as a regional leader in legume research and innovation.

To address these gaps and needs, the assessment has proposed a set of strategic recommendations, focusing on developing a clear vision and strategy for the RCoL, investing in infrastructure modernization, strengthening value addition and commercialization, enhancing regional and international collaboration, establishing sustainable funding mechanisms, strengthening human resource capacity, improving institutional arrangements and partnerships, enhancing research-extension-private sector linkages, mainstreaming climate resilience and sustainability, and strengthening monitoring, evaluation, and learning.

Implementing these recommendations will require concerted efforts and investments from the Zambian government, research institutions, development partners, and the private sector. It will also require a shift in mindset and approach, from a project-based and donor-driven model to a more strategic, sustainable, and stakeholder-oriented model of agricultural research and innovation.

CCARDESA, as the regional coordinating body for agricultural research and development in the SADC region, has a vital role to play in supporting the implementation of these recommendations and in facilitating greater regional collaboration, learning, and exchange among the RCoLs and other research and innovation actors. By working together and leveraging their comparative advantages, the RCoLs and their partners can create a more resilient, productive, and competitive legume value chain that contributes to improved food security, nutrition, income, and livelihoods for smallholder farmers and other value chain actors in Zambia and the wider SADC region.

However, achieving this vision will require sustained commitment, investment, and collaboration from all stakeholders, as well as a conducive policy and institutional environment that supports and incentivizes agricultural research and innovation. It will also require a willingness to learn from past experiences, adapt to changing contexts and needs, and embrace new ways of working and partnering for impact.

The needs assessment of the Zambian RCoL on legume-based farming systems has provided a valuable foundation for this process, by identifying the key challenges, opportunities, and priorities for action. It is now up to CCARDESA, ZARI, and their partners to take this forward, by developing a clear roadmap for implementation, mobilizing the necessary resources and capacities, and monitoring progress towards the achievement of the RCoL's goals and objectives.

If successful, the Zambian RCoL can serve as a model and inspiration for other RCoLs and agricultural research and innovation initiatives in the region and beyond, demonstrating the power of strategic partnerships, sustainable investments, and stakeholder-driven approaches in driving agricultural transformation and inclusive growth. It can also contribute to the broader goals of the African Union's Agenda 2063 and the United Nations' Sustainable Development Goals, by helping to end hunger, reduce poverty, promote sustainable agriculture, and build resilient and prosperous communities and economies.

Image Source: Consultants – taken during site visit

PART 2

Needs Assessment Towards the Establishment of RCOLs in the Remaining SADC Member States

Image Source: CCARDESA

4 Methodology

The methodology used in identifying the priority research and development commodities and gap analysis across all countries comprised of the following:

Completion of Questionnaires: This involved designing and submitting a questionnaire containing unstructured, semi-structured, and structured questions for the focal person to complete in consultation with other relevant stakeholders involved in the project. The list of focal persons who were consulted was discussed during the inception phase. Some questions were left open-ended for Member States to provide additional information. The questions were formulated based on a review of several documents, such as the programme design documents, the annual reports, and the mid- and end-of-project reports. The Response to Questionnaire Data Summaries and original Questionnaire are given at **Annexes 13 and 14** respectively.

Returned questionnaires were followed by clarification through emails and phone calls to increase the response rate, given that there were some delays in getting feedback from certain countries. Some countries submitted missing data that was elaborated on through phone calls. Analysis of the main priority product for each Country was accompanied by an analysis of that product's industry set-up.

The interview questions explored the agricultural commodities a country regards as having the best export performance in the region in comparative terms. Countries were requested to elaborate on the three most promising agricultural commodities, including the factors that hinder the products' optimal performance in the country, region, and internationally. The List of stakeholders consulted is given at **Annex 15.**

Priority 1 products were analysed more thoroughly using questionnaire data and a literature review. Priority 2 and 3 products are presented as annexes in summary form. However, if a Member State changes its priority at validation, the chosen product will be analysed in detail.

After identifying the priority products, the exercise involved identifying hindrances to their optimal performance to generate needs. This was followed by assessing high-level policies, initiatives, and institutional arrangements, including reviewing policies and evaluate the entry points for building a resilience focus into national planning mechanisms and policies.

Guided by the literature review, the interview questions comprised variables indicated below as part of exploring the challenges that affected the selected products to perform optimally:

- Availability of inputs for production
- Supportive infrastructure for production
- Availability of warehousing, including management of post-harvest/production logistics
- Export market potential
- Access to finance
- Availability of infrastructure for distribution
- Availability of marketing infrastructure
- Ease of exporting across the SADC region
- Potential for growth in sales or profitability
- Governance of the commodity

- Attractiveness of the commodity in terms of the External environmental
- Level of government support for the commodity
- Resistance to climate change
- Availability of opportunities for research and technology transfer
- Level of skills and other human resources within the commodity

Countries were also asked to indicate the extent to which the following regional policies and regulatory framework favour or hinder the performance of Agricultural Productivity in the region and the well-functioning of their RCoL. Based on the literature review, the following variables were used:

- Policies towards strengthening the institutional and enabling environment for technology adoption
- Policies on the importation of technology and industrial retooling/upgrading
- Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
- Policies to facilitate the trading of high-breed seed varieties within the SADC Member States
- Policies to support agricultural research
- Policies to facilitate training
- Policies that ensure ease of access to finance and innovative Public Expenditure Review
- Policies that favour infrastructure development
- Policies that reduce trade barriers
- The existence of a regulatory framework that supports production and exports

After completing the questionnaires, results were analysed to inform the needs assessment process. The data collected through the questionnaires was analysed alongside other secondary data to triangulate the findings.

Interaction with focal points helped to clarify gaps. The mixture of various approaches helped to ensure that one source was validated against another, increasing the validity and reliability of the findings, conclusions, and recommendations. The research faced delays in completing the questionnaire, missing data, and difficulties contacting respondents by telephone.

The following section presents the overall findings. Detailed individual country reports will follow this.

5 Overall Findings

5.1 Introduction

This section presents the findings on identifying priority products for the remaining SADC Member States that are yet to be supported in designing their new Regional Centres of Leadership (RCoL). These countries are Botswana, the Democratic Republic of Congo, Eswatini, Madagascar, Mauritius, Namibia, Seychelles, South Africa, the United Republic of Tanzania and Zimbabwe. Based on the terms of reference, Comoros was excluded because, at the time of the study, it was on a SADC sanction related to delayed payment of annual subscriptions. This section also presents the findings on the needs assessment based on the challenges faced by each country. The section also presents the findings on the policies that hinder the optimal performance of the agriculture sector, particularly those related to National Agricultural Research and Extension Systems (NARES) and the setup of RCoLs.

5.2 Identification of Priority Products for RCoL

In terms of the identification of a specific list of priority commodities for group 2 countries, the following was done.

- Identify the primary commodities for each country.
- Prioritise up to 3 commodities and rank them in terms of priority.

This report presents the needs assessment findings supporting the remaining SADC countries in establishing their new RCoLs. The exercise involved prioritising products by the remaining Countries. This was done by asking them to indicate their preferred priority agriculture commodity in their countries. Countries were requested to list three products in order of priority.

The table below presents the preferred products in each country.

Table 2: Choice of Priority Products

#	Country	Priority 1	Priority 2	Priority 3
1	Botswana	Cow Peas	Beans	Morama
2	DRC	Green Coffee	Palm oil	Cocoa beans
3	Eswatini	Wheat	Soya bean	Beans
4	Madagascar	Sorghum	Millet	Groundnuts
5	Mauritius	Sugar Cane	Poultry	Pineapples
6	Namibia	Beef	Grapes	Live Goats
7	South Africa	Citrus	Wine	Corn
8	Seychelles	TBA	TBA	TBA
9	Tanzania	Rice	Wheat	Maize
10	Zimbabwe	Horticulture	beef	fruits

The products are well distributed within the region, necessitating the need for each Country to focus on its priority 1 product as shown in table 3.2 below

Table 3: Final priority 1 products

#	Member State	Priority 1	Regional competitiveness	Prevailing gaps	Key recommendations
1	Botswana	Cow Peas			
2	DRC	Green Coffee			
3	Eswatini	Wheat			
4	Madagascar	Sorghum			
5	Mauritius	Sugar Cane			
6	Namibia	Beef			
7	South Africa	Citrus			
8	Seychelles	TBA			
9	Tanzania	Rice			
10	Zimbabwe	Horticulture			

Commented [BC1]: This table can be moved to the abridged report

5.3 Challenges and Needs Assessment

Regarding a hindrance to the optimal performance of the priority products, countries were asked to indicate the product's challenges. A variable scoring one was deemed to pose a minor challenge to the product, while those scoring other scores were considered to pose some moderate to significant challenges that required attention. While this report focused on the priority 1 products, the Indicative challenges for Priority 2 and 3 are given in graphical format at **Annex 16.**

The variables targeted were derived from the literature review (see References at **Annex 17**) and the study's Terms of Reference (See Annex 18). Most of the variables used are similar to those used to identify the needs of other countries such as Malawi, Mozambique, Zambia, Angola, and Lesotho, i.e., countries that have already received some assistance to set up the RCoLs.

The following findings emerged:

The extent to which the variables posed the Challenges towards optimal performance of the product.

Table 4: Challenges to Optimal Performance of Priority Products in SADC Countries

#	Variable name	% of countries		
		Very minor	Moderate to significant	Total
1	Availability of inputs for production	33	67	100
2	Supportive infrastructure for production	33	67	100
3	Availability of warehousing, including management of post-harvest/production logistics	11	89	100
4	Export market potential	44	56	100
5	Access to finance	0	100	100
6	Availability of infrastructure for distribution	22	78	100
7	Availability of marketing infrastructure	11	89	100

Commented [BC2]: You can pick key challenges from this table to form part of the prevailing gaps table in the abridged report. You cam also use this information to come up with actionable recommendations in the table for abridged report

#	Variable name	% of countries		
		Very minor	Moderate to significant	Total
8	Ease of exporting across the SADC region	33	67	100
9	Potential for growth in sales or profitability	44	56	100
10	Governance of the commodity	11	89	100
11	Attractiveness of the commodity in terms of the External environmental	22	78	100
12	Level of government support for the commodity	44	56	100
13	Availability of opportunities for research and technology transfer	44	56	100
14	Resistance to climate change	33	67	100
15	Level of skills and other human resources within the commodity	44	56	100

All the above variables affected the potential of key products to perform optimally, with all Member States agreeing on certain variables and some on others.

The variables in which the majority of Member States (above 50%) indicated that they were posing moderate to significant challenges included the following:

i. Availability of warehousing, including management of post-harvest/production logistics

The detailed country reports confirmed that most Member States of SADC are affected by post-harvest losses due to limited warehousing facilities. A Paper By Munetsi Madakufamba, the Executive Director of the Southern African Research and Documentation Centre (SARDC) and Neto Nengomasha (Senior Researcher, SARDC) was reviewed to understand this matter better. The research was on Post Harvest Management Interventions in Southern Africa during COVID-19. It was observed that post-harvest losses among smallholder farmers in the Southern African region had been a significant concern, with losses as high as 40 per cent of harvested crops. This has been due to poor infrastructure to protect crops before they move to the market. The slow movement of goods to the market causes quantitative losses due to the absolute destruction of the crops and qualitative losses due to a decline in prices.

The associated challenges accompanying post-harvest losses have been policy-related as there are no coordinated, harmonised and standardised regional policies to combat post-harvest losses at the regional level despite shortages of food in some parts of SADC. In contrast, in other parts, food will be thrown away. The other problem is the existence of fragmented and uncoordinated efforts at research and development on Post Harvest Losses (PHLs), limited knowledge platforms, universities, research institutions, and training centres.

Therefore, support for RCOIs should be accompanied by a new and robust Regional Post Harvest Management Strategy that brings together all relevant agricultural value chain players.

ii. Access to finance

Given that there are few years after the devastating COVID-19 period. Also, with the current geopolitical tensions (Ukraine and Israel), it is unsurprising that all SADC Member States mentioned finance as a challenge. A severe revenue decline accompanied the COVID-19 period and its aftermath as industries remained closed, taking time for many to recover. Under this, all SADC Member States recorded reduced economic growth rates, hence limited capacity to spend on agriculture and other development programmes related to NARES and RCoLs. The Geopolitical tensions have worsened the situation as international development funding has shifted away from supporting some agriculture projects to deal with the crises.

The support to RCoLs should, therefore be accompanied by a strategy that speaks to how SADC as a whole can combine efforts to come up with innovative domestic resource mobilisation schemes given that there are enormous opportunities for such resources considering the tax revenue leakages, capital flight and other tax avoidance schemes that exist within the region. Also, SADC Member States can benefit financially if mineral and agricultural commodities are exported after value addition.

iii. Availability of infrastructure (production, distribution and marketing)

It has been well established that a positive relationship exists between the level of infrastructure development and economic development. Access to roads, telecommunications, and electricity, for example, may lead to productivity increases through reductions in transaction costs, and hence stimulate agricultural growth and diversification. According to the SADC Secretariat, SADC faces challenges related to highly priced, unpredictable transport and logistics services, especially for landlocked states. For marketing to take place, there is a need for easier access to communication services. However, most SADC Member States still need more low-cost access to information and communications technologies.

Support for new RCoLs should be accompanied by efforts to promote and monitor the implementation of regional protocols, policies and strategies on infrastructure.

iv. Governance of the commodity.

It has been observed that policies needed to promote sectoral developments are sometimes missing, rigid, or inadequate in a number of SADC Member States. A relevant example here relates to land policies, which are said to be rigid in some SADC countries such as Madagascar. For example, farmers have to reapply to land boards before diversifying their production base – a horticultural farmer has to reapply to the relevant land board before adding a broiler or pig production enterprise. Because land boards are slow in processing applications, this often leads to loss of opportunities and reduces the responsiveness of farmers to dynamic economic conditions.

v. Ease of exporting across the SADC region

Ease of exporting may improve the motivation to produce priority products within the SADC region. However, the private sector has long faced many impediments to trade due to tariff and non-tariff barriers in the region. Pursuant to this, it is important that support for RCoLs be accompanied by other policy measures that improve the ease of exporting within the region.

vi. Attractiveness of the commodity in terms of the External environmental

Due to high standards and quality demands by importing countries in Europe, the USA, China and others, many products from SADC cannot penetrate these high-paying global markets. Hence, any support to RCoLs should also be accompanied by measures to improve on product quality.

vii. Availability of opportunities for research and technology transfer

Technology development and transfer are among the reasons for low agricultural productivity. Efforts are required towards intensification of technology research and adoption. Regardless of the existence of a SADC Protocol of Science, Technology and Innovation signed in August 2008, the use of Science and Technology is still low. This is despite the recognition that Science, Innovation and Technology are critical cross-cutting themes in the region that can be used to develop and strengthen national systems of innovation to drive sustained socio-economic development and the rapid achievement of the goals of the SADC region. Some of the aims and objectives of the Protocol in the region are to strengthen regional cooperation and coordination, promote the development and harmonisation of policies, share experiences and pool resources. However, the implementation of these measures could be better.

viii. Climate change challenges:

It has been observed (SARDC, 2021) that climate change is one of the significant causes of food insecurity in Southern Africa. Lately, SADC has had high-intensity floods, reduced rains, and tropical cyclones. Given that about 70 percent of the population in the SADC region depends on rain-fed agriculture for crop production, there is a need to increase investment in irrigation facilities. Further, there is a need to increase off-grid power sources, such as using solar energy to drive engine pumps.

ix. Human resources Skills and training:

The main challenges that have been identified related to human resources and skills included limited skills in various stages of the product value chain. This was also mentioned at policy level also by 67% of the countries that indicated weak p**olicies to facilitate training**.

5.4 Policy Attractiveness

After identifying the challenges hindering the optimal performance of the priority products from generating needs, an assessment of high-level policies, initiatives and institutional arrangements likely to hinder RCoL was conducted. The variables included the following:

- Policies towards strengthening the institutional and enabling environment for technology adoption
- Policies on the importation of technology and industrial retooling/upgrading
- Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
- Policies to facilitate the trading of high-breed seed varieties within the SADC Member States
- Policies to support agricultural research
- Policies to facilitate training
- Policies that ensure ease of access to finance and innovative Public Expenditure review
- Policies that favour infrastructure development
- Policies that reduce trade barriers
- Existence of a regulatory framework that supports production and exports

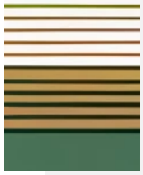
The findings are presented below.

Table 5: Assessment of Policy Attractiveness for RCoL in SADC Countries

#	Variable name	% of countries		
		Very conducive	Moderate to not conduciveness at all	Total
1	Policies towards strengthening the institutional and enabling environment for technology adoption	22	78	100
2	Policies on the importation of technology and industrial retooling/upgrading	22	78	100
3	Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders	33	67	100
4	Policies to facilitate the trading of high-breed seed varieties within the SADC Member States	33	67	100
5	Policies to support agricultural research	33	67	100
6	Policies to facilitate training	33	67	100
7	Policies that ensure ease of access to finance and innovative Public Expenditure review	11	89	100
8	Policies that favour infrastructure development	22	78	100
9	Policies that reduce trade barriers	33	67	100
10	Existence of a regulatory framework that supports production and exports	22	78	100

Above 60% of the SADC countries indicated that all the above policies were either moderate or outright not at all conducive in supporting the priority commodities

The above variables are pursued in detail under each country's specific needs assessment.



6 Needs and Gap Assessment in Botswana

6.1 About The National Agricultural Research and Development Institute: Ministry of Agriculture

The National Agricultural Research and Development Institute's (NARD) mandate is to increase the contribution of Agriculture to Botswana's GDP by improving utilisation of agricultural produce and natural products; fostering inclusion and knowledge transfer initiatives; and providing innovative solutions and adaptations to climate change, yield improvement and commercialisation of agriculture across Botswana's Agro-Ecological Zones. NARD has a vision to be a renowned transformative agricultural Research and Development institute, and a mission to generate innovative solutions for the agricultural sector.

Its work involves engaging in high-quality, innovation-intensive and needs-driven research and development; as well as commercialisation and technology transfer activities across the agricultural value chain, to benefit consumers, farmers, industry, government and science. The Company is configured to carry out its work from decentralised, cluster-focussed, commodity-based specialised Research & Innovation Centres; Testing and Diagnostic Laboratories; Field Stations; Experimental Sites (R&D Ranches & Farms), Technology Test-beds, Agri-business Incubation Centres and Technology Spin-Offs around the country.

In the area of Research and Development (R&D), NARD coordinates planning, manage and control research and development, foster technology development and innovation in all aspects of crop production, animal production and health and food science, maintains the overall quality of the Institute's research and development activities, facilitates the adoption of NARDI research, and ensures international recognition of the Institute as a world Leader in agricultural research and development, innovation and technology.

NARD comprise of the departments (1) Department of Animal Production and Health (2) Department of Field Crops And Horticulture (3) Department of Food Science And Technology (4) Department of Agricultural Economics And Statistics (5) Department Of Natural Resources Management (6) Department of Agricultural Engineering and Mechanisation and (7) Department of Technology Transfer And Commercialisation

6.2 Commodity Prioritization in Botswana

For Botswana, the following priority research and Development commodities were prioritised:

(1) Cowpeas
(2) Beans
(3) Morama

6.3 Overview of the Cowpeas sector in Botswana:

Botswana has a surface area of 581,730 km2, of which about 46 percent has been zoned for agricultural production. While agriculture accounts for less than 2 percent of GDP, it is vital to the livelihood of many citizens who operate subsistence farms. Just like Namibia, Botswana is largely covered in desert and receives very little annual rainfall.

Cowpea is consumed as a vegetable for the leaves, fresh pods, or grain. Cowpea is regarded as a cheap source of protein to poor resource farmers whose diet largely depends on starchy foods such as millet, sorghum, maize, and cassava, making it a potential crop to contribute to the alleviation of malnutrition.

The Botswana Agricultural Marketing Board (BAMB) notes the high demand for Tswana cowpeas that exceeds supply and, therefore, encourages the production of this product. Tswana cowpeas are drought tolerant, making them ideal for Botswana's climatic conditions. BAMB also encourages the production of black-eyed cowpeas, sugar beans, red kidney beans, and peas as these products are heavily consumed, and local supply struggles to meet demand.

6.4 8.4 Production figures

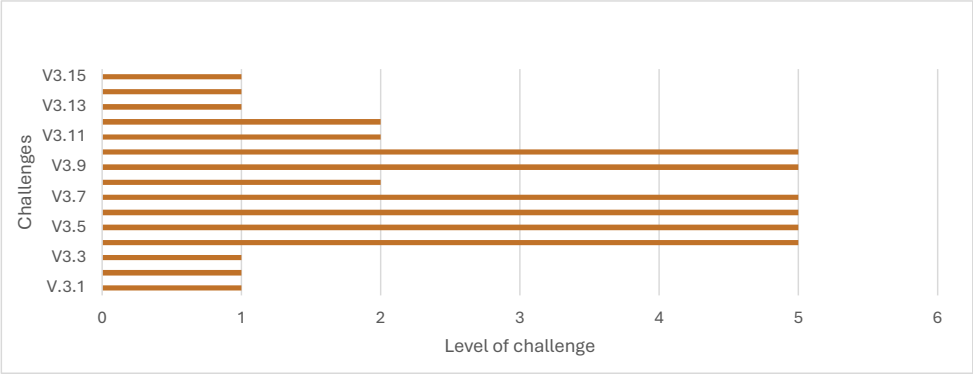
More up-to-date data on cowpeas production and exports in Botswana needs to be provided. The yield at average of 300 kg/ha are still low compared to a potential yield of 2500 kg/ha. Generally, low cowpea productivity and production is attributed to several factors such as biotic and abiotic stress, low yielding varieties, poor soils and poor crop husbandry (plant density) (Olasupo et al., 2016; Mwale et al., 2017). Additional potential constraints of cowpea production could be worsened by climate changes, drastic changes in rainfall patterns, and rise in temperature which could lead to unfavorable growing conditions thereby modifying growing seasons (Ajetomobi and Abiodun, 2010). The development and adoption of well adapted drought tolerant cowpea varieties that are able to cope with changing climate conditions is a priority in Botswana. Despite these challenges Botswana still think it has a comparative advantage to act as the RCOL for Cowpeas riding on it being drought-tolerant crop and can grow under harsh climatic conditions.

6.5 Challenges Affecting the Optimal Performance of Cowpeas

In terms of challenges affecting performance, officers were asked to indicate the challenges being faced by priority product 1 to perform optimally using a scale from (1) to (5) with (1) indicating very minor challenges and (5) indicating significant challenges.

The graph below presents the findings:

Table 6: Challenges faced by the Product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate change*
- V3.15 Level of skills and other human resources within the commodity

Based on the graph above that used the questionnaire data and literature review, the main challenges are grouped and presented below, inclusive of their features.

Table 7: Challenges and key features

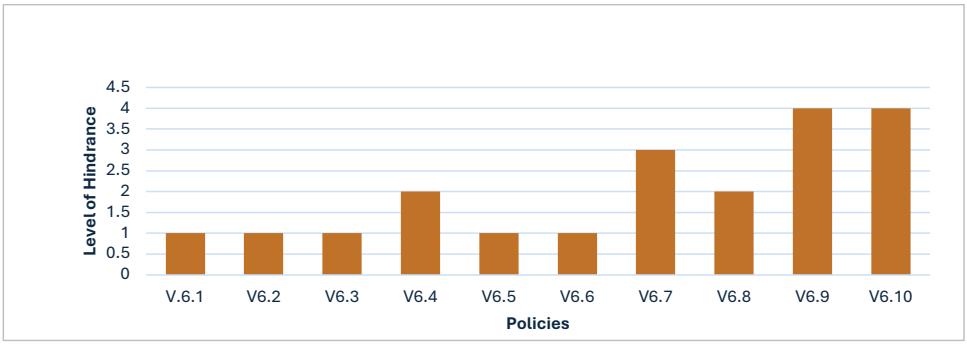
Major Gap/Challenge	Key features as per literature
Human resources and skills	• Shortage of skilled farm labour required for tasks such as land preparation, sowing, weeding, harvesting, and post-harvesting activities • Inadequate extension services
Availability of infrastructure (production, distribution, and marketing)	• Water scarcity due to recurring drought. Water deficit reduces leaf area index, chlorophyll content, number of pods per plant, and seed yield in cowpeas • Many of production farms are scattered and this make the fulfilment of infrastructure and provision of extension services slow
Access to Finance and low Public Expenditure	• Constrained financial resources affects research
Limited research in modern technology and transfer	• Technology transfer in Botswana is a challenge as several departments e.g. extension and the farmers, are based in various locations • Limited research on technology to protect the crop against insects, diseases, parasitic weeds
Profitability and Export Market potential	• Exceptionally low profitability from local sales and limited exports
Availability of inputs for production	• Use of poor seed varieties, inadequate application of inputs, and poor agronomic practices during crop production • Unavailability of improved seeds
Climate related challenges:	• Botswana climate is characterised by rising temperatures, high variability volatility in rainfall patters resulting in droughts and unpredictable trends in agricultural productivity (Department of Meteorological Services, 2011)

6.6 Gaps related challenges to the appropriateness of Policies and Institutional Setups

Officials were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings are indicated by the graph below:

Figure 4: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- V6.10 Regulatory framework that supports production and exports

Based on the graph above and literature review, the challenging policies and their features are summarised below:

Table 8: Policy related challenges and features

Major Policy related gaps	Key features
Technology, training and industrial retooling/upgrading:	• Weak in-service training frameworks and incentives to encourage private investments in training
Ease access to finance and innovative Public Expenditure review	• Lack of incentives for the private sector to invest in the provisions of financial resources to the sector
Infrastructure development	• Lack of policies that provide incentives for investments in cowpea production areas
Trade barriers	• Barriers related to the importation of chemicals and pesticides to control diseases and pests
Regulatory framework that supports production and exports	• Limited regulatory framework to encourage importation of appropriate inputs and farm machinery

6.7 Recommendations

Based on the analysis, the following recommendations are made:

- The priority research commodity for Botswana is **cowpeas,** and it is also recommended that the **National Agricultural Research and Development Institute (**NARD) be supported as the RCoL for Botswana.

- The following areas should be supported to strengthen the above-identified RCoL,

On human resources and skills, the identified RCoL is should be supported to address the shortage of skilled **cowpea farm labour required for tasks such as land preparation, sowing, weeding, harvesting, and post-harvesting activities**. This should include providing capacity building for extension workers through in-**service training, which is the principal intervention mechanism for filling the training gaps that are identified**.

Regarding Infrastructure, there is a need to support the provision of water infrastructure to address perennial water shortages, including drilling of bore halls, given the scarcity of rains.

On access to financial resources and Public Expenditure, there is a need to strengthen the resource mobilisation capabilities of the proposed RCol.

Due to limited research in new technology and transfer, there is a need to support the acquisition of technology and new equipment to improve farm operational efficiencies and effectiveness and scale up productivity.

On the availability of inputs for production, NARD needs to be supported to improve its coordination role and assist farmers in acquiring improved seed varieties and other inputs.

Regarding climate-related challenges, the proposed RCoL should be capacitated to lobby for appropriate resources to deal with drought incidences due to climate change.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps:

- Address the gaps identified in the operationalisation of agricultural extension services and transfer knowledge and practical skills to various farm initiatives
- Lobby for policies that provide incentives for the private sector to invest in the provisions of financial resources towards Cowpea farm operations
- Address policy and regulatory barriers related to importing chemicals and pesticides to control diseases and pests.

6.8 Implication for CCARDESA

It is also essential that support to Botswana be accompanied by further capacity building for CCARDESA to continue facilitating joint planning, programming, and resource mobilisation, given that financial resources were identified as a problem

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7 Needs Assessment in the Democratic Republic of Congo

7.1 About the Plant Protection Directorate in the Ministry of Agriculture

The Plant Protection Directorate falls under the Ministry of Agriculture in the Democratic Republic of Congo (DRC). Its mandate includes the following:

- Facilitates agricultural production and food self-sufficiency;
- Represent the ministry in terms of Planning of national production targets in the fields of agriculture and agroforestry;
- It facilitates the Promotion and supervision of Agricultural Associations and Cooperatives;
- Design, implementation, monitoring and evaluation of agricultural development programs and projects;
- Promotion of agricultural products for domestic food, domestic industry and export; Phytosanitary surveillance and management of plant quarantine in the interior of the country and at border crossings and permanent updating of the relevant regulatory measures;
- Orientation and support of economic operators interested in investing in agricultural sectors towards sites with high production potential to minimise operating costs; and
- Collection, analysis and publication of agricultural statistics in a directory.

Given its mandate, the Plant Protection Directorate falls under the Ministry of Agriculture in the Democratic Republic of Congo and could be considered to be the RCoL of DRC

7.2 Commodity Prioritization in the DRC

For DRC, the following priority research and Development commodities were prioritised:

i. Green Coffee
ii. Palm oil
iii. Cocoa Beans

7.3 Overview of the Green coffee sector in DRC

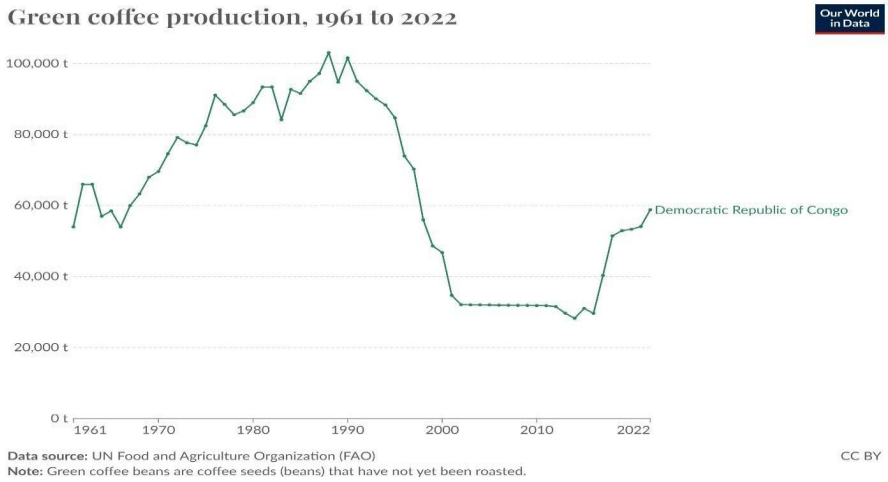
Coffee is one of the only cash crops grown in DRC. Two types of Coffee are dominant, namely the Arabica and Robusta coffee (13% and 87% respectively). Though Robusta has traditionally accounted for the majority of production, these days, Arabica is becoming more and more popular with farmers. Two of the most famous Arabica varietals grown are Bourbon, which does well in high altitudes, and Blue Mountain, a mutation of Typica that originated in Jamaica. A local variety of Robusta, called Petit Kwilu, is also found, having smaller beans and a milder, less bitter taste. The main growing areas are the eastern regions of the DRC, around the Ruwenzori Mountains and the volcanic Virunga range.

Smallholder farmers in DRC have long grown heirloom bourbon varieties, but until very recently, post-harvest processing was elementary, and the only buyers were informal traders. Today, innovative cooperatives and NGOs are making a difference in DRC. They are carving a path for smallholders to increase production and grow high-quality coffee that can access the global supply chain.

7.4 Latest Production figures:

The graph below shows growth trends of Green Coffee production in the DRC. At its peak, around 1990, DRC's Green Coffee production averaged 100,000 metric tonnes a year. However, in recent years, it has averaged around 60,000 metric tonnes.

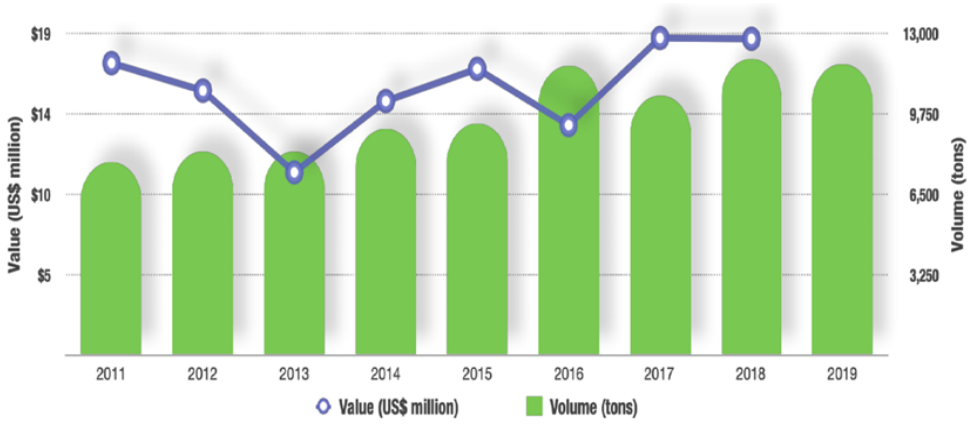
Figure 5: Green Coffee production: 1961-2022



7.5 Exports performance

Annual coffee exports have declined sharply since the 1980s. At that time, the country exported more or less 100 to 120,000 metric tonnes (MT) of coffee annually, while in 2020, the DRC exported approximately 11,000 MT. In 2008, exports hit a low point of just 8,000 MT.

Figure 6: Volume and value of DRC Coffee Exports, 2011-2029



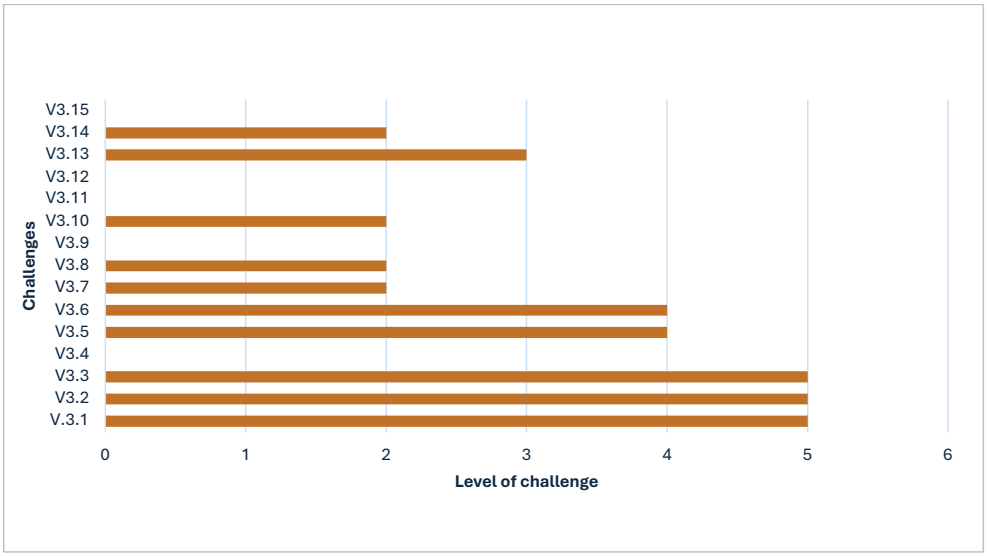
***Source:** Office National des Produits Agricoles (ONAPAC) and Development Solutions analysis (2020)*

7.6 Challenges Affecting the Optimal Performance of Green Coffee in DRC

Using a scale ranging from (1) to (5), the country was asked to indicate the level of challenges the product faces in performing optimally. The scale ranged from (1) Very minor Challenge and (5) Significant Challenge.

The graph below presents the findings:

Figure 7: Challenges faced by the product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- V3.2 Supportive infrastructure for production
- V3.3 Availability of warehousing, including management of post-harvest/production logistics
- V3.4 Export market potential
- V3.5 Access to finance
- V3.6 Availability of infrastructure for distribution
- V3.7 Availability of marketing infrastructure
- V3.8 Ease of exporting across the SADC region
- V3.9 Potential for growth in sales or profitability
- V3.10 Governance of the commodity
- V3.11 Attractiveness of the commodity in terms of the external environmental
- V3.12 Level of government support for the commodity
- V3.13 Availability of opportunities for research and technology transfer
- V3.14 Resistance against climate change
- V3.15 Level of skills and other human resources within the commodity

The questionnaire and the literature review identified several challenges. These are grouped and presented below, along with their features.

Table 9: Challenges and key features

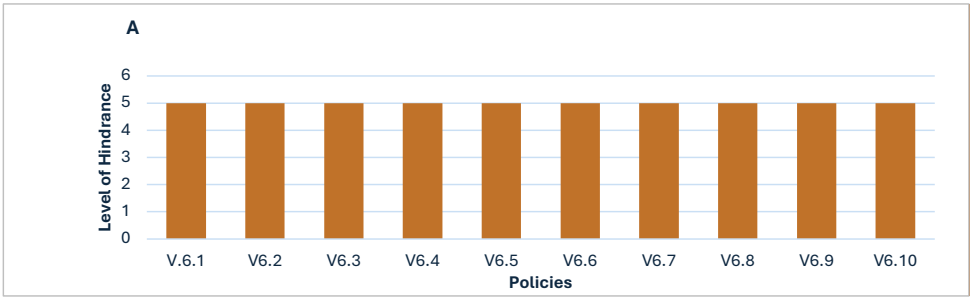
Gap/Challenge	Key features
Human resources and skills	• Limited education in specialty coffee production knowledge
Availability of infrastructure	• Redundant Coffee mills following years of unrest • Lack of equipment and washing stations
Financial Challenges and Public Expenditure	• Limited Cost-effective access to financing for producers, simplifying and reducing the costs of the exporting process
Limited research in new technology and transfer	• Low levels of research to manage Pests and Diseases affecting Coffee, such as coffee wilt disease (CWD), including information about the pathogen and its management
Profitability and export market potential	• Restricted export markets • Congo coffee is being exported cheaply as its price is below break-even, and much of it is smuggled
Availability of inputs for production	• Poor inputs supply
Climate-related challenges:	• Climatic and Weather changes cause Irregular Rains and Early Blooming. For example, the recent mudslide caused by violent storms ravaged large parts of the African Great Rift Valley and destroyed the coffee washing station

7.7 Gaps and related challenges in terms of appropriateness of Policies and Institutional Setups

Officials were requested to indicate the extent to which the following **regional policies and regulatory frameworks** favoured or were likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership. The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings from DRC are indicated below:

Figure 8: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*

- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

All the above ten policy dimensions for DRC were not conducive at different scale levels.

Table 10: Policy gaps and key features

Policy	Key features
Technology; training and industrial retooling/upgrading:	• Poor knowledge of efficient processing technologies leads to difficulties in processing coffee
Collaboration among researchers, the private sector, civil society, farmers and other stakeholders	• Low levels of scientific research are needed for better coffee seed varieties and how to deal with diseases.
Access to finance and innovative Public Expenditure review	• Limited credit facilities for the sector
Reduction of trade barriers	• High levels of Coffee smuggling across the neighbouring countries compared to what is exported legally • There is little incentive to produce high-quality coffee, as most legal and illegal coffee exporters charge the same price for coffee regardless of quality
Regulatory framework that supports production and exports	• High taxes and incidences of arbitrage behaviour create challenging conditions for doing business in the country

6.8 Recommendations

Based on the analysis, the following recommendations are made:

- *The priority Research Commodity for DRC is Green Coffee, with the Plant Protection Directorate under the Ministry of Agriculture in the Democratic Republic of Congo being considered the RCoL for DRC.*

- *The following areas should be supported to strengthen the identified RCoL, allowing it to address some of the gaps noted and be the one-stop centre of Excellence on Green Coffee issues in the SADC region.*

The proposed RCoL needs to be strengthened in human resources and skills to coordinate and strengthen training and extension services. This will facilitate an increase in qualified personnel and address knowledge gaps regarding speciality coffee production methods.

In terms of Infrastructure, the identified RCoL should be supported so that it can advocate for the re-establishment of Coffee mills following years of unrest and for other equipment and washing stations for Coffee.

Regarding Financial Challenges and Public Expenditure, the proposed RCoL needs to lobby for a robust resources mobilisation strategy to address financial gaps in the Coffee sector.

With limited research in new technology and transfer, there is a need to facilitate research on common pests and diseases that affect coffee, such as coffee wilt disease (CWD), including information about the pathogen and its management.

With regards to profitability and export market potential, there is a need for the identified RCoL to be capacitated to assist stakeholders by lobbying for the re-establishment of a well-functioning coffee trading market and dealing with smuggling. There is also a need to enhance the performance of Green coffee production; gaps related to the availability of quality production inputs need to be addressed. This calls for comprehensive research into high-quality producing seeds. Research into the latest technology was also found to be a hindrance, and as such, efforts have to be made to continue enhancing technology generation and sharing.

On the availability of inputs for production, the identified RCoL has to be strengthened to enhance Green coffee production's performance, as there are gaps related to the availability of quality production inputs. This calls upon for comprehensive research into high quality producing various in terms of seeds

On Climate-related challenges, the proposed RCoL has to be supported to advocate for the introduction of farming practices that promote proper use of nitrogen fertilisers, avoidance of deforestation and gas emissions, including proper wastewater and crop residues decomposing on the ground management

On **policy and institutional framework,** the RCoL should be supported to address the following gaps:

- *Research and knowledge generation in the Coffee sector.*
- *Institutional frameworks that discourage production, such as the smuggling of coffee across borders.*
- *Difficult ease of doing business legislative framework including addressing arbitrage challenges.*

7.8 Implication for CCARDESA

This implies the need to strengthen CCARDESA to be able to harmonise regional policies in the areas of:

- *Acquisition of technology*
- *Monitoring and evaluation.*

8 Needs and Gap Assessment in Eswatini

8.1 About the Department of Agriculture Research and Specialist Services under the Ministry of Agriculture

The Department of Agricultural Research and Specialists Services (DARSS) was initiated by the Ministry of Agriculture in 1959, with the establishment of the central research station at Malkerns, and sub-stations and Big bend and Nhlangano. Research plots were also located at Luve, Vuvulane and Mangcongco at this time. A fifth plot was added at Hebron in 1969 and the Swaziland Irrigation Schemes repossessed the Vuvulane plot at the end of the 1974/75 season. The wide divergent topographical zones within the country necessitated extensive coverage. The responsibility of the then Agricultural Research Division was transferred, in 1971, to the then University of Botswana, Lesotho and Swaziland to strengthen the University's presence in the country and formalise ties between the Faculty of Agriculture and research. The association continued until 1977, when the government announced the intention to reattach the Research Division to the Ministry of Agriculture and Cooperatives. This transfer dominated the 1977/78 season, and heavy staff losses at all levels devastated the various research programmes. Serious research activities resumed in the 1981/82 season, with the recruitment of an agronomist and the beginning of the Cropping Systems Research and Extension Training Project.

Responsible for developing and identifying applied and adaptive agricultural production technologies that ensure household and national food security, sustainable growth of the agro-business sector and national economy. The department is also responsible for phytosanitary services, safe-guarding food safety measures and conservation of national plant genetic resources heritage.

The major responsibilities of the Department are as follows:

- *Identification of adaptable crop varieties that can be grown successfully in the different agro-ecological zones of the country.*
- *Identification of the most efficient crop production methods.*
- *Screening and identification of cost-effective fertilizer/manure material and their best application practices across the country.*
- *Development and identification of cost-effective, user and environmentally friendly crop protection technologies.*
- *Development of appropriate water management practices in crop production to minimize the adverse effects of drought.*
- *Implementation of phytosanitary, quarantine and food safety measures.*
- *Collection, conservation and characterization of cultivated crops and their indigenous relatives.*
- *Analysis of food safety and development.*
- *Monitoring of plant health and risk surveillance.*

The department offers a number of services such as Cereals Agronomy, horticulture support, Soil Fertility and Plant Nutrition, General Entomology, Food Science and Technology, The Socio – Economic analysis, Plant Pathology, irrigation support etc.

8.2 Commodity Prioritization in Eswatini

For Eswatini the following priority research and Development commodities are prioritised:

(1) Wheat
(2) Soyabean
(3) Beans

8.3 Overview of the Wheat Sector in Eswatini:

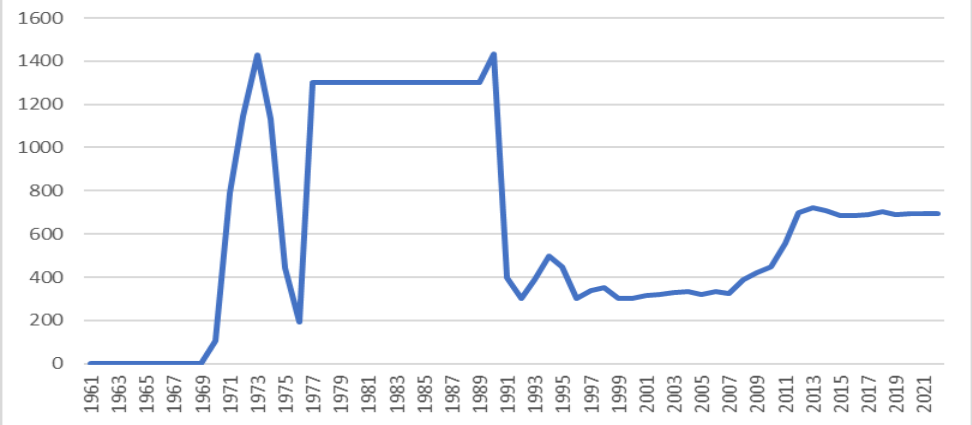
Eswatini's agricultural sector is the second largest contributor to the economy after the manufacturing sector. Commercial agriculture is dominated by sugar, canned fruit and beef production for export. Many locals

practice subsistence farming, primarily maize cultivation. The top five import products are wheat, yellow maize, rice, whole maize, and fruits and vegetables.

Besides subsistence production, the country meets much of its demand for agricultural products through imports from South Africa. Wheat is the only cereal with a significant import share from a country other than South Africa. Culturally, wheat is not a staple food in Eswatini. However, because of GKoE price controls on bread and poor maize yields, people are consuming increasing amounts of imported wheat.

8.4 Latest Production Figures and Export Performance

Figure 9:Eswatini Wheat Production (Ton)



Source: FAOSTAT

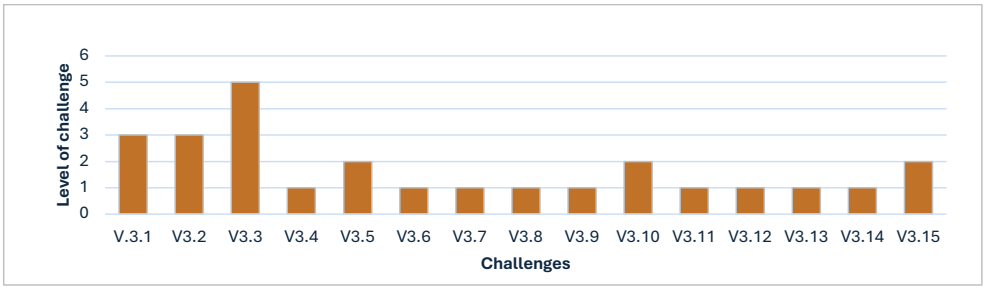
The graph above shows wheat production trends in Eswatini. From a peak of around 1400 t in 1973, wheat production fell to around 200 t in 1977 before rising again to 1400 t in 1979. The figures fell again to 250 t in 1989. The latest statistics indicate that Eswatini wheat production was at 693.73 t in 2022, down from 695.67 t in 2021, representing a change of 0.28%.

8.5 Challenges Faced by the Priority Product.

In terms of challenges affecting performance, officials were asked to indicate the challenges being faced by priority product 1 to perform optimally using a scale from (1) to (5) with (1) indicating very minor challenges and (5) indicating significant challenges.

The graph below presents the findings:

Figure 10: Challenges faced by the Product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate change*
- *V3.15 Level of skills and other human resources within the commodity*

Based on the graph above that used the questionnaire data and literature review, the main challenges are grouped and presented below, inclusive of their features.

Table 11: Challenges and key features of the Wheat Sector in Eswatini:

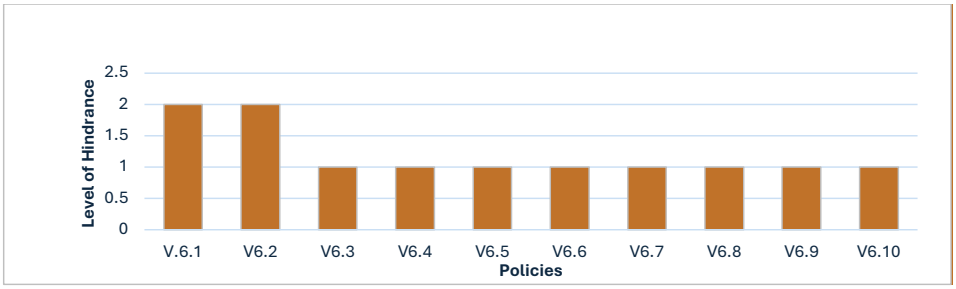
Gap/Challenge	Key features as per literature
Level of skills and other human resources within the commodity	• Lack of production and marketin
Availability of inputs for production	• Shortage and high inputs cost
Availability of supportive infrastructure	• Cost as well as the erratic supply of electricity for irrigation
Availability of warehousing, including management of post-harvest/production logistics	• High post-harvest loss due to lack of storage facilities and long distances to processors
Research in modern technology and transfer.	• Limited resources for research in wheat production and marketing
Governance of the commodity	• Incidences of unstable economic environment (e.g. high inflationary pressures) hence affecting incentives to produce

8.6 Gaps related related challenges to appropriateness of Policies and Institutional Setups

Officials were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings are indicated by the graph below

Figure 11: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

The challenging policies and their features are summarised below:

Table 12: Policy related challenges and key features

Policy	Key features
Technology, training and industrial retooling/upgrading:	• High incidence of use of old technology and equipment hence compromising on efficiency
Collaboration in researchers, private sector, civil society, farmers, and other stakeholders	• Limited collaboration among group of farmers and other stakeholders such as input suppliers, marketers, and distributors
Regulatory framework that supports production and exports	• Persistent cases of unstable macroeconomic environment that effects wheat productivity and competitiveness

8.7 Recommendations

Based on the analysis, the following recommendations are made:

- *The priority research commodity for Eswatini is proposed to be Wheat and that the department of Agricultural Research and Specialists Services (DARSS), be supported to be the RCoL for Eswatini.*
- *The following areas should be supported to strengthen the identified RCoL, which will address some of the gaps noted and be the one-stop centre of excellence on Wheat issues in the SADC region.*

In terms of Level of skills and other human resources within the commodity, the identified RCOL should be supported to coordinate acquisition of specialised skills in for small farmers, women, youth people. This should include support with skills and Technical and Vocational Education and Training (TVET)

Regarding the availability of inputs for production, there is a need to facilitate work seed producers and other inputs suppliers to offer credit facilities for wheat farmers include subsidies by government on inputs.

On the availability of supportive infrastructure, the identified RCOL need to be supported to improve on infrastructure by identifying opportunities in solar water pumping including exploring pump retrofitting

Regarding the availability of warehousing, including management of post-harvest/production logistics, the proposed RCOL need to be supported to be able to coordinate the acquisition of proper handling and storage with appropriate temperature and humidity throughout the Wheat value chain

With regards, to limited research in new technology and transfer and that given that technology is a key component of animal feed in Namibia, there is a need to invest in feed production technologies and carry out regular research to assess the needs of the farming community.

On Governance of the commodity, the identified RCOL need to be capacitated to work with Regulators to strengthen their capacity to improve the business environment and coordination and to facilitate policy dialogue and coordination.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps that were deemed as major by officials and also identified in literature.

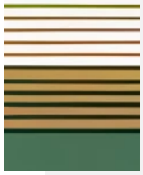
- *Technology, training and industrial retooling/upgrading, there is a need for the proposed RCOL to facilitate the transfer of technology research results close to the farmers by exchange visits. There is a need to assist farmers to acquire new technologies towards precision agriculture through use of GPS or automation to enhance farm efficiency*

- *On Collaboration in researchers, private sector, civil society, farmers and other stakeholders there is a need for the RCOL to coordinate farmers to be in groups in order to enhance their scale and thereby making it easier to provide extension, monitor production and collect produce.*

- *Regulatory framework that supports production and exports, there is a need for the RCOL to work with farmers union to lobby for a more conducive environment that promotes production and exports.*

9.7. Implication for CCARDESA

It is also essential that support to ESwatini be accompanied by further capacity building for CCARDESA to continue playing its role in facilitating joint planning, programming, and resource mobilisation, given that financial resources were identified as a problem.



9 Needs and Gap Assessment in Madagascar

9.1 About Ministry of Agriculture, Livestock and Fisheries

The Ministry of Agriculture, Livestock and Fisheries is responsible for designing, implementing and coordinating the strategies necessary for the achievement of the objectives set out in the General State Policy (EMP) in the field of agriculture. Agriculture, Livestock and Fisheries as well as agricultural research.

The Ministry of Agriculture, Livestock and Fisheries aims for accelerated economic growth of the rural world through a transformational vision of Agriculture in order to:

- *Sustainably increase productivity and develop competitive agribusiness-based production systems to meet the needs of national, regional and international markets,*
- *Extend production areas, and develop standardized operating infrastructures,*
- *Increase the incomes of agricultural producers and fishermen, and provide decent jobs for the rural population,*
- *Contribute to food and nutrition security and to improving resilience to climate change,*
- *Make Madagascar the breadbasket of the Indian Ocean and Sub-regions.*

9.2 Commodity Prioritization in Madagascar

For Madagascar, the following priority research and Development commodities were prioritised as communicated to CCARDESA by officials from Madagascar.

(1) Sorghum
(2) Groundnuts
(3) Millet

9.3 Overview of the Sorghum sector in Madagascar:

While sorghum has traditionally been produced in Madagascar, the overall quantity of sorghum produced has declined significantly since the 1990s and remains relatively low, despite multiple efforts to reintroduce the drought-tolerant cereal crop across agricultural lands. One of the development partners, USAID-Madagascar is committed to a better understanding of the opportunities presented by sorghum cultivation and marketing in Madagascar. The partners are prepared to assist to further diversify existing farming systems in response to the environmental and production challenges that smallholder farmers and the larger agricultural sector are facing. With this interest in a shift towards increased sorghum production in Madagascar in response to both environmental and economic concerns, there is strong recognition of the need for a consistent and profitable markets to ensure the long-term income and food security for sorghum producers.

Driving market demand and developing a “pull” effect to ensure value creation are priorities, as is a comprehensive understanding of the available sorghum varieties that are well-adapted to Madagascar’s agroecological zones and exhibit crucial end use characteristics.

Recent investments in commercial poultry production in the country present a compelling possibility for value chain development aimed at sorghum production for poultry feed. Madagascar has agroclimatic conditions favourable for growing sorghum, and it is possible to see sorghum planted in traditional maize areas. Regardless of sorghum’s strong adaptation to water-limiting environments, drought remains a concern, however, and so does the low soil pH found commonly across multiple field sites visited within the country. Securing access to water and common soil amendments will go far in creating quick positive outcomes for sorghum producers, both commercial- and subsistence-level.

9.4 Latest Production and export figures

Starting with low figures of 1million Kgs in 2008, production grew gradually to pick up at around 1.3 million Kgs in 2012 before falling slightly in 2013. Thereafter production has been rising gradual reaching close to 1.4 million kgs in 2021.

9.5 Challenges Affecting the Optimal Performance of Sorghum

A review of literature identified several challenges that affect the optimal performance sorghum production. These are listed below:

Table 13: Challenges and key features

Gap/Challenge as per	Key features as per literature
Availability of infrastructure	• *Undeveloped road system in Madagascar* • *Old infrastructure and difficulty accessing agricultural markets*
Limited research in modern technology and transfer	• *Insufficient knowledge and access to improved techniques* • *Lack of research on Sorghum production*
Availability of inputs for production	• *Low seed production leading Sorghum seed shortage* • *Low seed quality* • *Lack of varietal diversity in the sorghum planted.* • *lack insecticides and, in some cases, the equipment to apply insecticide*
Climate related challenges:	• *Unpredictable rainfall patterns and extreme climate conditions* • *vulnerability to natural hazards (cyclones, droughts, and floods)* • *Intense deforestation leading to drought*

While numerous efforts exist to try to address these constraints, those efforts are limited in scope when compared to the overall need.

9.6 Gaps related related challenges to appropriateness of Policies and Institutional Setups

The challenging policies and their features are summarised below:

Table 14: Policy related challenges and features

Policy	*Key features*
Technology, training and industrial retooling/upgrading:	• *Low use of modern technology and access to training facilities by wheat growers*
Collaboration in researchers, private sector, civil society, farmers, and other stakeholders	• *Limited extension services*
Access to finance and innovative Public Expenditure review	• *Limited capital of the banking sector following COVID 19.* • *High concentration of lending activities among medium-sized and big farms*
Infrastructure development	• *Poor transportation connectivity cuts across all modes of transport and severely hampers business in Madagascar* • *Weak modes of transport for transporting both people and goods*
Regulatory framework that supports production and exports	• *Slow pace in ratifying the SADC industry protocol and delayed implementation* • *Policy unpredictability that creates barriers to entry and uncompetitive markets hence affecting investments (World Bank 2021)*

9.7 Recommendations

Based on the analysis, the following recommendations are made:

- That *the* priority research commodity for Madagascar be Sorghum and that the Ministry of Agriculture, Livestock and Fisheries be supported to be the RCoL for Madagascar.

- The *following* areas should be supported to strengthen the identified RCoL, which will address some of the gaps noted and be the one-stop centre of excellence on Sorghum industry in the SADC region.

On Availability of infrastructure, the proposed RCOL need to be supported to review the infrastructure gaps in the wheat producing areas and to explore with the Government and cooperating partners to close the missing transport links.

Regarding limited research in new technology and transfer, the identified RCOL need to be supported to facilitate access to modern technology including importation of new equipment from other countries.

Regarding availability of inputs for production, there is need to support the RCol to identify high quality inputs in form of hybrid seed varieties and technology to address diseases and pests.

On climate related challenges, given that Madagascar is the fourth most vulnerable nation globally affected by climate change that comes in form of droughts and cyclones, it is important for RCOL to put in place mitigation strategies both terms of prevention and mitigation. These includes the need to address deforestation, habitat destruction and veld fires, while on the other hand putting measures to copy with impact of climate change such as drought preparedness and evacuation of the affected people.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps:

- *Technology, training and industrial retooling/upgrading, the RCOL to be capacitated to improve Malagasy farm workers' knowledge in terms of farming techniques.*
- *Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- **On Access to finance and innovative Public Expenditure** there is need to reduce high concentration of lending activities to medium-sized and big farms by promoting financial inclusion to cover rural farms.
- **On Infrastructure development**, RCOL to be supported towards the promotion of Public investment in expanding road infrastructure and to encourage public-private partnership (PPP) in infrastructure delivery.
- **Reduction of trade barriers**
- **On regulatory framework** that supports production and exports, RCOL to be supported to facilitate the creation of appropriate environment for the wheat industry to prosper including the ratification of the SADC industry Protocol signed by Madagascar in 2019

10.7 Implication for CCARDESA

It is also essential that support to Madagascar be accompanied by further capacity building for CCARDESA to continue playing its role in facilitating joint planning, programming, and resource mobilisation, given that financial resources were identified as a problem.

10 Needs and Gap Assessment in Mauritius

10.1 About the Food and Agriculture Research and Extension Institute under the Ministry of Agro-industry & Food Security

The Food and Agriculture Research and Extension Institute (FAREI)'s mandate is to support and implement priority research, development and training (RDT) programmes, projects, and appropriate technologies for food security. Its work is also to enhance competitiveness, sustainability and stakeholder equity across agri-food value chains in Mauritious. The institute operates four departments, namely (1) Crop Research, (2) Livestock Research, (3) Extension & Training, and (4) Central Support Services.

The Crop Research Department supports and oversees development in the non-sugar crop sector and ensures that the industry's needs are addressed through research and adopting new technologies. The department conducts adaptive research through its division to address the nation's needs. It also applies relevant knowledge and techniques from basic research elsewhere to adapt technologies to suit local conditions. It comprises six research divisions: Agronomy, Vegetable and Ornamental, Fruit, Resource Management, Entomology and Plant Pathology. Its Objectives include the following:

- Develop cost-effective technologies
- Introduce and develop new varieties
- Maintain germplasm and promote underutilised crop species
- Develop best agricultural practices for sustainable production
- Optimise the use of farming resources
- Develop protocols, norms and standards for minimally processed and preserved products and fruit juices.
- Develop Integrated Plant Protection Management strategies
- Increase production of strategic crops for enhanced food security

The Livestock Research Department comprises the Animal Production and Animal Health Divisions. It is mandated to conduct strategic research in the livestock and poultry sectors and adapt relevant knowledge and techniques to local conditions. The department fosters close interaction among scientists, farmers and extension staff to ensure that research activities are planned in a multidisciplinary and participative manner. Its Objectives include the following:

- To develop new technologies and improve farming practices through applied and adaptive research aiming at increasing farm production and productivity in a sustainable way
- To support livestock farmers in value addition and marketing of their products as a profitable enterprise
- To assist farmers in the conception and implementation of livestock and poultry project

The Extension and Training Department ensures technology transfer to the farming community and agro entrepreneurs in the horticultural sector (vegetables, fruits, ornamentals) and livestock sector (cattle, poultry, goat, sheep, deer, rabbit and pig). The main activities include providing technical advisory services, training and information dissemination, facilitating access to government incentives, field data collection on production, and socio-economic and agronomic issues. Its objectives include the following:

- Professionalise the sector by improving farmers' knowledge and skills through technical advisory services and training;
- Improve farm productivity, farmers' income and welfare;
- Modernise the sector through the adoption of new technologies;
- Promote value addition to agricultural produce;

- Enhance food security;
- Improve linkages among farmers, extension, research and other stakeholders; and
- Facilitate access to government incentives and services.

10.2 Commodity Prioritisation in Mauritius

For Mauritius, the following commodities were prioritised in that order:

(1) Sugar Cane
(2) Poultry
(3) Pineapple

10.3 Overview of the Sugar Cane sector in Mauritius

Mauritius's prioritisation of sugarcane is consistent with industry observation and literature. This is because sugarcane is one of Mauritius's competitive crops; hence, Mauritius is justified in taking the lead in this crop within the SADC region. This is more so if one considers the diversification and value addition that has taken place within the sugarcane value chain in Mauritius, which provides the opportunity for other stakeholders in SADC to learn from the Mauritian experience through peer learning and exchange. Diversification into electricity and bioethanol production motivates Mauritius to be supported further to become an RCoL for sugar can and sugar-related products.

Sugar cane was the first agricultural plant of economic significance introduced to Mauritius in 1639. Dutch settlers used it on an artisanal basis primarily to produce alcoholic beverages. Today, it remains the most important sector in the Mauritian economy.

10.4 .Sugar cane Production trends in Mauritius

Sugarcane represents 85% of Mauritius's arable land, and on average, Mauritius produces around 3,000,000 tonnes of sugarcane per year, enough to supply the three biggest mills in the country. Sugar is marketed and distributed by Mauritius Sugar Syndicate, an organisation driving the industry's sustainability vision.

In 2017, the average area cultivated for sugar cane was estimated at 54,000 hectares, with an annual harvest of 49,000 hectares, producing close to 3,500,000 tonnes of cane. The average yield is estimated at 70 tonnes per hectare (Statistics Mauritius, 2018). Around 120,000 tonnes of molasses and 1,200,000 tonnes of bagasse were produced concurrently as main byproducts (Statistics Mauritius, 2018a).

According to Statistics Mauritius, at the end of June 2022, some 326 hectares of sugar cane for crop 2022 were harvested, yielding 24,141 tonnes of sugar cane and 2,117 tonnes of sugar. The corresponding figures for 2021 were 511 hectares, 38,081 tonnes of sugar cane, and 4,401 tonnes of sugar, respectively. The average extraction rate as of June 2022 was 7.34%, lower than the 7.80% as of June 2021. These figures indicate the potential growth of the sugar industry in Mauritius.

To reduce the dangers of its high dependence on sugar and the drastic reduction of EU prices by around 30%, Mauritius has diversified into electricity generation, ethanol production, and rum.

According to The Mauritius Sugar Industry, 2022, the following are the factors that make the Mauritius Sugar Cane Industry Competitive in the SADC region:

- **Rich soil and favourable climate:** Mauritius' volcanic soil and tropical climate provide the perfect conditions for growing sugar cane. The soil is rich in nutrients and minerals, and the climate is warm and humid, which helps the sugar cane to grow quickly.

- **Traditional cultivation methods**: Mauritian sugar cane is still grown using traditional cultivation methods, such as hand-cutting the sugar cane and using oxen to plough the fields. This results in higher-quality sugar, as the sugar cane is handled with care throughout the production process.

- **High-quality sugarcane varieties: Mauritius is home to several high-quality varieties**, such as the "Mauritius Yellow" and "Mauritius Red" varieties. These varieties have a high sucrose content and produce very high-quality sugar.

- **Modern production techniques:** While traditional cultivation methods are still used, modern production techniques are also employed to ensure the highest quality of sugar. This includes using state-of-the-art machinery to extract the juice from the sugar cane and refining the sugar using advanced techniques.

- **Strict quality control standards**: Mauritian sugar is subject to strict quality control standards, which ensures that only the highest quality sugar is produced. The sugar is tested for purity, colour, and moisture content to ensure that it meets the strict standards set by the Mauritius Sugar Syndicate.

In terms of exports, despite the price cuts, up to 530,000 tonnes of sugar are exported to the European Union markets annually.

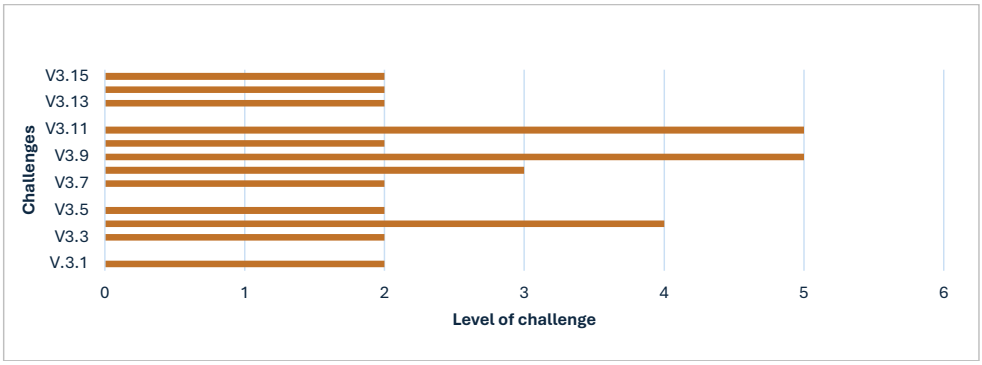
10.5 Gaps/Challenges Affecting the Optimal Performance of sugar cane in Mauritius

Although Mauritius has succeeded in several areas in maintaining the sugar cane industry as a viable sector, some challenges exist that need to be addressed for other countries to benefit from having Mauritius as an RCoL in sugar cane.

The country was asked to indicate the level of challenges the product faces to perform optimally using a scale from (1) to (5). The scale ranged from (1) very minor challenge to (5) significant challenge.

The graph below presents the findings on some challenges that may need to be addressed.

Figure 12: Challenges faced by the Product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*

- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the external environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate change*
- *V3.15 Level of skills and other human resources within the commodity*

Several challenges have been identified from the questionnaire and the literature review. These are grouped and presented under table 4.1 below, inclusive of their features:

Table 15: Key challenges and corresponding features

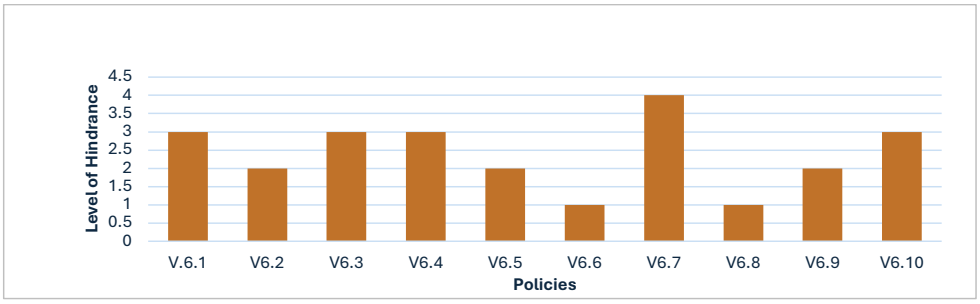
Gap/Challenge	Key features
Human resources and skills	• Shortage of appropriate skills
Availability of infrastructure	• High sugar losses in cane processing due to old processing infrastructure
Financial Challenges and Public Expenditure	• Gaps exist between the planned target of revamping the sugar industry and available resources
Limited research in new technology and transfer	• Limited research and innovation in technology
Profitability and export market potential	• The EU's erosion of preferential markets and the removal of guaranteed remunerative sugar prices have threatened the sugar industry. • Access to preferential export markets with guaranteed prices is a problem.
Availability of inputs for production	• Inputs for production were also observed as a challenge in Mauritius. • Research into the latest technology was also found a hindrance. • Use of low-yield plant varieties
Climate-related challenges:	• The country faces the challenge of increasing greenhouse gas (GHG) emissions driven mainly by the power sector (79 per cent of imported fossil fuel electricity generation • Cyclones

10.6 Appropriateness of Policies and Institutional Setups

Officials were also asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or are likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership. The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings are indicated in the graph below:

Figure 13: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

While Mauritius designed a primary policy framework for the sugar industry, the Multi-Annual Adaptation Strategy (MAAS), to restructure and establish a more competitive sugar sector, some gaps have been noted, mainly in the implementation of policy-related activities. The identified limitations in terms of conduciveness are shown below, accompanied by features and proposed remedies.

Table 16: Key gaps and features related to policy issues

Observed Policy implementation gaps	Key features
Technology, training and industrial retooling/upgrading:	• Low incentives to promote industrial equipment for retooling
Collaboration among researchers, the private sector, civil society, farmers and other stakeholders	• Limited incentives for collaboration in research among various stakeholders
Access to finance and innovative Public Expenditure review	• Limited financial support from Development Finance institutions
Infrastructure development	• Limited collaboration between the private sector and government to improve infrastructure such as feeder roads
Reduction of trade barriers	• Heavy excise duty results in the high cost of manufacturing
Regulatory framework that supports production and exports	• While the regulatory policies exist in favour of sugar production, there have been some gaps in implementation

10.7 Recommendations

Mauritius has done well to ensure that its sugar cane industry remains viable despite a number of pressures that compromise its competitiveness. The country has adopted appropriate policies and strategies that have been supported by well-coordinated implementation plans. With extra support from cooperating partners, the sugar cane industry in Mauritius could be one of the best RCoL.

Based on the analysis, the following recommendations are made:

- Support the Sugar cane product as the priority research commodity for Mauritius with FAREI as the RCoL.

- The following areas should be supported to strengthen the identified RCoL, in order to address some of the gaps that have been noted.

In terms of Human resources and skills, there is a need to provide capacity to FAREI to lobby for skills and research capabilities to improve sugar cane varieties with high yields and high sucrose and fibre content to meet domestic and international markets. Furthermore, it is important to invest in human resources covering agricultural operations, processing and planning.

In the area of infrastructure, the identified RCoL should be supported to advocate for enhancing and modernising production infrastructure and cane processing, including infrastructure to mechanise field operations, including small-scale growers.

With regards to Financial Challenges and Public Expenditure, there is scope for FAREI to be capacitated to implement a robust resource mobilisation strategy that involves the Government, the private sector, and cooperating partners.

On limited research in new technology and transfer, there is a need for the proposed RCoL to be capacitated to advocate for more Investment in research that promotes the use of innovative and modern technologies that bring better cane varieties and sugarcane co-products, including supporting efforts to innovate around sugarcane value-added products such as unique sugars, bagasse electricity, and fuel ethanol, and their cost-effective scaling up.

The weakness noted on Profitability and export market potential, could be solved through facilitation of diversification and value addition to sugar and through exploring other markets in addition to existing ones, such as the EU.

Gaps related to availability of inputs for production, can be addressed through comprehensive research into high-quality seed production including the need to continue enhancing research into new technology and improved pest—and disease-free cane varieties.

The climate-related challenges could be addressed through reducing heavy reliance on fossil fuels and hence the need for the RCoL to be capacitated to support Mauritius in achieving her Nationally Determined Contributions' of reducing the country's Green House Gas (GHG) emissions by 30 per cent by 2030. This should include the adoption of circular economy principles.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps:

- Reduction of duties for importation materials and machinery
- Put in place some incentives to promote collaboration in research
- Put a legislative framework from the Development Bank, including institutional support from the Development Bank of Mauritius.
- Put incentives for collaboration.
- Rationalise excise duties to support manufacturing.
- Implement the regulatory provisions that promote the production of high-quality sugarcane varieties and the modernisation of farms.

4.6. Implication for CCARDESA

The above gaps require CCARDESA to continue facilitating joint planning, programming, and resource mobilisation. This implies the need to strengthen CCARDESA to be able to harmonise regional policies in the areas of acquisition of technology, monitoring and evaluation.

11 Needs and Gap Assessment in Namibia

11.1 About the Department of Agriculture Development under the Ministry of Agriculture water and land reform

The Department of Agriculture Development falls under the Ministry of Agriculture Water and Land Reform and is mandated to promote, manage, and utilise agriculture resources sustainably. Its vision is "To be a recognised leading contributor to food and nutrition security, equitable access to agriculture resources, and enhanced livelihoods." The department is driven by the mission to create an enabling environment and develop strategies, programmes, and projects to enhance food and nutrition security and improve the livelihoods of all Namibians.

This Department is at the Centre of Namibia's NARES and, hence, could be the host of Namibia's RCoL. In particular, the department's 3 Directorates of (1) Agricultural Production, Extension And Engineering Services, (2) Agriculture Research And Development and (3) Veterinary Services play very critical roles in the development of agriculture in Namibia.

The Agriculture Research and Development Directorate supports the development of adequate and skilled human resources for agriculture. It undertakes crop, livestock, and natural resource research within the communal and commercial sectors with the objective of ensuring food security in Namibia.

The Directorate of Agricultural Production, Extension And Engineering Services is mandated to provide professional agricultural advisory services to farmers for sustainable and optimal market-oriented agricultural production. The Directorate promotes appropriate and improved agricultural technologies practices and creates a conducive environment for the private sector and other stakeholders to participate in optimal and sustainable agricultural production. Its objectives include:

- Providing Agricultural Services in the form of advice, information dissemination and training.
- Identifying technology and training needs in all aspects of agricultural production.
- Promoting the development, adaptation and adoption of appropriate technologies.
- Promoting Plant and Livestock production
- Contributing to the implementation of agricultural-related policies
- Engaging in production and contributing to household and national food security.
- Providing Agriculture Engineering Services
- Regulating the importation and exportation of agro-chemicals, farm feeds, plant and plant products

The Directorate of Veterinary Services (DVS) is mandated to maintain and promote optimal animal health, production and reproduction and assure the safe and orderly marketing of animals and animal products through animal disease control, epidemiology, veterinary extension, and veterinary public health services.

11.2 Commodity Prioritisation in Namibia

In terms of priority research and development commodities, Namibia prioritised the following commodities: (1) **Beef,** (2) **Grapes,** and (3) **Live Goats** in that order.

11.3 Overview of the Beef sector in Namibia:

Namibia is one of the top countries that produce beef products in the SADC region. Cattle raising is predominant in the central and northern areas, while sheep and goat farming is concentrated in the more arid

southern regions. The limited rainfall Namibia receives makes it difficult for the country to grow crops. However, due to its vast land, Namibia has a comparative advantage in cattle and beef production on its rangeland. In this regard, the country prioritises cattle rearing and beef production as the most sustainable way to farm since crops require a significant amount of water. Therefore, the cattle and beef industry is at the core of Namibia's economy. The Namibian beef is also regarded as one of the best in the World in terms of taste. However, land degradation increases bushes and shrubs at the expense of grasses and forbs. This has also been worsened by the rising cost of production and overgrazing that has resulted in the reduction of quality grazing land and, hence, in cattle production, a key ingredient towards the beef industry.

11.4 Production figures

Beef production is one of the most competitive sectors of Namibia's agriculture as it constitutes approximately 85 per cent of gross agricultural income and around 10 per cent of the Gross National Product (GNP). Namibia's livestock and meat industries are amongst the largest in SADC and Sub-Saharan Africa. The downside factor is that the country is characterised by the driest seasons in the SADC region, with only 2% of Namibia's land receiving average to above-normal rainfall to grow crops. Over the past few years, there has been a steady decline in cattle meat production in Namibia. This trend is expected and is a result of the abovementioned reasons, which are accompanied by rising production costs, climate change, and the economic crisis.

11.5 Exports performance

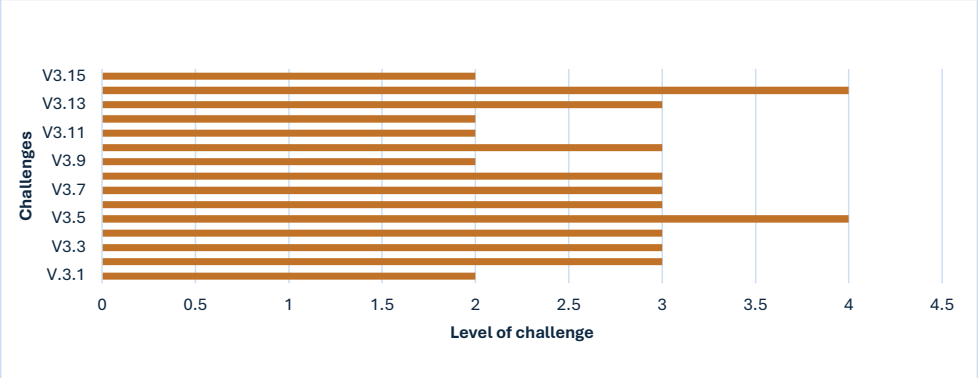
Namibia exports its beef to countries such as the United States of America, China, South Africa, the United Kingdom, Norway, Germany, the Netherlands, Italy and other EU countries. The export performance followed the same trend as the production trend. Years that witnessed severe droughts were followed by low productivity and, in turn, low exports of meat products. Exports of bovine live animals in 2021 were over 14% lower than in 2010. All declines were associated with drought years.

11.6 Challenges Affecting the Optimal Performance of Beef Industry in Namibia

Officials were asked to indicate the level of challenges the product faces to perform optimally using a scale from (1) to (5). The scale ranged from (1) very minor challenge to (5) significant challenge.

The graph below presents the findings:

Figure 14: Challenges faced by the Product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*

- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate* change
- *V3.15 Level of skills and other human resources within the commodity*

In the questionnaire and the literature review, several challenges have been identified. These are grouped and presented below, inclusive of their features.

Table 17: Challenges and key features

Gap/Challenge	Key features
Human resources and skills	• Limited technical skills • Limited extension services and the need for frequency of training for livestock farmers
Availability of infrastructure	• A study by Neema & Katinayi (2023) revealed that key infrastructure challenges in Namibia include energy, water, internet, and transport • Infrastructure related to fencing and paddocks for herd and wildlife management • Small-scale farmers, particularly in Northern Namibia, face serious hurdles when it comes to solving the logistics of reaching markets and consumers
Financial Challenges and Public Expenditure	• Limited access to production and marketing credit facilities. • High cost of borrowing •
Limited research in new technology and transfer	• Low level of agricultural technology and diversification • Research and technology transfer • Use of outdated agricultural techniques • Limited technology/ automation for tracking and monitoring cattle movements and improving operations. • Limited research to address high Livestock diseases
Profitability and export market potential	• In Namibia, carcass profitability has been a challenge due to the high cost of animal feed
Availability of inputs for production	• High cost of production due to water shortages • Animal feed, a key component in the livestock and meat industries, is in short supply • Poor Cattle genetics • The scarcity of animal feed hampers productivity and profitability
Climate-related challenges:	• Climate change-induced recurring droughts and erratic rainfall cause significant threats to livestock agriculture in Namibia. • Elevated temperatures in northern Namibia. • High indecencies of flooding • Critical water shortages • High Exposure to climate hazards

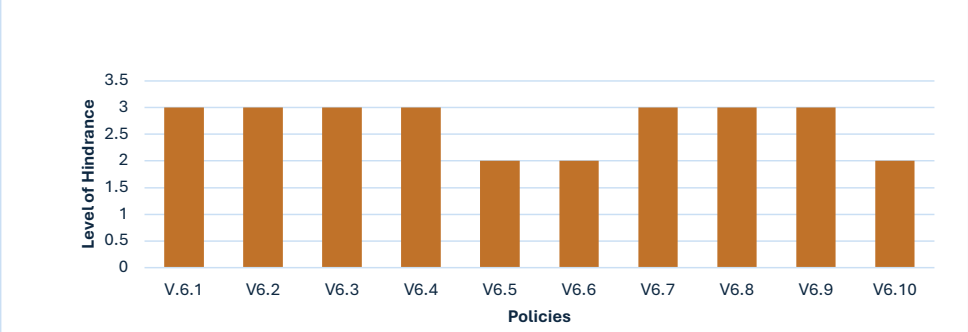
11.7 Gaps and related challenges to the appropriateness of Policies and Institutional Setups

The Government of the Republic of Namibia is guided by long-term development objectives outlined in the National Development Plans (NDPs) and Vision 2030 strategy regarding policies and institutional frameworks in the agriculture sector. The Ministry of Agriculture, Water and Land Reform has the mandate to promote, develop, manage, and use agricultural, water, and forestry resources, including addressing some institutional challenges.

Officials were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings are indicated by the graph below:

Figure 15: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

The challenging policies and their features are summarised below:

Table 18: Policy related gaps and features

Policy	Key features
Technology, training and industrial retooling/upgrading:	• Low levels of training in areas such as innovation and technology
Collaboration among researchers, the private sector, civil society, farmers and other stakeholders	• Limited collaboration among stakeholders
Access to finance and innovative Public Expenditure review	• Limited creation of policies that increase access to finance • Budgetary constraints and weak public service management systems
Infrastructure development	• Inadequate transportation and the high cost of transportation have adverse effects on returns to investments
Reduction of trade barriers	• Farmers of livestock must demonstrate that they have complied with export restrictions before they are entitled to export
Regulatory framework that supports production and exports	• The prevalence of customary or communal land tenure systems is associated with lower agricultural productivity, especially in Northern Namibia

11.8 Recommendations

Based on the analysis, the following recommendations are made:

- The priority research commodity for Namibia is proposed to be beef, and the Department of Agriculture Development, which falls under the Ministry of Agriculture Water and Land Reform, is supported as the RCoL for Namibia.

- The following areas should be supported to strengthen the identified RCoL, which will address some of the gaps noted and be the one-stop centre of excellence on beef issues in the SADC region.

Regarding human resources and skills, the identified RCoL need to be supported to improve skills and provide training in extension services to address the challenges of cattle feed and diseases. Furthermore, there is a need to increase agricultural training centres and train more extension agents to assist farmers in staying up to date with the latest information and skills on production methods and technology in Agriculture.

On Infrastructure, the identified RCoL should be supported to advocate for more financial resource allocation for infrastructure provision and address issues regarding access to water and electricity in rural areas to ensure bore hall drilling given the scarcity of rains.

Concerning financial challenges and public expenditure, the proposed RCoI must be strengthened to lobby for improving financial markets and resource mobilisation capabilities of financial intermediaries.

In terms of limited research in new technology and transfer, the proposed RCoL should be capacitated to support stakeholders in enhancing the research and acquisition of new technologies, such as using big data, clouds, the Internet of Things (IoT), robotics, drones, and sensors to manage cattle movements. Given that technology is a key component of animal feed in Namibia, there is a need to invest in feed production technologies and carry out regular research to assess the needs of the farming community.

Regarding profitability and export market potential, the identified RCoL need to be supported to work with stakeholders to address the high feed cost by researching other methods of feeding schemes, such as developing irrigation schemes to grow more maize, which is one of the main ingredients of animal feed. This should include support with storing, packaging, labelling and trading agricultural produce. In drought years, ensure farmers remain sustainable by providing government incentives to encourage them to sustain their agricultural activities.

Regarding the availability of inputs for production, the identified RCoL need to be strengthened to be able to assist towards improving the supply of inputs such as feed to the beef industry.

On Climate-related challenges, the proposed RCoL should be capacitated to promote agricultural practices that strengthen resilience to climate change and variability to ensure food and livelihood and to carry out exchange visits to countries such as Egypt and Israel, which have more arid land and suffer extreme weather conditions but have managed to increase their agricultural productivity. In addition, there is a need to ensure that policies that deal with climate change, frequent forest fires and increased bush encroachment are implemented. This should include ensuring effective management and Conservation of Biodiversity, Integrated Land Use Management, Land Tenure, Ownership, and User Rights to address Environmental Degradation and Pollution, including the use of environmentally friendly methods in agricultural production.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps:

- Ensure full implementation and regular monitoring of Namibia's National Science, Technology and Innovation Policy (2020-2030) (NSTIP), whose mission is to entrench the production and application of science, technology and innovation in all sectors of the economy to achieve the goals as set out in Vision 2030, national development plans and the global Sustainable Development Goals.

- Coordination with the private sector is essential for small farmers to optimise their learning by doing the process.

- Promote agro financing and put policies that enhance financial capacity through loans from financial institutions.
- Ensure trade barriers are removed, particularly those that hinder the importation of capital goods instead of finished goods.
- Address policies that deal with land ownership to enable Banks to provide credit based on long leasehold or title deeds.

11.9 Implication for CCARDESA

It is also essential that support to Namibia be accompanied by further capacity building for CCARDESA to continue playing its role in facilitating joint planning, programming, and resource mobilisation, given that financial resources were identified as a problem.

CCARDESA can also facilitate harmonised joint research among SADC MS RCoLs, including facilitating technology acquisition, monitoring, and evaluation.

CCARDESA should be supported in establishing a proper implementation framework and an inclusive Monitoring and Evaluation System to help Member States.

It can be supported to enhance coordination, regional consultation, and weak participation of Member States.

Should have access to pooled regional funds to support the participation of SADC Stakeholders in coordination meetings.

CCARDESA should be capacitated to respond to lessons learned under the ongoing RCoL initiatives and initiate new programmes.

It should also facilitate access to financing and technical skills.

12 Needs and Gap Assessment in South Africa

12.1 About the Agriculture Research Council of South Africa

The Agriculture Research Council (ARC) was established in 1990 through the Agricultural Research Act 86 of 1990 (as amended by Act 27 of 2001) and is the principal agricultural research institution in South Africa. It is located at 1134 Park Street, Hatfield Pretoria. The vision of ARC is "Excellence in research and innovation for sustainable agricultural systems and economic development". ARC desires to become an organisation known for its excellence in its core business area. It is driven by the mission to “research, develop partnerships and human capital, to foster innovation for a sustainable agriculture sector". The core mandate of ARC includes promoting agriculture and related industries, facilitating natural resource conservation and management and contributing to a better life.

Its main functions include:

- Carrying out and promoting research, technology development and technology transfer;
- Utilising the technological expertise in its possession and making it generally available;
- Publish information concerning its objectives and functions and establish facilities for the collection and dissemination of information in connection with research and development;
- Publish the results of the research;
- Establish and control facilities in the fields of research, technology development and technology transfer that the Council may determine from time to time;
- Cooperate with departments of state, institutions, persons and other authorities for the promotion and conduct of research, technology development and technology transfer;
- Promote the training of research workers using bursaries or grants-in-aid for research, technology development and technology transfer, and contribute financially;
- Research, development and technology transfer programmes;
- Hire or let facilities; and
- Cooperate with persons and authorities in other countries conducting or promoting agriculture research, development, and technology transfer.

Based on its mandate, ARC can become the RCoL for specific commodities where it has a comparative advantage.

3.2. Commodity Prioritisation in South Africa

For South Africa, the following priority commodities were proposed:

1 Citrus
2 Wine
3 Corn

3.3. Overview of the Citrus sector

It is not by coincidence that the focal persons in South Africa prioritised Citrus. This is because the country is currently the biggest producer and exporter of Citrus within SADC and the second largest citrus exporter in

the world. All the main varieties of Citrus grown in South Africa indicate an upward trend in terms of production figures.

South Africa accounts for more than 10 per cent of global exports. Two-thirds of citrus production is exported as fresh fruit, generating 95% of total citrus earnings annually and supporting substantial employment creation. The regions that grow citrus in South Africa include the Western & Northern Cape regions. In these regions, the Mediterranean climatic conditions are very favourable for plants. Several citrus varieties are grown in South Africa. The main ones include Oranges, lemons, grapefruit, mandarins, tangerine and lime. These are elaborated below:

Oranges: These originate from China and South Vietnam. The main varieties include Navel Oranges. The Sweet Orange is the citrus type that makes up the most significant portion of South Africa's production and exports. The main varieties include the Navel, Valencia, and Satsumas.

Lemons: Lemons are small evergreen trees in the flowering plant family. They are native to Asia, primarily Northeast India, Northern Myanmar, and China. Varieties planted in South Africa include Eureka (75%), Lisbon (8%), and 2PH Seedless (6%). Lemons are mainly used in drinks and for flavouring various foods.

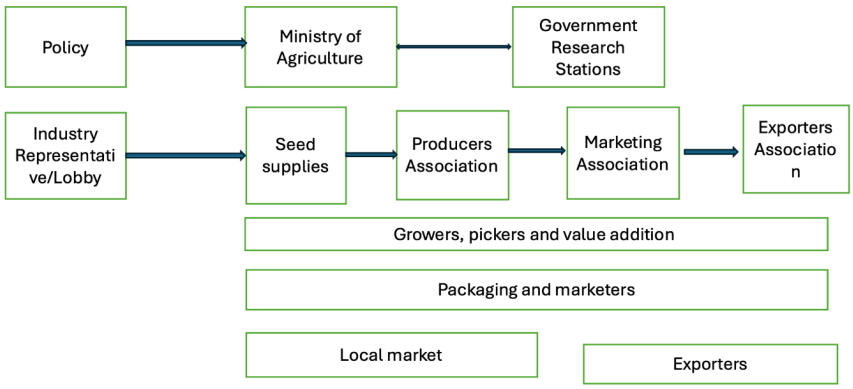
Grapefruit: The most popular grapefruit varieties in South Africa are the Star Ruby, a seedless variety with a long harvest season running from April to September, and the Marsh, a flavoury variety cultivated mainly for processing.

Mandarins (Soft Citrus-Tangerines, Nartjies & Tangelos): Mandarins produce delicious fruits with loose rinds and are best suited to regions with cool to cold winters,

Limes: Limes originate from tropical Southeast Asia, where they still grow in the wild. The main varieties grown in South Africa include Bearss and Tahiti. Lime fruits are used for preserves, garnishes and juices,

Institutional set-up: The citrus industry in South Africa comprises various players within the value chain, including tree input suppliers, seed companies, nurseries, growers, equipment and technology suppliers, fruit processors, packhouses, marketing and logistics, industry associations, and policymakers, including Ministries dealing with agriculture, environment, and trade.: The institutional setup of the Citrus commodity sector is illustrated Figure 3.1 below:

Figure 16: Overview of citrus industry in South Africa



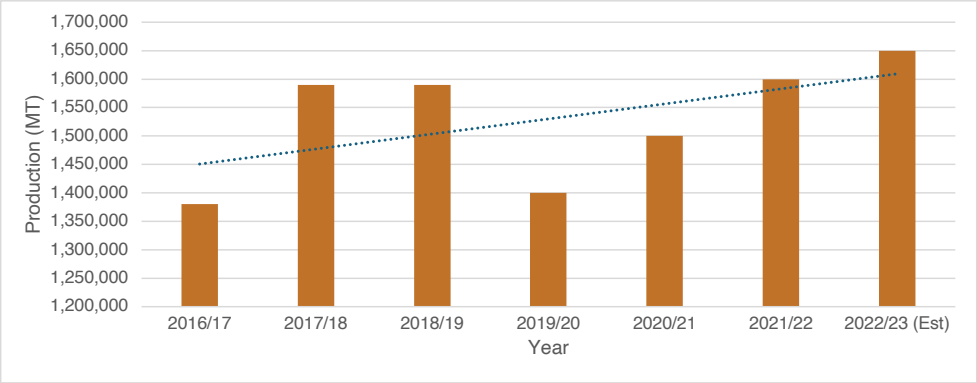
12.2 Citrus Production figures

Despite the incidences of COVID-19, the South African Citrus sector has remained very strong, as shown by the production figures below.

12.2.1 Oranges

The latest production estimates (2016-2023) for oranges in Metric Tonnes (MT) are shown in the graph below, and they indicate an upward trend even in years of COVID-19.

Figure 17: Oranges Production (MT)



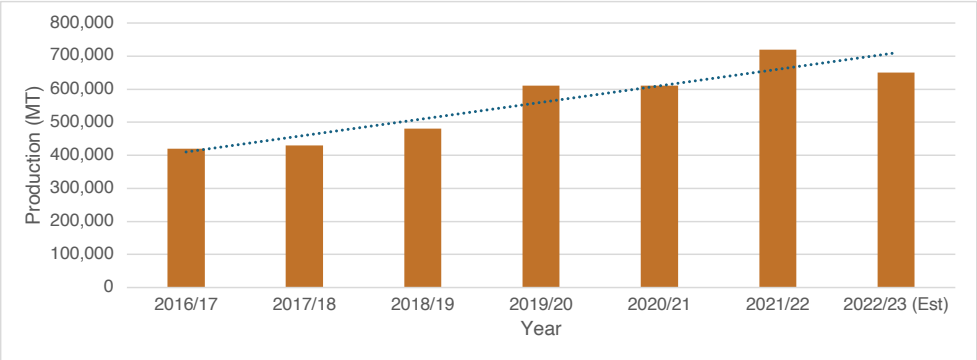
Source: CGA & Post Estimates/Forecast

Orange production sharply declined from a peak of around 1,590,000 MT in 2018/19 to a low of 1,400,00 MT in 2019/20. This was mainly attributable to COVID-19. However, since 2020/21, there has been an upward trend, reaching an estimated high of 1,610,000 MT in the 2022/23 period.

12.2.2 Lemons

The latest production estimates (2016-2023) for lemons in Metric Tonnes (MT) are shown in the graph below, and they indicate an upward trend even in years of COVID-19.

Figure 18: Lemon Production (MT)



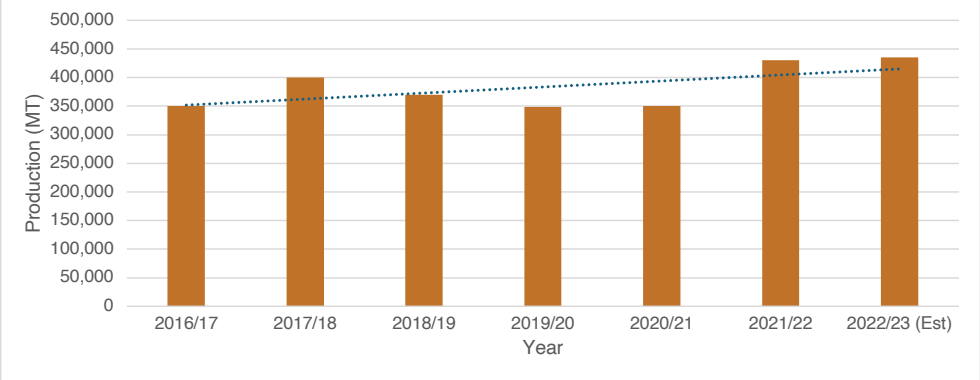
Source: CGA & Post Estimates/Forecast

For Lemons, regardless of COVID-19, production levels have consistently increased from as low as 420,000 MT in 2016/17 to around 650,000 MT in 2022/23

12.2.3 Grapefruit

The latest production estimates (2016-2023) for grapefruit in Metric Tonnes (MT) are shown in the graph below, and they indicate an upward trend even during COVID-19. It rose from 350,000 MT in 2019/2020 to around 435,000 MT in 2022/23.

Figure 19: Grape Production (MT)



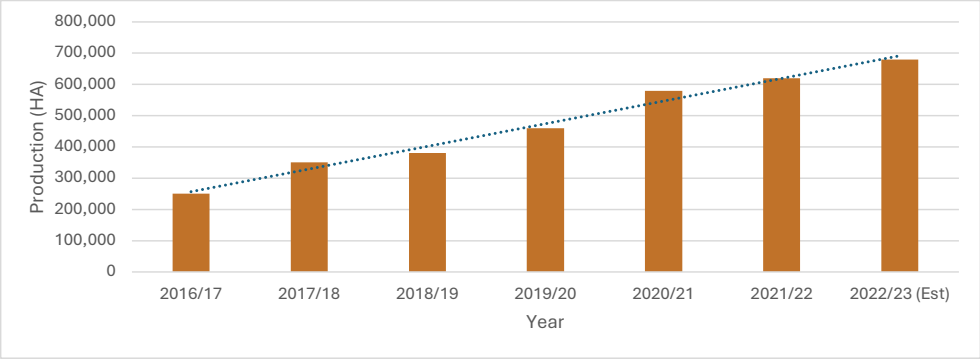
Source: CGA & Post Estimates/Forecast

Grapefruit production has grown by an average of 16% over the past five years. This is mainly due to increased capacity utilisation and global demand, especially in Europe, Asia, and the Middle East.

12.2.4 Mandarina/Tangerine

The latest production estimates (2016-2023) in hectares (HA) planted for Mandarina/Tangerine are shown in the graph below, and they indicate an upward trend even in years of COVID-19.

Figure 20: Magarina Tangarine Production (Hectors)



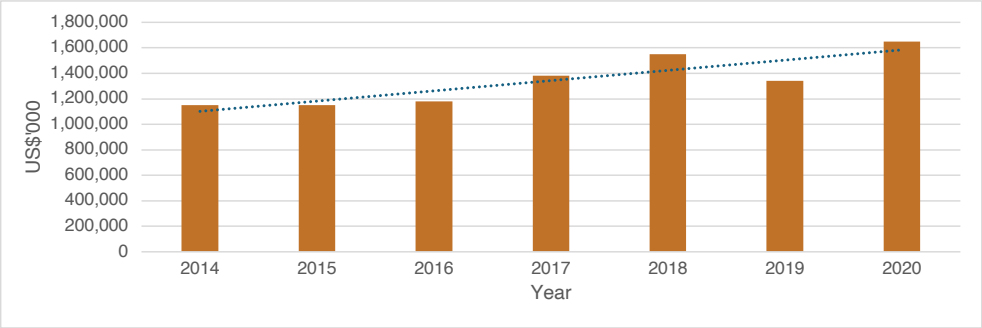
Source: CGA & Post Estimates/Forecast

Measured by the planted area, the tangerine/mandarin production has seen a steady upward increase from as low as 250,000 HA to 680,000 HA in the 2022/23 season.

12.3 . Exports performance

For some years, South Africa has been the world's second exporter of citrus. Indications are that all the major citrus varieties have been performing well in terms of exports both globally (mainly China) and within the SADC region from 2014 to 2018 before slowing down in 2019 and increasing again in 2020.

Figure 21: Citrus Exports



Source: Source: ITC Trade Map

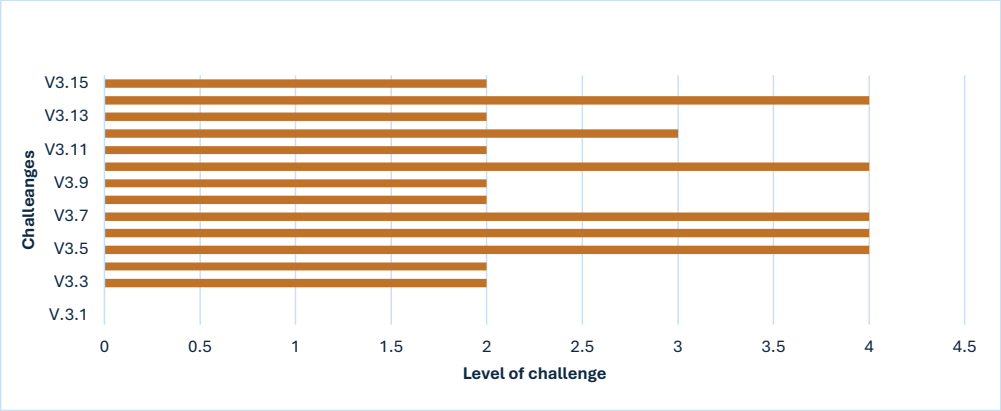
Orange exports in South Africa have averaged around 5% annually. However, exports decreased by 11.2% y-o-y from 2.6mn tonnes in 2022 to 2.3mn tonnes in 2023. The South African Citrus Growers' Association has identified the country's electricity and logistics problems as significant factors behind the decline in exports. However, there is scope to improve. The main factors affecting exports include electricity shortages, weakened macroeconomic conditions and the weakening rand. Other factors include the stringent EU export requirements against the accelerating input costs due to higher shipping and transportation expenses.

12.4 Challenges Affecting the Optimal Performance of the Citrus Industry in South Africa:

Using a scale ranging from (1) to (5), the country was asked to indicate the level of challenges the product faces to perform optimally. The scale ranged from (1) very minor challenge to (5) significant challenge. In the analysis, a score of 1 indicated minor challenges that did not warrant interventions. However, scores from 2 upwards were deemed moderate to significant challenges that warrant some actions as part of the needs assessment for the set-up of the RCoL.

The graph below presents the findings:

Figure 22: Challenges faced by the product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate change*
- *V3.15 Level of skills and other human resources within the commodity*

Key Gaps/Challenges:

Several challenges have been identified from the questionnaire and the literature review. These are grouped and presented below:

Level of skills and other human resources, including skills in terms of research and technology training and transfer

The level of skills and access to sufficient human resources, research and technological know-how remains challenging in the citrus sector. A literature review has also identified several pests and diseases affecting the citrus sector that would require skilled personnel to assist in controlling. The main challenges in citrus production that could be sorted out through skilled people include pests and diseases, insects: Brown Citrus Aphids, Citrus Thrips and others. The above challenges could be addressed by supporting the RCoL with research capacity and appropriate technology provision. There is a need to facilitate research into the latest technology, as this was also found to be a hindrance. As such, efforts must be made to enhance technology development and innovation. A good opportunity exists under ARC to address some of the identified shortfalls if supported. This is because ARC is already engaged in training covering various subjects such as agriculture engineering, crop health, disease and pest management, agro-processing, fruit production and protection, etc.

It is essential to capacitate ARC in its work to establish facilities in research, technology development and technology transfer that the Council may determine from time to time.

Availability of infrastructure.

While the supportive infrastructure for production was deemed to be not a big problem, of late, electricity load shedding and deteriorating public infrastructure have caused some challenges. Infrastructure for distribution and marketing was found to be a significant problem within the citrus value chain. Also, the availability of warehousing, including post-harvest/production logistics management, is a challenge. As a result of infrastructure challenges, several marketing-related challenges were noted as factors that hinder the potential for optimal performance. Delays at the Durban border post have also caused some logistics challenges. These include challenges such as access to export markets and the generally poor performance in terms of sales and profitability of the Citrus industry.

Financial Challenges and Public Expenditure

Access to finance was found to be one of the challenges affecting the Citrus commodity sector in South Africa. The national budgeting and public sector expenditure setup cannot allocate sufficient resources towards the optimal performance of the citrus sub-sector. It must, however, be noted that there are some opportunities for the private sector to play an essential role in funding the citrus sector. For example, the South African Citrus Growers Association (CGA) actively mobilises resources for its members. The Government is also committed to allocating some resources to the sector through grants. For example, the Zebediela Citrus Estate in Limpopo, South Africa, received a 500-million-rand (USD$34 million) grant as part of the government's post-Covid-19 economic recovery plan (SABC, 2021)

https://www.citrusresourcewarehouse.org.za/home/document-home/news-articles/fresh-fruit-

Climate-related challenges:

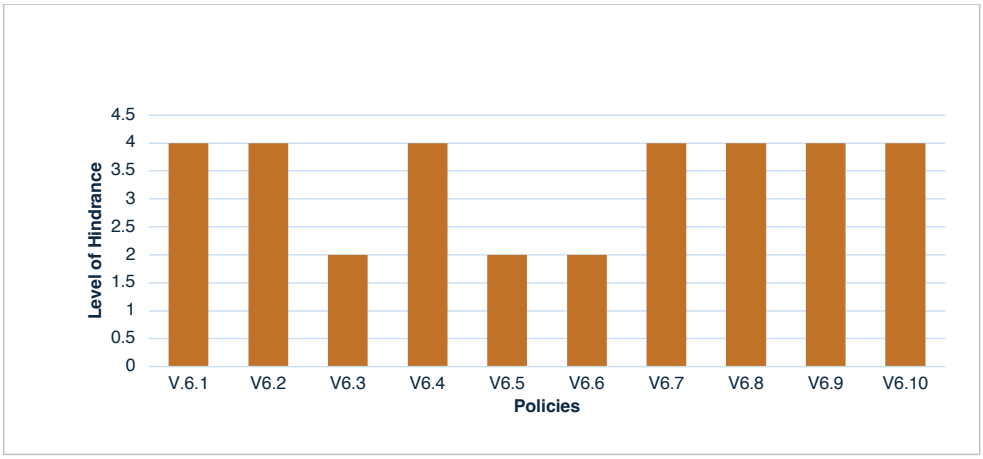
Creating resistance against climate change is one of the problems or gaps affecting the citrus industry. There has been high intensity in South Africa and other SADC countries of floods, reduced rains, and tropical cyclones. Given that about 70 per cent of the population in the SADC region depends on rain-fed agriculture for crop production, there is a need to increase investment in irrigation facilities. Further, there is a need to increase off-grid power sources, such as solar energy, to drive engine pumps. Climate change has been found to alter the distribution and intensity of pest species, the spread of diseases and the growth of weeds. The impact of climate change against high dependence on rain-fed agriculture creates some challenges, hence the need for redress through better crop practices and irrigation facilities.

12.5 Appropriateness of Policies and Institutional Setups

The country was asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or were likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5) Not Conducive at all.

The findings from South Africa are indicated below:

Figure 23: Appropriateness of Regional Policies and Institutional setups



Notes

- *V6.1 Policies towards strengthening the institutional and enabling environment for technology adoption*
- *V6.2 Policies on the importation of technology and industrial retooling/upgrading*
- *V6.3 Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders*
- *V6.4 Policies to facilitate the trading of high-breed seed varieties within the SADC MS*
- *V6.5 Policies to support agricultural research*
- *V6.6 Policies to facilitate training*
- *V6.7 Policies that ensure ease of access to finance and innovative Public Expenditure review*
- *V6.8 Policies that favour infrastructure development*
- *V6.9 Policies that reduce trade barriers*
- *V6.10 Existence of a regulatory framework that supports production and exports*

For South Africa, all the following regional policies and institutional frameworks were deemed to be able to affect significantly the performance of the RCoL at level (5):

- Policies towards strengthening the institutional and enabling environment for technology adoption
- Policies on the importation of technology and industrial retooling/upgrading
- Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
- Policies to facilitate the trading of high-breed seed varieties within the SADC Member States
- Policies to support agricultural research
- Policies to facilitate training
- Policies that ensure ease of access to finance and innovative Public Expenditure review
- Policies that favour infrastructure development

- Policies that reduce trade barriers
- Existence of a regulatory framework that supports production and exports

12.6 Recommendations

Based on the review of the priorities and the observed gaps, the following recommendations are made:

- The priority commodity for South Africa is Citrus
- According to its mandate, ARC should be considered a potential RCoL for South Africa.
- The following areas should be supported to strengthen the identified RCoL, allowing it to address some of the gaps noted and be the one-stop centre of excellence for Citrus in the SADC region.

Human resources and skills:

- There is a need to strengthen the proposed RCoL to coordinate and improve the level of skills and other human resources, including skills in research and technology transfer, to address various challenges noted in the citrus value chain, including the issue of diseases and pests affecting citrus.

Infrastructure

- Challenges were noted in the citrus sectors related to the availability of infrastructure for research, storage, demonstration, marketing and distribution. In this regard, the ARC should be supported to draft position papers to be used to lobby for infrastructure, including the challenges related to electricity shortages.

Financial Challenges and Public Expenditure

- In order to sustain all other operations, the RCoL should be capacitated to design and implement a robust resource mobilisation strategy.

Limited research in new technology and transfer

- Strengthen the capacity of ARC towards enhanced Research and Acquisition of new technologies.
- ARC to be capacitated towards facilitating knowledge generation and sharing seminars.

Profitability and export market potential

- RCoL to be capacitated to assist stakeholders by providing them with price and market trend information to enable them to compare and buy cheaply.

Climate-related challenges:

- RCoL to be capacitated to be able to promote agricultural practices that strengthen the resilience to climate change and to deal with the frequency of climate-induced challenges.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps identified gaps:

- Appropriateness of policies and institutional setups, including enhancing policies towards strengthening the institutional and enabling environment for technology adoption
- RCoL to lobby for the simplification of import and export procedures within SADC and the resolution of tariff and non-tariff barriers to trade

12.7 Implication for CCARDESA

It is also essential that the support to South Africa be accompanied by further capacity building for CCARDESA to continue facilitating joint planning, programming, and resource mobilisation, given that financial resources

were identified as a problem. CCARDESA can also facilitate harmonised joint research among SADC MS RCoLs, including facilitating the acquisition of technology, monitoring, and evaluation.

13 Needs and Gap Assessment in Tanzania

13.1 About Tanzania Agriculture Research Institute

The Tanzania Agricultural Research Institute (TARI) was established by the Parliamentary Act No. 10 of 2016 to enhance and strengthen of agricultural research system in Tanzania. TARI is a semi-autonomous body under the Ministry of Agriculture, responsible for all agricultural research activities conducted by the National Agricultural Research System (NARS) in Tanzania.

The Institute's mandate is to conduct, regulate, promote and coordinate all agricultural research activities conducted by public and private research institutes or organisations in Tanzania. TARI aims at strengthening national agricultural research system to enhance development and dissemination of technologies, innovations and management practices (TIMPs) to address the real needs of farmers and other agricultural stakeholders.

The Vision of TARI is to be the Institute of Excellence for agricultural research in the country and beyond. Its mission is to generate and promote application of knowledge, innovation and agricultural technologies as catalyst of change in achieving agricultural productivity, food and nutrition security, sustainable agriculture and economic growth involving stakeholders in the country and global community with a goal to contribute to increased agricultural productivity through development and deployment of improved agricultural knowledge and technologies by adopting innovation systems approach.

TARI has a network of 9 research Centres and 8 Sub Centres. The Centres are TARI Makutupora, TARI Ilonga, TARI Selian, TARI Ukiriguru, TARI Naliendele, TARI Mlingano, TARI Tumbi, TARI Uyole and TARI Kihinga. The Sub Centres are TARI Hombolo, TARI Dakawa, TARI Maruku, TARI Mikocheni, TARI Tengeru, TARI Kifyulilo, TARI Ifakara and TARI TARI Kibaha.

Table 19: Mandates of TARI Research Centers and Sub Centers

Center/Subcenter	Mandates
TARI Uyole (Mbeya)	Beans, Maize, Irish Potato, Pyrethrum, Agro-mechanization
TARI Kifyulilo (Mufindi, Iringa)	Beans, Irish Potato
TARI Ukiriguru (Mwanza)	Cotton, Roots, and Tubers
TARI Maruku (Kagera)	Banana
TARI Selian (Arusha)	Wheat, Barley and Maize
TARI Tengeru (Arusha)	Vegetables, Spices and Fruits
TARI Naliendele Mtwara)	Cashew, Groundnuts and Sesame
TARI Ilonga (Kilosa, Morogoro)	Maize, Grain Legumes, Sunflower, Sorghum & Millets; and Post-Harvest Management.
TARI Dakawa Mvomero, Morogoro)	Rice, Maize (Low & medium attitude); vegetables
TARI Ifakara (Morogoro)	Rice
TARI Tumbi (Tabora)	Agroforestry
TARI Mlingano (Tanga)	Soil and Sisal
TARI Kibaha (Pwani)	Sugarcane
TARI Mikocheni (Dar es Salaam)	Coconut, Biotechnology
TARI Hombolo (Dodoma)	Sorghum and millets

Center/Subcenter	Mandates
TARI Makutupora (Dodoma)	Grapes
TARI Kihinga (Kigoma)	Oil palm

13.2 Commodity Prioritisation Tanzania

For Tanzania, the following priority research and Development commodities were prioritised:

(1) Rice
(2) Wheat
(3) Maize

13.3 Overview of the Rice sector in Tanzania

Tanzania's economy is agriculturally based, contributing more than 25% to the gross domestic product. It also provides 85% of exports and employs 80% of the workforce. Tanzania grows an extensive array of crops for domestic consumption and export. These include coffee, sisal, tea, cotton, pyrethrum, cashew nuts, tobacco, cloves, corn, wheat, cassava, banana and vegetables. Livestock production includes cattle, sheep and goats. Cashew, coffee, tea, cotton, sisal, cloves and pyrethrum account for most of the export earnings.

Rice is the second most important food crop after maize in Tanzania. It is grown by 18% of farming households and is more marketed than maize. The quantity of marketed rice is approximately 42% of the total production while that of maize is 28%, thus being more commercialised than maize. Tanzania is among the top three countries in Africa and ranks 22nd in the world in terms of rice production. This indicates how important this crop has evolved to be in Tanzania. The rapidly increasing trend in rice production and consumption is partly due to the increase of population, urbanisation and rice preference.

Notwithstanding the evidence that Tanzania is one of the top producers of rice in Africa, the rice productivity is one of the lowest in the world. It ranges from 0.71 tons/ha to 3.31 tons/ha which is far below the world standard of 4.5 tons/ha. Increasing rice production/productivity and value addition in Tanzania will have paramount effects on resource poor farmers in Tanzania in terms of food security, livelihoods and source of income. Rice value addition will not only introduce new cuisine with rich taste but also spurs small- and large-scale industries such as wine, vinegar, flour blending, furniture, and animal feedstuff making. This will enable farmers to have alternative sources of income as well as empowerment and poverty eradication.

In Tanzania, rice is cultivated under three major ecosystems namely rain-fed lowland, upland rice and irrigated ecosystems. The large-scale rice farmer's account for small proportion (less than 10%), while the majority of rice farmers in Tanzania are small scale farmers (about 90%). Most large-scale rice producers use irrigation because of their economies of scale and large investment. Hence, it is estimated that only 5% of rice is produced under irrigation system. Most of small-scale farmers can't afford irrigation system investment therefore it is estimated that 85% of rice is produced under rainfed lowland and around 10% produced under upland ecosystem.

Upland Rice Ecosystem - Upland rice is cultivated under a monocropping system and sometimes under a mixed cropping system with other food crops. The Upland rice ecosystem represents 20% of rice growing in Tanzania. Usually, it uses little inputs such as machines, inorganic fertilizers and pesticides. Soils are relatively poor, and water is inadequate. The productivity in this ecosystem is low and it ranges from 0.8 to 1.2 t/ha.

Lowland Rainfed Rice Ecosystem - Farmers rely on rainfall for water needed to grow the rice. Water is not reliable and problems of flooding and drought or rainfall are persistent since rainfall is unpredictable. The

rainfed rice ecosystem represents 71% of rice growing ecosystem in Tanzania. Soils are relatively fertile compared to upland soils. It is characterized by the use of hand hoe or ox plough, little use of tractor, transplantation by hand, farmers generally apply little fertilizers, farmers usually use farm saved seeds and minimal use of other inputs. The productivity in this ecosystem is low and it ranges from 1.4 to 2.1 t/ha and there is only one season for rice cultivation per year.

Irrigated Rice Ecosystem - Irrigated ecosystem is the system or rice cultivation whereby the rice fields have assured water supply throughout the growing season. In Tanzania only few farmers (around 9%) use this rice ecosystem. It is characterized by use of modern mechanization technology such as tractors, rice planters, agrochemicals and good agricultural practices. Rice productivity ranges from 3.2 to 4.5 t/ha with great scope for further yield improvement through improved crop management and further intensification. In this system some farmers in Tanzania they have 2 - 3 season for rice cultivation per year.

13.4 Latest Production and export figures:

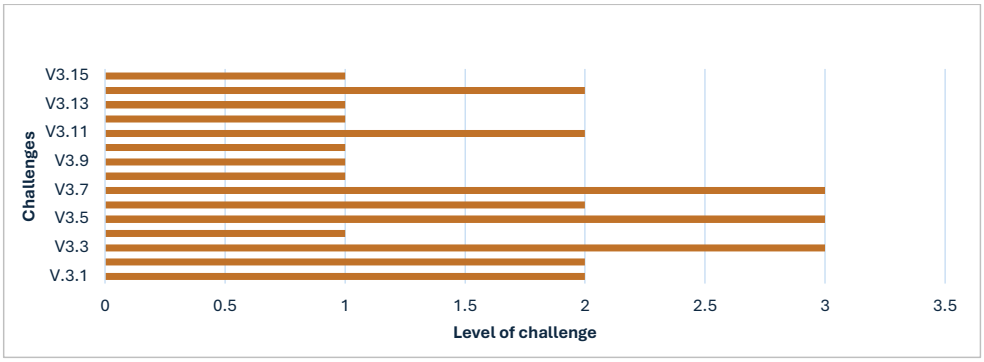
Tanzania produced 3,474,766 and 4,528,000 tons of rice in 2019 and 2020 respectively. However, at 2,688,000 tons there was a significant decline in production in 2021. In 2022, Tanzania exported $189M in Rice, making it the 19th largest exporter of Rice in the world. At the same year, Rice was the 10th most exported product in Tanzania. The main destination of Rice exports from Tanzania are Uganda ($108M), Rwanda ($41.6M), Kenya ($28.5M), Burundi ($8.68M), and Democratic Republic of the Congo ($1.48M).

13.5 Challenges Affecting the Optimal Performance of Rice,

In terms of challenges affecting performance, officials were asked to indicate the challenges being faced by priority product 1 to perform optimally using a scale from (1) to (5) with (1) indicating very minor challenges and (5) indicating significant challenges.

The graph below presents the findings:

Figure 24: Challenges faced by the Product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*

- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- V3.14 Resistance against climate change
- V3.15 Level of skills and other human resources within the commodity

Based on the graph above that used the questionnaire data and literature review, the main challenges are grouped and presented below, inclusive of their features.

Table 20: Challenges and key features

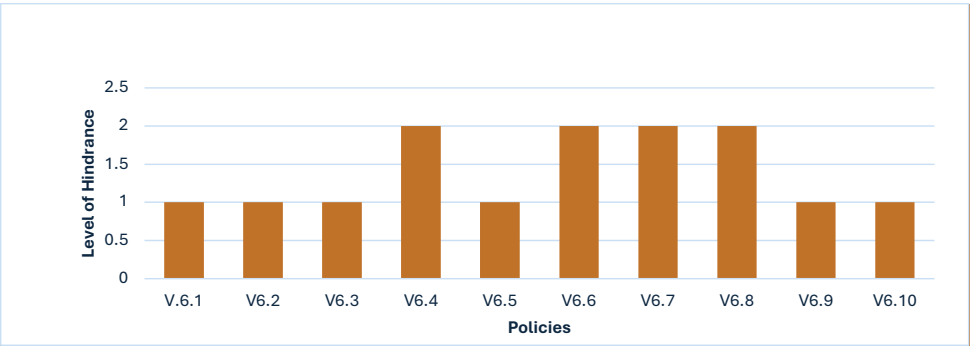
Gap/Challenge	Key features as per literature
Human resources and skills	• Shortage of trained personal • Inefficient extension and training services
Availability of infrastructure (production, distribution, and marketing)	• Poor infrastructure related to transport, storage, laboratories for research
Financial Challenges and Public Expenditure	• Rice price fluctuations make farmers vulnerable to investment losses. • Inadequate investment policies
Limited research in modern technology and transfer	• Challenge of technologies to deal with pests and diseases. • little use of improved variety and low adoption of good agricultural practices. • Expensive machinery and irrigation systems • Government and Agricultural stakeholders' intervention to improve research. • Agriculture extension services using ICT
Profitability and Export Market potential	• Seasonal price fluctuations in price of rice affect profitability
Availability of inputs for production	• Poor Soil • Little water • Poor seed quality • Irrigation equipment too expensive for the majority
Climate related challenges:	• Rice is among crops likely to be affected severely due to its photoperiod sensitivity and susceptibility to altered environmental effects such as salinity, drought and new pest and diseases.

11.4. Gaps Related Challenges to Appropriateness of Policies and Institutional Setups

Officials were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5)- Not Conducive.

The findings are indicated by the graph below

Figure 25: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

The challenging policies and their features are summarised below:

Table 21: Policy related gaps and features

Policy	Key features
Technology; training and industrial retooling/upgrading:	• Research on drought-resistant seed. • Pests and diseases management • Need for research to counter diseases
Collaboration in researchers, private sector, civil society, farmers, and other stakeholders	• Poor networking and information among stakeholders in the rice sector
Access to finance and innovative Public Expenditure review	• Lack of regular funding from the national government • Budgetary constraints and weak public service management systems • Poor resource mobilisation frameworks
Infrastructure development	• Limited transport services and the prohibitive cost of transportation have adverse effects on returns to investments
Reduction of trade barriers	• Import and Export restriction
Regulatory framework that supports production and exports	• Limited access to productive land

11.6 Recommendations

Based on the analysis, the following recommendations are made:

- The priority research commodity for Tanzania is rice and the Tanzania Agricultural Research Institute (TARI) is proposed to be supported to be the RCoL for Tanzania.
- The following areas should be supported to strengthen the identified RCoL, which will address some of the gaps noted and be the one-stop centre of excellence on rice issues in the SADC region.

Regarding human resources and skills, the proposed RCoL in Tanzania should facilitate working with a number of stakeholders training programmes including the use of vocational and technical colleges to improve the pool of workers that are knowledgeable with rice production.

Regarding Infrastructure, the identified RCoL should be supported to improve on alternative water infrastructure source such boreholes instead of maintaining a high dependence on rainfall water which is erratic due to climate change.

On Financial Challenges and Public Expenditure, the identified RCoL should work with various stakeholders to mobilise innovative resources to finance rice production in Tanzania.

On limited research in new technology and transfer, there is a need for the identified RCoL to facilitate research on new varieties and more rice value addition that should be adopted. There is a need to do research towards coming up with improved variety of seeds and adoption of good agricultural practices

Regarding profitability and export market potential, there is a need to support the RCoL in the area to facilitate value addition and storage of rice in order to address income losses due to seasonal price fluctuations that cause revenue losses during certain seasons. Storage and value addition have been known to address this challenge.

On availability of inputs for production, the identified RCoL should be supported to facilitate research in order to explore the production of better seeds and other inputs such as fertilizers that help to enhance rice yield.

Regarding Climate-related challenges, the proposed RCoL should be capacitated to promote agricultural practices that strengthen resilience to climate change. This is in order to sustain rice farming systems farmers resilient against climate change, global warming and globalization effects climate smart technologies.

On **policy and institutional framework,** the RCoL should be supported to cover the following gaps:

- Formulation of policies that address weak Technology and training programmes to support rice industrial retooling.
- Identified RCoL need to lobby for policy framework that put incentives for Research on various factors that promote proper functioning of the rice value chain covering a number of areas such as highbred seeds, Pests and diseases management system, policies that improves access to productive finances and those that ensure existence of sufficient public goods including infrastructure.

11.7 Implication for CCARDESA

Like in other countries, It is also essential that support to Tanzania be accompanied by further capacity building for CCARDESA to continue playing its role in facilitating joint planning, programming, and resource mobilisation, given that financial resources were identified as a problem.

14 Needs and Gap Assessment in Zimbabwe

14.1 About the Agriculture Research Department under the Ministry of Lands Agriculture and Fisheries

The Agriculture Research Department's mandate is to provide research-based technologies, technical information for advisory services, and products to support enhanced agricultural productivity and the production of various crops and livestock (except tobacco, tea, sugarcane, pigs, and forestry). The technologies, knowledge and information are designed to:

i. Facilitate improved or increased productivity per unit area or resource quantum;
ii. Protect Zimbabwe's agriculture through the provision of a dependable, effective, efficient and competitive regulatory service that prevents the introduction of pests and diseases and ensures the availability of quality agricultural inputs and products;
iii. Deliver specialist services that promote sustainable agricultural and economic growth;
iv. Remove drudgery for farmers, speed up activities and save on time, physical and financial resources;
v. Develop value-addition technologies to increase farmers' capacity to generate additional income; and
vi. Facilitate the development of agriculture by commercialising research-based technologies.

The Crop Research Division is one of the divisions of the department that has the mandate "To provide research-based information, technology and products for supporting enhanced productivity and production of various crops, including horticulture, cereals, oilseeds, legumes, roots/tubers, coffee and cotton (except for tobacco, tea, sugarcane and forestry)". The division is responsible for the following:

- Developing new crop varieties that are adaptable to Zimbabwe's five agro-ecological zones
- Providing breeders' seed to seed houses to support Foundation seed production and, subsequently, certified seed for the market
- Carrying out research for developing appropriate field and horticultural crop production technologies for use by farmers
- Packaging and disseminating research-based crop management technologies,
- knowledge and information aimed at increasing agricultural productivity in an environmentally sustainable manner
- Collecting, characterising and conserving plant and crop genetic resources for input into future crop variety development and propagation and distribution to growers as disease-free clean material
- Developing and sharing technologies on crop produce handling, processing and value-addition technologies

14.2 Commodity Prioritisation in Zimbabwe

For Zimbabwe, the following priority commodities were proposed:

(1) Horticulture
(2) Beef
(3) Fruits

14.3 Overview of the Horticulture sector in Zimbabwe:

The prioritisation of horticulture by Zimbabwe takes into account the fact that the sector is fast-growing and is a significant sub-sector of the agriculture industry that is dominated mainly by vegetables and fruits. It makes crucial contributions to nutrition, income and economic growth. The sub-sector has the potential to become

one of the primary sources of foreign exchange earnings and a significant driver of economic growth in Zimbabwe. It is a specialised form of farming that does well in wet climates, with good soils and relatively low temperatures. Horticulture is mainly grown in Zimbabwe's Natural Regions I, II and III, which receive sufficient rain. However, due to the availability of boreholes and solar power facilities, it is now being grown in other drier regions. The most common vegetables grown in Zimbabwe include tomatoes, cabbage, rape, onion, beans, butternuts, cucumbers, okra, and carrot among others. Other horticultural crops, such as potatoes and watermelons are also emerging to take some significant shares.

14.4 Latest Production and export performance:

Zimbabwe's horticulture output is expected to grow steadily in the coming years. Following an expansion in cultivated land during the 2023–2024 summer cropping season, it is expected to surpass its peak annual earnings of US$140 million recorded in 1999. Statistics observed in 2023 by the Minister of Lands, Agriculture, Fisheries, Water, and Rural Development, Anxious Masuka, show a notable increase in the area planted with various horticultural crops.

On average, USD18 million horticulture products are exported annually in Zimbabwe, covering vegetables and fruits. The main export destinations include South Africa, Zambia, Mozambique, the Netherlands and the United Kingdom, with South Africa at the top for fruit and vegetables. The EU, Netherlands and the United Kingdom are important markets for Zimbabwe's vegetables. In the SADC region, other export markets include Zambia, Malawi, Botswana and Angola.

14.5 Main Stakeholders

The main horticulture stakeholders in Zimbabwe horticulture include the following:

Government: Plays a vital role in creating a conducive policy environment for the horticulture value chain to thrive. The government also creates an economic environment and facilitates education and training. The Government is represented by the Ministry of Lands, Agriculture and Fisheries, that is assisted by various departments that deal with the following:

- Veterinary Field Services and Tsetse Control
- Veterinary Technical Services
- Agricultural Economics and Marketing
- Agricultural Engineering and Technical Services
- Agricultural Research and Extension (AREX)
- Agricultural Education
- Finance and Administration
- Human Resources

Other stakeholders include:

- Farmers' Associations
- Wholesalers and traders
- Processors and distributors
- Domestic formal markets
- Service providers

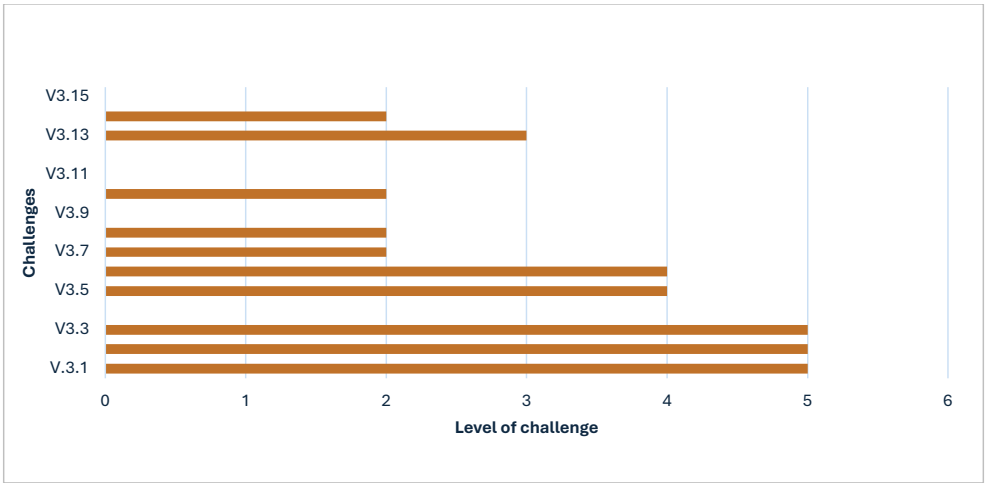
- logistics sector
- Domestic informal markets
- Export markets
- Technical and agricultural education Institutes

14.6 Challenges Affecting the Optimal Performance of Horticulture Industry in Zimbabwe

Using a scale ranging from (1) to (5) officials were asked to indicate the level of challenges the product faces to perform optimally. The scale ranged from (1) Very minor Challenge and (5) Significant Challenge.

The graph below presents the findings:

Figure 26: Challenges faced by the product to perform optimally



Notes

- *V3.1 Availability of inputs for production*
- *V3.2 Supportive infrastructure for production*
- *V3.3 Availability of warehousing, including management of post-harvest/production logistics*
- *V3.4 Export market potential*
- *V3.5 Access to finance*
- *V3.6 Availability of infrastructure for distribution*
- *V3.7 Availability of marketing infrastructure*
- *V3.8 Ease of exporting across the SADC region*
- *V3.9 Potential for growth in sales or profitability*
- *V3.10 Governance of the commodity*
- *V3.11 Attractiveness of the commodity in terms of the External environmental*
- *V3.12 Level of government support for the commodity*
- *V3.13 Availability of opportunities for research and technology transfer*
- *V3.14 Resistance against climate change*
- *V3.15 Level of skills and other human resources within the commodity*

The questionnaire and the literature review identified several challenges that hinder the optimal performance of the NARES system in Zimbabwe in terms of horticulture.

These are grouped and presented below, inclusive of their features.

Table 22: Key gaps and features

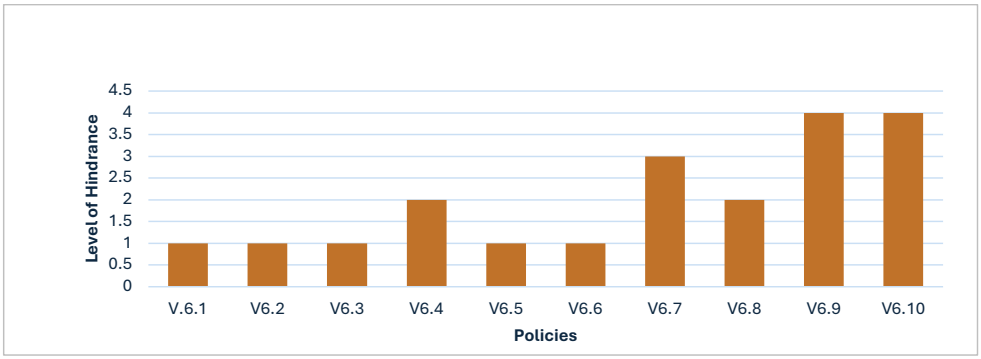
Gap/Challenges	Key features as per literature
Human resources and skills	• The literacy level in Zimbabwe is generally high. However, due to limited training materials and laboratories, more practical and hands-on skills are needed • High staff turnover • Limited capacity for exchange visits and exchange visits
Availability of infrastructure	• Electricity challenges • Limited access to water has a significant impact on the Horticulture industry throughout the value chain • Farm infrastructure such as boreholes, irrigation facilities • Water storage and harvesting warehousing • Irrigation infrastructure • Pack sheds • Cold transport
Financial Challenges and Public Expenditure	• Limited access to production and marketing credit facilities • Foreign Currency challenges for importation of capital goods
Limited research in new technology and transfer	• Use of outdated agricultural techniques • Limited technology/ automation for tracking and monitoring cattle movements and improving operations.
Profitability and export market potential	• Post-harvest losses and unpredictable prices of horticulture commodities compromise profitability
Availability of inputs for production	• The cost of production is high due to expensive inputs (seeds, water, fuel, electricity, transport, storage, etc.)
Climate-related challenges:	• Climate change-induced recurring droughts and erratic rainfall cause significant threats to crops • Tropical cyclone Idai, which occurred in March 2019, is an example.

14.7 Gaps and related challenges to the appropriateness of Policies and Institutional Setups

Officials were also asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or were likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of the chosen Regional Centre of Leadership (RCoL). The following scale was used: (1) Very Conducive to (5) Not Conducive.

The findings are indicated in the graph below:

Figure 27: Appropriateness of Regional Policies and Institutional setups



Notes: Existence of enabling Environment/policies that deal with

- *V6.1 Technology adoption*
- *V6.2 Technology and industrial retooling/upgrading*
- *V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders*
- *V6.4 Trading of high-breed seed varieties within the SADC MS*
- *V6.5 Agricultural research*
- *V6.6 Facilitation of training*
- *V6.7 Ease access to finance and innovative Public Expenditure review*
- *V6.8 Infrastructure development*
- *V6.9 Reduction of trade barriers*
- *V6.10 Regulatory framework that supports production and exports*

The challenging policies and their features are summarised below:

Table 23: Main challenges and features

Policy	Key features
Technology; training and industrial retooling/upgrading:	• Limited Technology for processing and value addition. • Few qualified field training marshals
Collaboration among researchers, the private sector, civil society, farmers and other stakeholders	• Limited stakeholder consultation at various phases of the horticulture value chain
Access to finance and innovative Public Expenditure review	• Limited finance to address the needs in the horticulture sector (training, infrastructure, research, etc.) • Limited access to Export credit facilities and Insurance for goods in transit
Infrastructure development	• Shortage of Cold Chain management infrastructure
Reduction of trade barriers	• Complex import and export procedures • Tariff and non-tariff barriers • Low enforcement of regional and international quality standards regulations
Regulatory framework that supports production and exports	• Limited sharing of information on export requirements • Limited knowledge of ISO certification & Global GAP and phytosanitary requirements

14.8 Recommendations

Based on the review of the priorities and the observed gaps, the following recommendations are made:

- It is recommended that the priority research commodity for Zimbabwe be the horticulture, with an emphasis on vegetables and that the Agriculture Research Department under the Ministry of Lands Agriculture and Fisheries be the RCol for Zimbabwe, considering its mandate and ongoing activities.

- The following areas should be supported as a way of strengthening the identified RCoL, allowing it to address some of the gaps noted and be able to be the one-stop centre of Excellence on Horticulture issues in the SADC region.

In terms of human resources and skills, it is recommended the proposed RCoL be supported to be able to coordinate and strengthen practical training and extension services in horticulture production and marketing skills. This should involve putting in place incentives to retain qualified staff within the research stations dealing with horticulture. There is also the need to concentrate on imparting practical skills to students and trainees in tertiary and vacation learning and research institutions.

In terms of Infrastructure, the identified RCoL should be supported in drafting position papers to lobby for sufficient technical and financial support to improve infrastructure provision, such as electricity, water supply, and Farm feeder roads, in the horticulture sector. Other areas to be improved relate to farm infrastructure, such as boreholes, irrigation facilities, Water storage, warehousing, Pack sheds, cold rooms and refrigerated transport.

With regards to Financial Challenges and Public Expenditure, the proposed RCol should be capacitated to be able to lobby for increased budgetary resources to support the horticulture sector, including incentives for the private banking sector and development banks to finance it. Other areas include advocating for the prioritising of the horticulture sector in the allocation of foreign currency to import capital goods. This support should also include the supporting with drafting and implementing a robust resource mobilisation strategy.

With regards to limited research in new technology and transfer, there is a need to Strengthen capacity towards enhanced Research and Acquisition of new technologies, facilitate know generation and sharing and the enhancement of engagement with stakeholders through developing collaborative research projects.

On Profitability and export market potential, the proposed RCoL should be supported to assist stakeholders by providing them with price and market trend information to enable them to compare and buy cheaply. There is also a need to work with the Standards Association of Zimbabwe to strengthen its capacity to offer support for implementing SADC and international standards such as GLOBALG.A.P to enhance the acceptability of horticulture products.

On the availability of inputs for production, the proposed RCoL should be strengthened to assist farmers with information on various input suppliers and also to facilitate bulky purchases. The RCoL should be capacitated also to play a critical role in advocating and facilitating the improvement of an enabling environment for the chain actors to access production infrastructure (e.g. electricity supply, financial resources, fuel, etc.) for them to be available and affordable in comparison with other SADC countries to hence regional competitiveness.

In terms of Climate-related challenges, the proposed RCoL should be capacitated to be able to promote agricultural practices that strengthen the resilience to climate change and variability to ensure food and livelihood.

On **policy and institutional framework,** the RCoL should be supported to address the gaps identified through

- Facilitation of regulatory frameworks that give incentives towards the importation of technology and value addition equipment

- Advocating for the accreditation of qualified agricultural certified agents

- Lobbying for the simplification of import and export procedures within SADC and the resolution of tariff and non-tariff barriers to trade

14.9 Implication for CCARDESA

The above gaps require CCARDESA to be able to continue playing its role towards the facilitation of joint planning, programming, resource mobilisation, monitoring and evaluation.

15 Annexes

Annexes - Part 1

Gap Assessment of the Malawi RCoL

15.1 Annex 1: List of Documents Consulted

APPSA Project Appraisal Document

APPSA Progress Reports

APPSA End-of-Project Evaluation Report

National Agricultural Policy

National Agricultural Research Policy

National Agricultural Investment Plan

Transcripts of interviews and meetings conducted during the needs assessment

15.2 Annex 2: List of Entities and Stakeholders Consulted

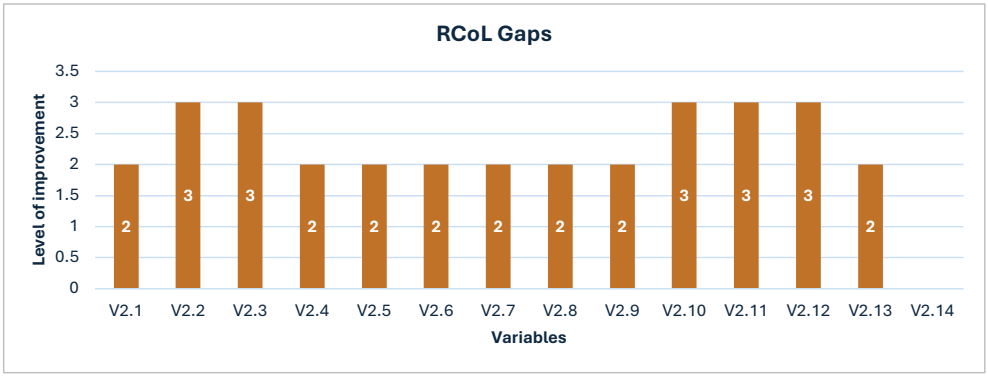
Mr. David Kamangira	Snr. Deputy Director DARS)
Mrs Susan …..	Deputy Director
Mr Hector Malaidza	Principal Agricultural Research Scientist
Mr. Aubrey Chimaliro:	Economist, Ministry of Agriculture, Department of Agricultural Research Services
Mr Samson Kazombo	Ministry of Agriculture, Dept. of Agric. Research Services (DARS), Chitedze Agricultural Research Station,
Dr. Lawrent Pungulani	Chitedze Station Manager
Dr. Kaonga	Cereals National Research Coordinator
Dr. Pankomela	National Research Coordinator
Mr. Elias Jeke	Rice Breeder (Lifuwu Research Station
Mr. Imani Mukowi:	Station Manager (Lifuwu- Research Station
Mr Thokozani Banda	Rice Researcher Lifuwu Research Station
Group of Small-Scale Farmers	Lifuwu Research Station

15.3 Annex 3: Transcript of the RCoL Data Collection Questionnaire

1 Assessment of indicative remaining Gaps:

As [art of gap assessment, countries were asked to indicate the extent to which the following factors did improve since the time support was given to establish the RCoL in their countries. The responses ranged from low value (1) indicating **insignificant improvement** and high value (5) indicating **very significant improvement**.

For Malawi, the indicative assessment is shown below:



Notes:

V2.1	Opportunities for strengthening value addition
V2.2	Opportunities for promoting exports
V2.3	Access to agricultural technologies to support production activities
V2.4	Level of training & dissemination of agricultural technologies status
V2.5	Management styles used in dealing with the product
V2.6	Institutional arrangements supporting the commodity
V2.7	Human Resources, leadership, and Governance supporting the product
V2.8	Level of capacity in terms of research, knowledge, and technology generation
V2.9	Infrastructure for conducting research and production (Lab, transport, equipment etc),
V2.10	Infrastructure for marketing and distribution
V2.11	Collaboration among stakeholders to share knowledge.
V2.12	Investment in agricultural research.
V2.13	Ability to deal with climate change and other natural disasters

Indicating some gaps, insignificant to moderate improvements were observed for the following variables:

- Opportunities for strengthening value addition
- Level of training & dissemination of agricultural technologies status
- Management styles used in dealing with the product
- Institutional arrangements supporting the commodity
- Human Resources, leadership, and Governance supporting the product
- Level of capacity in terms of research, knowledge, and technology generation
- Infrastructure for conducting research and production (Lab, transport, equipment etc).

2 Areas of improvements

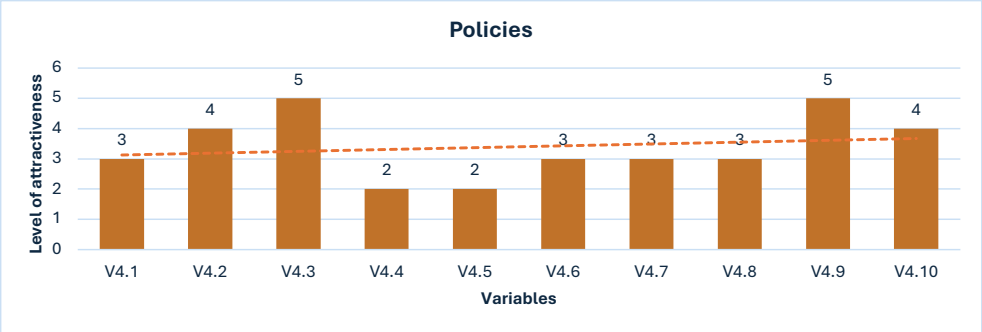
Countries were requested through focal points to briefly recommend areas that they required to be addressed specifically to improve the situation related to the performance of RCoL. For Malawi the following areas of improvements were recommended:

Variable that needs strengthening	Proposed intervention
Opportunity for value addition	Strengthen development of mechanised innovations that add value.
Opportunity to promote Exports	Ease up prohibitive processes placed by the Government of export marketing
Access to agricultural technologies to support production activities	Increase funding and capacity building on technology transfer.
Improved Level of training & dissemination of agricultural technologies status	Capacity building and support to the technology transfer unit
Improved Management styles used in dealing with the product	Packaging and distribution
Improved Institutional arrangements supporting the commodity	Blanc
Improved Human Resources, leadership, and Governance supporting the product	Blanc
Improved Level of capacity in terms of research, knowledge, and technology generation	Blanc
Improved infrastructure for conducting research and production (Lab, transport, equipment etc),	Provision of materials such as equipment and reagents
Improved infrastructure for marketing and distribution	There is a need to establish a farm shop
Improved collaboration among stakeholders to share knowledge.	The government policy on disbursement of per diems using employment numbers of limits collaboration
Improved investment in agricultural research.	Funding from the Government and contribution from stakeholders of dissemination activities has improved.
Improved ability to deal with climate change and other natural disasters	Blanc

3 Assessment of the level of supportive policies:

Countries were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of their Agricultural Productivity and the well-functioning of the Regional Centre of Leadership (RCoL). Responses from lower codes (1) indicating “Not Conducive at all” to higher codes (5) indicating “Very Conducive”.

For Malawi the following Outcomes were observed



Notes:

V4.1	Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption
V4.2	Policies on Importation of Technology and industrial retooling/upgrading
V4.3	Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
V4.4	Policies to facilitate the trading of high breed seed varieties within the SADC Member States
V4.5	Policies to support to agricultural research
V4.6	Policies to facilitate training
V4.7	Policies that ensure ease access to finance and innovative Public Expenditure review
V4.8	Policies that favor infrastructure development
V4.9	Policies that reduce trade barriers
V4.10	Existence of regulatory framework that support production and exports

For Malawi the following policies were found to be less conducive and hence warranting some attention:

- Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption
- Policies to facilitate the trading of high breed seed varieties within the SADC Member States
- Policies to support to agricultural research
- Policies to facilitate training
- Policies that ensure ease access to finance and innovative Public Expenditure review
- Policies that favour infrastructure development

15.4 Annex 4: List of Documents Consulted

- National Rice Development Program (NRDP-2016 - 2027)
- National Rice Program (PNA) 2030
- Agricultural Policy Instruments and Agricultural Production in Mozambique (Rabia Aiuba, 2023, OMR 139)
- Strategic Plan for the Development of the Agrarian Sector 2022-2031 (PEDSA II)
- National Investment Plan for the Agrarian Sector 2022-2026 (PNISA II)
- IIAM Strategic Plan (2011-2015)
- IIAM EVALUATES PERFORMANCE AND REFINES STRUCTURING STRATEGIES! Visited on June 08, 2024
- APPSA Project Appraisal Document
- APPSA Progress Reports
- APPSA End-of-Project Evaluation Report

15.5 Annex 5: List of Entities and Stakeholders Consulted

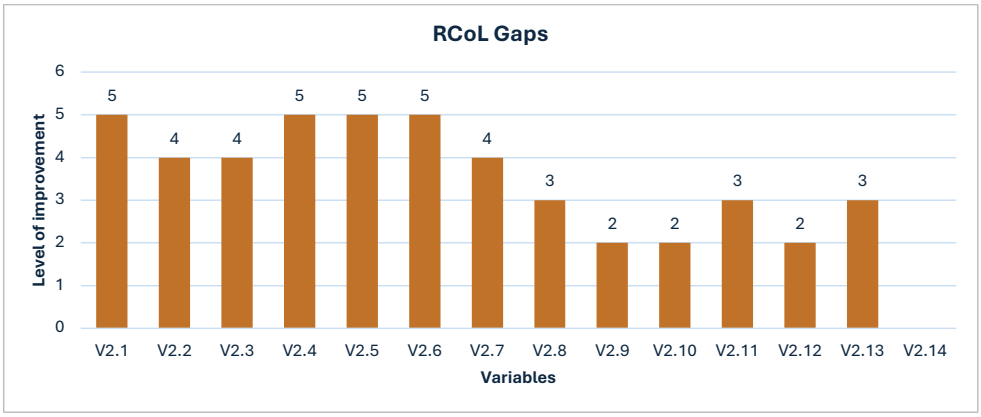
Zélia Menete,	Director of IIAM,
Carlos Quembo,	Coordinator of the Central Regional Center of IIAM,
Constatino Tomás Senete	Director of Agronomy and Natural Resources
Júlio Guilherme Manjate	Director of Planning, Administration and Finance
Herminio Habade	Manager of the RCoL
Leonardo Moiane	Biotechnology Laboratory and Head of the Research Department
Leonardo Niquice	Mechanization
Malissa Doliz Nhandhema	Department of Documentation, Training and Technology Transfer (socio-economist)
Vania Malimue	Administration and Finance
Dr Nilsa Munguambe	Plant Breeder
José Popisky	Plant Breeder
Carlos Filimone	CCARDESA Focal Point
Américo Humulane	CCARDESA Focal Point
Tomás Sitói	Monitoring and Evaluation IIAM
Gildo Fonseca	Seed Producer in partnership with the Beneficiary Training Center
Lionel Converso	Seed producer and training beneficiary
Ismael Mariano da Silva	Seed beneficiary producer, shares trial fields
Jabula Arlindo Zibia	Ditrector dos Serviços Proviciais de Actividades Económicas da Zambézia
Lucas José Jackson	Director dos Serviços Provinciais de Economia e Finanças da Zambézia

15.6 Annex 6: Transcript of the RCoL Data Collection Questionnaire

1 Assessment of indicative remaining Gaps:

As part of gap assessment, countries were asked to indicate the extent to which the following factors did improve since the time support was given to establish the RCoL in their countries. The responses ranged from low value (1) indicating **insignificant improvement** and high value (5) indicating **very significant improvement**.

For Mozambique, the indicative assessment is shown below:



Notes:

V2.1	Opportunities for strengthening value addition
V2.2	Opportunities for promoting exports
V2.3	Access to agricultural technologies to support production activities
V2.4	Level of training & dissemination of agricultural technologies status
V2.5	Management styles used in dealing with the product
V2.6	Institutional arrangements supporting the commodity
V2.7	Human Resources, leadership, and Governance supporting the product
V2.8	Level of capacity in terms of research, knowledge, and technology generation
V2.9	Infrastructure for conducting research and production (Lab, transport, equipment etc),
V2.10	Infrastructure for marketing and distribution
V2.11	Collaboration among stakeholders to share knowledge.
V2.12	Investment in agricultural research.
V2.13	Ability to deal with climate change and other natural disasters

Indicating some gaps, insignificant to moderate improvements were observed for the following variables:

- Human Resources, leadership, and Governance supporting the product.
- Level of capacity in terms of research, knowledge, and technology generation.
- Infrastructure for conducting research and production (Lab, transport, equipment etc).
- Infrastructure for marketing and distribution.
- Collaboration among stakeholders to share knowledge.
- Investment in agricultural research.
- Ability to deal with climate change and other natural disasters.

2 Areas of improvements

Countries were requested through focal points to briefly recommend areas that they required to be addressed specifically to improve the situation related to the performance of RCoL.

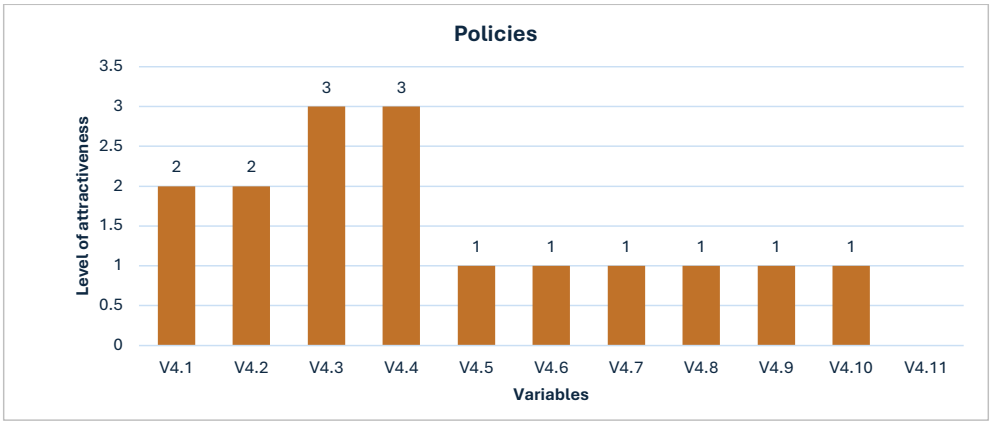
For Mozambique, the following areas of improvements were recommended:

Variable that needs strengthening	Proposed intervention
Strengthen value addition	1- Problem of understanding the actors in the chain 2- Lack of image construction relating to RCoL 3- Poor problem solving 4- Poor identification of partners! 5- Poor use of the Feedback received
Promote exports	1- Excess of production surpluses for exports 2- Unattractive prices 3 Poor industrialization 4- Low production, low quality products for competitiveness in the market
Access to agricultural technologies to support productive activities	1- Restricted access to technologies, lack of massive dissemination of them. 2- Quantity and quality of extension services 3- Weak investment in the promotion of agricultural technologies
Improve the level of training and dissemination of the status of agricultural technologies	1- Fraco investment and 2- Quality and quantity of extension services 3- Non-comprehensive policies for participating in trainings
Improved management styles used to handle the product	1- Poor training 2- Poor institutional development
Improved Institutional Arrangements That Support the Commodity	Poor processing and sealing of products
Improved human resources, leadership, and governance supporting the product	1- Poor conception of policies that meet reality and benefit the national product. Laws that marginalise the sector
Improve the level of capacity in terms of research, knowledge and technology generation	1- Weak institutional development in terms of training in the short, medium and long term 2- Infrastructure improvement (irrigated area, equipment assembly, training in the use of equipment
Improved infrastructure for conducting research and production (laboratory, transportation, equipment, etc.),	1- Lack of transportation, inappropriate equipment, unequipped laboratories, irrigation systems.
Improved infrastructure for marketing and distribution	1- No advertising boards or funds to hire companies for advertising services
Improve collaboration among stakeholders to share knowledge.	1- Little collaboration with similar institutions at the CGIAR or National level
Improving investment in agricultural research.	1-Lack of perception that Agricultural Research is the key to boosting the National and Regional economy. There is no country where there is peace while its people are starving.
Improving capacity to cope with climate change and other natural disasters	1- Weak development of technological packages that minimize/mitigate the effects of climate change

3 Assessment of the level of supportive policies:

Countries were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of their Agricultural Productivity and the well-functioning of the Regional Centre of Leadership (RCoL). Responses from lower codes (1) indicating “Not Conducive at all” to higher codes (5) indicating “Very Conducive”.

For Mozambique, the following outcomes were observed



Notes:

V4.1	Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption
V4.2	Policies on Importation of Technology and industrial retooling/upgrading
V4.3	Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
V4.4	Policies to facilitate the trading of high breed seed varieties within the SADC Member States
V4.5	Policies to support to agricultural research
V4.6	Policies to facilitate training
V4.7	Policies that ensure ease access to finance and innovative Public Expenditure review
V4.8	Policies that favor infrastructure development
V4.9	Policies that reduce trade barriers
V4.10	Existence of regulatory framework that support production and exports

For Mozambique, the following policies were found to be less conducive and hence warranting some attention:

- Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption.
- Policies on Importation of Technology and industrial retooling/upgrading.
- Policies to support to agricultural research.
- Policies to facilitate training .
- Policies that ensure ease access to finance and innovative Public Expenditure review.
- Policies that favor infrastructure development.
- Policies that reduce trade barriers.
- Existence of regulatory framework that support production and exports.

4 Risk and Recommendations

Countries were asked to indicate some of the risks they faced and how they did overcome them as they strengthened their RCoL including recommendations to overcome them?

For Mozambique the following were observed:

RISK	REMEDIAL ACTION/RECOMMENDATION
Lack of Organic	Establishment of an organic structure in order to make various processes more flexible and better internal organization
Poor provision of basic services (electricity, water and sanitation)	Financing, use of the prepaid system (credilec), for better control of consumption
Lack of manpower	Maximization of production areas
Lack of transportation for employees and maintenance of farm equipment	The displacement of employees in order to meet the goals established for each activity Maintain the equipment
Lack of an irrigation system for testing and seed multiplication. Lack of assembly of purchased equipment and training of personnel	Establish 20 ha irrigation system for rice crop and another 15-ha system for the different crops Assemble equipment, train laboratory personnel in biotechnology, plant health, soils and other laboratories

15.7 Annex 7: CLiPA Specific Needs List

REPUBLIC OF MOZAMBIQUE

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

MOZAMBIQUE AGRICULTURAL RESEARCH INSTITUTE

ZONAL CENTER CENTER

CENTRO DE LIDERANÇA E PESQUISA DE ARROZ

CLiPA NEEDS FOR ITS OPERATIONALIZATION

0. General

Needs to give CLiPA visibility and make it operational

i. Acquisition of 3 Flags (a Flag of the Republic of Mozambique, One with the IIAM Logo and the Other with the CCARDESA OR SADC Logo;
ii. Sign indicating/Sects of areas/functional blocks;
iii. Headstone with designations of the Institution
iv. On the road identification of the center, both for those going to the town of Namacurra and for those going to the city of Quelimane (two languages: Portuguese and English);
v. Redevelopment of the car park (porch, markings on paving);
vi. Requalification of the main gate;
vii. Blackout curtains on windows and internet;
viii. Installation of the Renewable Energy System (Solar or Wind Panel System)
ix. Acquisition of 5 banners for the outdoor area;
x. Acquisition of 5 Roll Ups for the interior of each block in order to enable access to the block, whether administrative or technical blocks;
xi. Acquisition of fire extinguishers (9)
xii. Installation of two irrigation & drainage systems (20 ha for others and 10 ha for other crops) (one on the institution's premises and the other in the experimental fields);
xiii. Installation of security cameras in the main blocks.

1. PLANT HEALTH LABORATORY INSTRUMENTS AND MATERIAL

Name	Quantity/lot	Description
Analytical balance	1	AUW-220D with accuracy of; 0.1 mg (0.0001 g) for samples ranging in weight up to 220 g; 80mm plate diameter; 220 x 330 x 310mm (W x D x H);
Precision digital scale 5000g/1g	3	Capacity up to 5kg, electronic, weighing tests and samples or precision balance (BALANCE PRECISION INT CAL 4500G TO 0.01G)
Electronic scale	1	Capacity up to 25kg, electronic, weighing larger samples
Low shape glass beaker 1000 ml	10	Short shaft / for volume handling
Low shape glass beaker 500 ml	10	Short shaft / for volume handling
Low shape glass beaker 250 ml	10	Short shaft / for volume handling
Low shape glass beaker 100 ml	10	Short shaft / for volume handling
Low shape glass beaker 50 ml	10	Short shaft / for volume handling
Sample bottles	50	125 ml sample bottles (preferably glass) with screw caps
Sample bottles	50	50 ml sampling bottles (plastic with green cap), sterile packaged
McCartney bottle 30 ml	200	30 ml transparent glass bottles with lid (metallic)
Bottle media RDN BLU 1000 ml	40	1000 ml clear glass bottles with lid (plastic)
Burettes	2	25mL each burettes (as for Fisher Scientific BWK210015N)
Burettes	2	Burettes of 50mL each (as for Fisher Scientific BWK210035H)
Graduated cups	10	Glasses graduated in ml, up to 1 liter
Dendrometer	1	Diameter Gauge (Criterion RD1000 Electronic BAF¬scope/Dendrometer)
1000 ml Erlenmeyer flask	10	Graduated BL / for plant extracts
500 ml Erlenmeyer flask	10	Graduated BL / for laboratory use
250 ml Erlenmeyer flask	10	Graduated BL / for plant extracts
100 ml Erlenmeyer flask	10	Graduated BL / for plant extracts
50 ml Erlenmeyer flask	10	Graduated BL / for plant extracts
Moisture meter	1	mt-16 grain moisture meter
Portable Leaf Area Meter	2	Model CI-202 Leaf Area Meter. Includes: Datalogger (data store)
Complete Micro Ulvas	5	Low volume sprayers, requires batteries, 1 liter tank
Micro Ulvas Plus	5	Small battery-powered machines, used in phytosanitary treatments (UBV)

Name	Quantity/lot	Description
Multichannel micropipette	4	P100L/100 - 1000 UL/Plastic Ejector, FA 10006P
Single channel micropipettes	4	2-100 ul
Pachymeter	5	Haglof Digitec Professional Computer Caliper/Caliper (1)
Pachymeter	1	Traceable Digital Calipers (1)
Digital caliper	2	Total length of 150mm, measures in inches and millimeters, graduated in 0.0005" / 0.01mm, digital display
0.1 ml graduated glass pipette	5	Ref. K4663-Yankee A-1 / for volumetrics and titrations.
1 ml graduated glass pipette	5	Ref. VI 01557 /for volumetrics and titrations.
10 ml graduated pipette	5	1/10 CLB / for measuring volumes
Pipette	5	1-channel stainless steel pipette
Graduated glass pipette	5	MHOR graduated pipette 10 ml
Volumetric pipette	5	PDA601 or PDH 650
Glass desiccator	10	3 liter glass sealed desiccator
Blade scalpel	5	Metal laboratory scalpel
Trays	20	Plastic laboratory trays (white) of 20 liters
Trays	20	Plastic laboratory trays (white) 18" x 14" x 3"
Plastic bottles 250 ml	250	250ml transparent plastic bottles with screw cap
Complete Entomological Case	5	Complete entomological case
Graduated cylinder	5	Graduated cylinder
glass fubil	3	glass funnel
Squirt bottle	5	50ml squirt bottle
Squirt bottle for washing (250 ml)	5	250ml squirt bottle
1000ml squirt bottle	5	1000ml squirt bottle
Portable Brix Refractometers	1	Vee Gee STX-3 or Megabrix ZGRH 0-32ATC model with LED and 0.2% accuracy
digital refractometer	1	Manual Refractometer Range 0 - 32% Brix Model Ref. RHS-203ATC, division and accuracy of 0.2%, 0-32% Brix, 0-28% salinity
Beaker	5	Graduated cylinders
Graduated cylinder	5	1000 ml glass beaker
Graduated cylinder	5	500 ml glass beaker
Graduated cylinder	5	250 ml glass beaker
Test tubes	50	Test tubes 16 x150mm

Name	Quantity/lot	Description
Sieves	2	Lot of sieves with different sizes to collect mites and tiny insects
Tweezers, Brushes and Stylets	90	6. Tweezers, brushes, styluses - Tweezers No. 02 small curved tip (10 units), Tweezers No. 03 large curved tip (10 units), Tweezers No. 03 large curved tip (10 units), Tweezers No. 09 crossed with spatula (5 units), Cutting No. 31 (5 units), Mosquito Tweezers No. 8 (10 units), Scalpel Handle No. 3 and blades (5 units), Mosquito Tweezers No. 8 (5 units), Tweezers No. 14 Rat Tooth (10 units) ; brushes of three different thicknesses (10 units/each); styluses (10 units)
Insect pinning blocks	4	Measurements: Length1: 7.25 cm Length2: 4.5 cm Length3: 2.5 cm Width: 2.5 cm Height1: 1.75 cm Height2: 2.25 cm Height3: 3.0 cm Depth of holes: Hole1: 1.5 cm Hole2: 2.0 cm Hole3: 2.5 cm
Entomological pins	10	made of tin-free stainless steel and with a nylon head, in sizes
Stretchers for mounting insects	10	Insect mounting supports for conservation
Insect conservation blades	1000	Blades for preserving insects
Graduated micro-syringes	5	For topical application
Thermohygrometers	10	Thermohygrometer (temperature between -50 and 100ºC)
Freeze dryer	1	Alpha 1-4 LSCbasic Freeze Dryer. With drying distributor, Condenser capacity: 4 kg, Condenser temperature: -55 °C, Ice condenser performance 4 kg/24 h, Abmessungen des Grundgeräts (W x H x D) 390 x 415 x 540 mmLSCbasic controller, Method Dual chamber, Max. of acrylic chambers 2, Diameter of acrylic chambers 300 mm, Max. of connections 24
Sequencer	1	ION s5 sequencer, complete DNA or RNA sequencing in less than 5 hours; process up to 96 samples in a single run; shorter time for results with automated genotyping.Voltage:100-240V Current (max):14 A,Frequency:50/60 Hz, Consumption:1,350 W.
Kettle	1	Electric kettle with 1.5 liter capacity
Blender	1	MODEL:EC-9821G-1.5LITERS,AC 230V 50HZ 450W
Water purification system	2	Water purification system (7003/7005/7010/7015), fully integrated and modern, providing superior quality ultrapure water (Type 1) and pure water (Type 2) directly from a tap water source
Centrifuge	1	Eppendorf 5427 R Centrifuge, 48x1.5/2mL AT-QL rotor, 220V, 50/60Hz includes aerosol-proof QuickLock FA-45-48-11 rotor, temperature settings –11°C to 40°
Freezer -86oC	1	Evosafe Ecologic -86°C. Freezer with touch screen eye level controllers and green HFC gas, no need for a building

Name	Quantity/lot	Description
		monitoring system, temperature data with scrolling function, new advantages of the EC axial fan
Magnetic stirrer	1	RPM-TPM MAGNETIC/SBS-STIRRER
Solar system equipment	1	Photovoltaic solar energy source with panel system
Ice making machine (laboratory flake ice)	1	Capable of producing 220 kg of flake ice per day, Bin Capacity of 80 kg, Air Cooled, HxWxD (1635x685x555
LabSmart Microcentrifuge	1	Model: DM3024, 15,000rpm, 24 x 1.5/2ml tubes
Energy Stabilizer (Electric current intention stabilizer)	5	Electric current stabilizer, capable of withstanding the conditions of internal installations in Mozambique
Telstar, vacuum pump	2	Model: 2F-3, free air displacement at 50 / 60HZ: (3m3 / 3.6h), Vacuum rating factor: 0.03 / 25, Rated power: 0.18 KW, RPM: 2800/3360, Dimensions : 280mmx240mmx
Vortex Mixer	1	(Standard rubber cup (Vortexer flat head. PN 36117310); operating environment 4°C to 45°C, speed control - 200 to 3200 rpm, LDA Dimensions (13 x 16 x 17 cm / 5.1 x 6 .2 x 6.6 in.).
Orbital laboratory shaker, voltage 110-230 V. Speed range 0-2500 rpm	1	Orbital shaking movement 4 mm, motor type - electric, voltage 110-230 V. Speed range 0-2500 rpm
GILSON pipettes	3	Various micropipettes between (1-1000ul)
Liquid Nitrogen Container	1	5 liter capacity liquid nitrogen container with conical top cylinder
PCR Rack	20	MicrocL 17 thermoscientific
PH 8 + DHS meter, selectable resolution: 0.1 / 0.01pH	1	Simultaneous display of pH/mV and temperature. Analog view with MIN/MAX alarm. Agitator plate included (in agitator version). Memory retrieval of last calibration, date and time, and electrode calibration timer condition information with alarm
Eppendorf tube holder	20	Ependorff 1.5-2.0 ml
McCartney Bottles	2000	wood
Neutral glass	100	ASTM E-438 Type 1B
Solar panel	10	Maximum power point current (Impp)
UV-L50 transilluminator;	1	Dimension (width x width x mm) 495 x 330 x 95, filter size (mm) 200 x 200; Wavelength (nm) Single 365 Single 312, Dual 365+312; Lamps 15Wx6ea (90W); Weight (kg) 12; Power supply AC110V, 60Hz or AC220V, 50/60Hz
Microwave oven	1	For agarose gel preparation/fusion, with capacity for 28 sizes. It could be your normal household microwave
Gel electrophoresis tank with different size combs	1.00	Electrophoresis cell, power supply up to 150 Volts

Name	Quantity/lot	Description
Nanodrop spectrophotometer with software and computer	1	Absorbance accuracy 3% (at 0.74 Abs at 350 nm); Absorbance range 0 - 300 Abs; Accuracy 0.002 * SD of 10 individual measurements at 0.74 Abs; Applications Nucleic acid, protein, cell culture and USB connections; Microvolume spectrophotometer; Detection range 2-15,000 ng/μL (dsDNAmL (BSA); Detector type 2048 linear element CCD array; Footprint 14 x 20 cm; Xenon flash lamp; Measurement time <5 sec; No. of samples 1; Sample volume (metric) 0.5-2.0 μL; Spectral resolution ≤1.8nm (FWHM in Hg 253.7); System requirements Microsoft Windows 7 Professional (32-bit and 64-bit), Windows 8 (32-bit and 64-bit) and Windows 10 Pro (64 bits); Voltage 12VDC; Weight (metric) 2.0 kg;
Powder-free latex gloves (medium and large)	1000	Latex Powder Free Surgical Gloves Size No. 7.5
Gel electrophoresis current supplier	2	The power supply can create and save protocols for all your gel and blotting experiments, and includes a pause/resume function for greater flexibility. The power supply includes an output range of 5-600V, 1-1200mA, 1-500W, voltage, current and power readable on the LCD and four power connections to run multiple experiments simultaneously. Able to control constant power, current or voltage. 24cm x 30.5cm x 10cm 5.6 lbs

1. INSTRUMENTS BIOTECHNOLOGY LABORATORY MATERIAL

List of Needs for Equipment Assembly			
stereo microscope		1	Extender and stabilizer
Exteroscope microscope		2	Extender and stabilizer
Water Purification System		2	Plumbing and electrical wiring and circuit breaker
Centrifuge		2	Extender and stabilizer
Laminar flow chamber		1	Extender, stabilizer and circuit breaker
Incubator		4	Extender, stabilizer and circuit breaker
Freezer		1	Extender and stabilizer
Stove		3	Extender, stabilizer and benches
PCR - real-time qPCR		2	Extender and stabilizer
Thermocycler		2	Extender and stabilizer
Microcentrifuge		1	
	L. Biotechnology	DNA extraction	
			Bench assembly (1)

List of Needs for Equipment Assembly			
			Installation of washbasins
			AC assembly
			Gas exhaust piping
			External electrical installation of sockets and circuit breakers
			External water piping
	Lab. Biotechnology	RNA extraction	
		Lab leader's office.	Assembly of benches (2)
			Installation of washbasins
			External electrical installation of sockets and circuit breakers
			External water piping
	Lab. Biotechnology	PCR	
			Assembly of benches (2)
			Installation of washbasins
			External electrical installation of sockets and circuit breakers
			External water piping
	Lab. Biotechnology	Electroforence	
			Assembly of benches
			External electrical installation of sockets and circuit breakers
	L. Plant health	Tissue culture	
			Assembly of benches (2)
			External water piping
			External electrical installation of sockets and circuit breakers
	L. Plant health		
			Assembly of benches (one for each room)
Freeze dryer			

List of Needs for Equipment Assembly			
Fluorimeter			
Vortex Mixer			
Orbital electric shaker			
Nanodrop spectrophotometer with software and computer			
MATERIAL FOR THE CLASSICAL BREEDING AND PLANT PRODUCTION LABORATORY			
Meteorological Station/Park		1	Complete meteorological park
Construction of crossing blocks		2	Cross blocks for classical improvement activities
Cold storage/germplasm bank		1	For conservation of around 500 genotypes/cultivar samples
Cold storage/seed storage		1	To store and conserve around 20 tons
Bottles/jars for seed conservation		1000	To preserve seed rows
Vacuum Emasculator for intersections		1	For intersections
Seed Counter		1	Seed counter 10 - 5000 seeds
Mini rice processor		2	To evaluate rice yield
Electronic scale		2	Precision electronic scale
Refrigerated display cases		1	Showcase for storing bottles/conservation jars
Crossover cartridges			
LABORATORY CONSUMABLES			
70% ethyl alcohol		5	1 liter bottle of alcohol with a concentration of 70%
Ethyl acetate		10	For laboratory use
Liquid detergent		15	Household cleaning detergent (liquid soap
Gloves		1	Gloves for rectal palpation
Microscopic slides		1000	Microscope slides cx 50
surgical gloves		10	Pair of surgical gloves
Procedure gloves		50	Procedure gloves
Tip boxes		40	Tip boxes - yellow to hold 20-200ms tips
Powder-free latex gloves (medium and large)		1000	Latex Powder Free Surgical Gloves Size No. 7.5
5. LABORATORY REAGENTS			
Consumables for PCR / Master mix and water nuclease-free:		2x250 tests	Master or ready mix with dNTPs (dATP, dGTP, dCTP, dTTP), taq polymerase and MgCl included at a concentration of 100 mM

List of Needs for Equipment Assembly		
DNA ladder	2 x 1.5ml	100bp DNA Ladder / Lonza 100bp-1000bp, 160ul for 1000 applications
Dye loader (Loading dye)	2 x 1.5ml	6X DNA Dye Loader
EZ-Vision Bluelight DNA Dye	2x100 ml	EZ-Vision Blue Light DNA Dye, sensitive, non-mutagenic and safe fluorescent DNA dye designed for gel staining. Compatible with a UV transilluminator or a gel reader equipped with blue light excitation, such as a blue LED gel imaging system or a Dark Reader.
6. COMPUTER EQUIPMENT		
Desktop computers	20	Intel core i7, HDD 500 GB, RAM 500 GB, 4.0 GHz, 64 bit. Desktop computer (core i7; 20" monitor; 8Gb RAM; 1TB Hard disk; Windows 10; Wireless and Bluetooth; office 2016; DVD player and SIMcard reader)
Portable computer	15	Intel core i7, HDD 750GB, RAM 4.00 GB, 4.0 GHz, 64 bit. 450 G2, Core i7, 14" HD touch screen.
Printer (Desktop)	5	Print, copy, scan, fax (email on WorkCentre 3045i), scanner. PSC printer (Officejet; Printer, scanner and copier; wireless; A4 paper)
Digital camera	1	21.1 Megapixels, full frame cmos, eos movie HD, ISO 6400, 3.9 frames per second, 9 point AF, live view, LCD 3.0 clear view, EF lenses, HDMI, self cleaning sensor unit.
Drones for image capture	2	
Drones for pest management (pests and weeds)	1	
External Hard Drive	5	HD 1TB; USB 3.0
Memory cards	30	8Gb Memory Cards
Antivirus	10	Kaspersky_Internet Security, 3 PC
SAS, Rstudio and Genes statistical package	1	Version 10.3 or newer version (unlimited)
OFFICE EQUIPMENT		
Entomological cabinet	1	Closet made of wood, with 60 drawers (55 x 55 x 8 cm each drawer)
ECO-COFFEE TABLE FOR OFFICE	1	Ecos table 3.5 to 3.6 m table length by 0.7 to 0.9 table width, with metal support table structure, with formic top; lockable fixed drawers
ECO-EXECUTIVE TABLE CGV 1600X1600X750	3	Ecos table 3.5 to 3.6 m table length by 0.7 to 0.9 table width, with metal support table structure, with formic top; lockable fixed drawers

List of Needs for Equipment Assembly		
DZX - HIGH CABINET FOR FILES	1	DZX - HIGH CABINET FOR FILES
DZX - LOW CABINET FOR FILES	2	DZX - LOW CABINET FOR FILES
SOFA SET with 3 seats	1	SOFA SET with 3 seats
TWO-SEATER SECRETARY	1	Desks 1.4 to 1.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
ROOMS SECRETARIAT	3	Desks 3.8 to 3.6 m long by 0.7 to 0.9 wide, with metal support structure, with a shaped top; lockable fixed drawers
RECEPTIONIST'S DESK	3	Counters 3.1 to 3.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
BLACK BLOCK CHAIR	20	Chairs 20.2 to 20.6 m long by 6.7 to 0.9 m wide, with metal support structure, with shaped top; lockable fixed drawers
OFFICE CHAIR for the Director's office	4	Office chairs for living room 4.0 to 4.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
OFFICE CHAIR for visits to the Director's office and two laboratories	6	Office chairs for visitors in the director's office and 6.7 to 6.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
OFFICE CHAIR for meeting room	40	Office chairs for living room 40.7 to 40.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
ECO-MEETING TABLE	3	Ecos table 3.5 to 3.6 m table length by 0.7 to 0.9 table width, with metal support table structure, with formic top; lockable fixed drawers
File Cabinet	20	Cabinets 20.0 to 20.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
Receptionist desk	3	Counters 3.0 to 3.6 m long by 0.7 to 0.9 wide, with metal support structure, with a shaped top; lockable fixed drawers
Balcony chairs	6	Chairs 6.0 to 6.6 m long by 0.7 to 0.9 wide, with metal support structure, with shaped top; lockable fixed drawers
4-seat secretary	4	Desks 4.0 to 4.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers

List of Needs for Equipment Assembly		
4-Seat Desk Chairs	16	Chairs for secretaries measuring 16.0 to 16.6 m in length by 0.7 to 0.9 in width, with metal support structure, with shaped top; lockable fixed drawers
Office waste baskets	30	Waste bins 30.5 to 30.6 m long by 0.7 to 0.9 wide, with metal support structure, with a shaped top; lockable fixed drawers
One-Seat Secretariat Desks	12	Secretarial tables 12.0 to 12.6 m long by 0.7 to 0.9 wide, with metal support structure, with a shaped top; lockable fixed drawers
Chairs for visitors in One Place Secretariats	24	Chairs for visitors in secretariats measuring 24.0 to 24.6 m in length by 0.7 to 0.9 in width, with metal support structure, with shaped top; lockable fixed drawers
Cabinet	1	Locker type cabinet, metal and glass. Two doors; 2 to 2.5 m high and 1 to 1.5 m wide
Lockers	2	Metal locker with two doors and 5 shelves (five entrances)
Laboratory chairs	6	Adjustable swivel chairs, with arm and back height up to the shoulders
Simple chairs	6	With metal support; not giartoria and leather iron; with arm
Bookcase	1	5x4 bookcase with two doors and drawers, to store files and books
Shelves	4	With drawers
Sofa	6	Type L, in leather
Dining table	6	6 seats, wood
Dining table chairs	36	With backrest, in wood
Center table	6	In wood and glass
4 seater table	6	wood
Chairs	24	with backrest, wooden
Double bed	6	wood
Headboards	12	wood
Comfortable	6	wood
Desk/table	1	Desks 1.4 to 1.6 m long by 0.7 to 0.9 wide, with metal support structure, with formic top; lockable fixed drawers
OFFICE CONSUMABLES		
pencil sharpener	2	table sharpener

List of Needs for Equipment Assembly		
Schedule	15	3 consecutive years
Stapler	3	DS-435 stapler
Staples	5	Reference 24/6
Staples	5	23/10mm
Notepads	30	A5 format
Rubber	1	Size 5cm
Cardstock	2	A4 size
Clips	3	Size 5cm
Envelopes	3	Envelops, A4 format
Ballpoint pens	3	BIC Medium_Blue
Glue tape	2	Normal
Plastic marking tapes	5	Five ribbons of different colors
Flipchart	6	23/10mm
Awl	2	Kangaro brand paper punch
Pencil	3	Hard Brand Pencil (HB)
Calculating machines	2	Brand scientific calculating machines
Bookmarks	3	Permanent markers from 0.1mm to 0.5mm
Ream paper	10	Vista Plus or Smart Copy brand ream paper
Documents folder	4	Document folder, A4 format
Sticky notes	3	Yellow or green Post It
White board	2	Whiteboard used with markers for training
Underliner	1	Size 10cm
Turner	20	85A
50cm ruler	2	transparent plastic material and minimum graduation of 1 mm
8. COLD EQUIPMENT		
Glacier	1	Cooler capacity 220 or 500 liters with 220 V voltage, with temperature control, and with removable shelves.
Freezer -20°C	3	Freezer from 210 to 600 liters up to -20ºC
Air conditioning	2	Split Hi-Wall; 24000 BTUs; 220V
Glacier	6	2 ports, 300ml
Microwave	6	30L

List of Needs for Equipment Assembly		
4-burner mixed cooker	6	stainless steel,
Deep freezer -40˚ C	6	Upright / upright freezer; Temperature range: -10 to - 40˚C; Voltage and frequency: 220 V / 50 Hz; Capacity: 300 L Microprocessor controller for precision temperature; Audible and visual alarm systems with password protection configuration page; ABS plastic for the internal cabinet and painted steel for the external body; Security door lock; Sturdy casters; Drawers for easy storage. Ecological refrigerant with R507 (CFC-free); Certificate: CE, ISO9001, ISO14001; Weight: 200/225 kg
Name	**Quantity/lot**	**Description**
Magnifiers	5	Pocket magnifiers for 10 to 16x image magnification
Plastic basins	5	Plastic bowls without lid with a capacity of 5 liters
Buckets	5	Plastic buckets with a capacity of 20 liters
Drum	2	Plastic buckets with a capacity of 100 liters
sisal twine	3	5 kg rolls per unit
Synthetic ropes	3	100m synthetic ropes
Hang tags	3	Synthetic labels
Measuring tape	2	50m
Measuring tape	1	100m
Rain boots	14	rain proof boots
Field boots	14	Boots nos. 39, 40, 41 and 42 from Javelco brand (shoe style)
Field folder	14	Tiger TT Field Pack MKII
Rain coats	14	Leather raincoats
20 liter gallons	14	Empty oil cans
Field lanterns	3	Rechargeable portable flashlights
Field tarp	3	Blue polyethylene tarpaulin 3x3m 180m/110g Foxlux
Plant identification signs in the field	500	Each unit is 5x3.5 cm and 15 cm high, white, polypropylene,
Atomizer	1	AT-1000 Atomizer - 110v - Pulsfog
Dorsal spray	8	15 liter knapsack sprayer
Watering cans	14	Watering cans of 15 liters each

List of Needs for Equipment Assembly		
Bags	5	Bags for the field
Raffia bags	100	Raffia bags 50 kg
sisal bags	50	Sisal bags 50 kg
Rotating drum for seed treatment	1	manual rotating drum, used for seed treatment, capacity 20L
Tents	5	Capacity for 2 people each.
Pruning shears	5	Model BP3180
Insect capture net (puçá)	10	Capture Net (Puçá Entomológico), Retractable cable, made of high quality and highly resistant aluminum that resists impacts and traction. Feature (Approximate size): Handle: 75 cm Basket Diameter: 38 cm
Collection material (glassware, plastic bags, etc.)	1	Plastic bags 2kg (500 units), plastic bags 5 kg (500 units); wide-mouth bottles (100 to 200 mL) with polyethylene lid (500 units), 70% alcohol, ether, chloroform, disposable syringe, paper towel, plastic containers with good sealing (plastic containers), scrap paper and a Styrofoam box for material transport
Insect lethal chamber	2	Insect chamber
Tray type traps	10	Yellow water tray traps
Light traps, type “Luiz de Queiroz”	2	With ultraviolet, fluorescent lamp. Made from 2mm thick white polystyrene plastic, height: 90cm (without collection container), diameter: 38cm, plastic collection container.
Pitfall traps	20	Pitfall traps
Material for making Pitfall traps	30	Plastic containers (10 units), formaldehyde (10 units) and detergent (10 units)
Yellow sticky cards for collecting flying insects	2000	Recommended mainly for aphids, leafhoppers, leafminers, whiteflies, kitty flies, fruit flies, etc. (2000 units) - These yellow Bio Trap adhesive plates have adhesive on both sides, measuring 24.5 cm high x 10 cm wide
Acrylic insect cages		to condition insects
Entomological collection boxes	20	Boxes 20.6 to 20.6 m long by 0.7 to 0.9 wide, with metal support structure, with a shaped top; lockable fixed drawers
Pesticides	200	insecticides, fungicides, acaricides and others
Coveralls	8	Cloth monkey costume
Plastics for sample collection (sheets)	2000	500g transparent polyethylene plastic with zipper

List of Needs for Equipment Assembly		
Gloves	50	hand gloves
Face masks	50	For individual protection
String Rolls	5	Roll of ropes to align the fields, test fields and seed multiplication
10. MEANS OF TRANSPORTATION		
Mini Bus Vehicle	1	35 seats
Mini Bus Vehicle	1	15
Double Cab 4x4	6	5 Places
Single cabin vehicle	1	2 Places
10 T truck	1	Trucks 1.0 to 1.6 m long by 0.7 to 0.9 t wide, with metal support structure, with shaped top; lockable fixed drawers
Honda XL motorcycles	5	2 Places

11. REGISTRATION OF NEEDS FOR THE FULL OPERATION OF THE WORKSHOP, MACHINERY PARK AND RICE SEED PROCESSING UNIT (UBS)

Order No.	Item	Amount	Specifications/Description
1	Tool box	1	
2	Bench for Mechanics	1	
3	Lathe	1	
4	Pachymeter	2	
5	Micrometer	2	
6	Pliers ammeter	2	
7	Pliers	10	
8	Torquemeter	2	
9	Manometer	2	
10	Hydraulic jack	2	
11	Hydraulic winch	1	
12	Personal Protective Equipment (PPE)	10	
13	Steering Aligner	1	
14	Entry and Exit Record Book	2	
15	Request Book	2	

Order No.	Item	Amount	Specifications/Description
16	Tool and Parts Cabinet	1	
17	Car Wash Machine	1	
18	Mass Lubrication Pump	2	
19	Oil Lubrication Pump	2	
20	Hydraulic Lift	1	
21	Hiring a Mechanic	2	
22	Grinding wheel	2	
23	Drill	2	
24	Saca-Pulia	4	
25	Soldering machine	1	
26	Air compressor	1	
27	Power arm	4	
28	Lubricants	4	
29	Filters	12	
30	Table	3	
31	Chairs	6	
32	Computer	3	
33	First Aid Kit	1	
34	Fire extinguishers	1	
35	Alarm	1	
36	Alternative Ports	3	
37	Iron Drills	10	
38	Diamond Discs	4	
39	Glue		
40	Iron Discs	10	
41	Stainless steel sink for workshop	1	
42	Air conditioning	2	
43	Assembly of the Rice Seed Processing Unit	1	
44	Construction of infrastructure to install the Rice Seed Processing Unit	1	
45	Batteries for Tractors	4	

Order No.	Item	Amount	Specifications/Description
46	Hammer	2	
47	Sledgehammer	2	
48	Dowels	20	
49	Scople	2	
50	Installation of Glass to Separate the Reception and Work Area	1	
51	Ramp Requalification	1	
52	Printer	1	
53	Transmission Shafts for Tractors	6	

Machines and maintenance needs

Tractors	Model	Year of Acquisition	State	Comments
Tractors				
Tractor 1	DEUTZ-FAHR 100	2015	Damaged	Lack of a damaged rear tire, starting system and hydraulic system (needs a general overhaul)
Tractor 2	KUBOTA L 3408 VN	2015	Damaged	Missing rear tire, damaged three-point hitch (needs a major overhaul)
Tractor 3	KUBOTA L 3408 VN	2015	Damaged	Missing rear wheel axle seal, tires, damaged three-point hitch (needs a general overhaul)
Tractor 4	KUBOTA B 2420 VN	2015	Damaged	Lack of tires
Tractor 1	DEUTZ-FAHR 50	2015	Damaged	Missing crankshaft seal, one rear tire, damaged starting and three-point hitch system (needs a general overhaul)
Scarifier				
Scarifier 3		2015	Damaged	Missing teeth
Motor pump				
Motor pump 1	VIKYNO RV125-2-N	2015	Broken	Needs general review
Motor pump 3	HONDA-WL30XH	2015	Functional	Missing crank
Rice Harvester				

Tractors	Model	Year of Acquisition	State	Comments
Rice Harvester 2	VPR-120	2015	Broken	Engine problems, needs overhaul
Chainsaw 1	STIHLM5381	2015	Functional	need cutting tool
Cars				
Car 1	ford ranger	2015	Functional	lack of payment at the maintenance office
Car 2	ford ranger	2015	Damaged	Engine Heating, Needs overhaul
Car 3	BT 50	2013	Functional	Lack of battery and damaged door lock (Needs overhaul)
Grid				
Grid 1	JOPER	2015	Broken	Lack of Tires, Lubrication
Thresher				
Thresher	Model		state	Comments
Thresher 1	VIKYNO RV125-2-N	2015	Functional	Damaged accelerator
Thresher 2	VIKYNO RV125-2-N	2015	Broken	Problems with engine, tires, belts, needs overhaul
Thresher 3	HIPPO0861HP2461	2015	Broken	Lack of tires and belts, Needs general inspection
Sieve				
Sieve 3		2015	Broken	Problems with engine, wheels
Motor				
Motor	Model		state	Comments
Engine 1	VIKYNO RV-125-2-N	2015	Functional	Shock Problems
Engine 2	VIKYNO RV-125-2-N	2015	Functional	Shock Problems
Greenhouses				
Seed Dryer	Model		state	Comments
Greenhouse 1 (Seed Dryer)	MEMMERT 30-750	2015	Broken	Damaged electrical system
Greenhouse 3 (Seed Dryer)	MEMMERT 30-752	2015	Functional	Damaged central control button
Lawn Mower				
Lawn Mower 1	OHV	2009	Broken	Lack of Power Tubes and Propellers

Tractors	Model	Year of Acquisition	State	Comments
Lawn Mower 2	2-STROKE	2020	Broken	Damaged main shaft, missing propellers
Lawn Mower 3	2-STROKE	2020	Broken	Damaged main shaft, missing propellers
Spray				
Trailer 1	JOPER	2015	Functional	Damaged tailgate

Motorbikes	Model	Year of Acquisition	state	Comments
Motorbikes				
Motorbike 5	Super Dream	2015	Broken	Lack of ignition keys, tires, cameras, engine oil and spark plugs
Motorbike 6	Super Dream	2015	Broken	Lack of ignition keys, tires, cameras, engine oil and spark plugs
Motorbike 7	Super Dream	2015	Broken	Lack of ignition keys, tires, cameras, engine oil and spark plugs
Motorized Sprayers				
Sprayer 13	OMEGA	2015	Damaged	Motor,Needs general review
Tractors				
Tractor 1 (Motorcultivator)	YANMAR TC 12	2006	Damaged	Motor,Needs general review
Tractor 2	KUBOTA L3408VN	2015	Functional	Need to change filters, oil, damaged three-point hitch system
Tractor 3 (Motorcultivator)	YANMAR TC 12	2006	Damaged	Motor,Needs general review
Tractor 4	KUBOTA L3408VN	2015	Damaged	Needs rear tires, three-point hitch damaged
Tractor 5	MASSIE FERGUSON 460	2009	Damaged	Damaged Steering bar, Steering pump, needs overhaul
Motor pumps				
Motor pump 3	HONDA	2009	Broken	Motor,Needs general review
Motor pump 5		2015	Broken	Motor,Needs general review
Chainsaw				
Chainsaw	HUSQVARNA	2015	Broken	Missing cutting tool
Seeder 1	STARA	2015	Broken	Needs General Revision
Cars				
Car 1	NISSAN	2002	Damaged	Needs general review
Car 2	MAZDA	2009	Damaged	Needs general review
Car 3	RANGER	2009	Damaged	Needs general review
Transplanters				
Transplanter 1	KUBOTA SPW-482	2015	Damaged	Needs general review

Transplanter 2	KUBOTA SPW-483	2015	Damaged	Needs general review
Thresher	VIKYNO RV-125-2-N	2008	Damaged	Needs general review
Self-combined	PHOTON	2009	Damaged	Needs general review

12. IRRIGATION AND DRAINAGE SECTOR

Order	Item	Specification	Amount
1	Greenhouse benches	To place Styrofoam trays, germination trays, among others	6
2	Localized irrigation system	Microsprinkler	2
3	Fertigation system	With 5000 liter tank	2
4	Thermometer	For measuring the ambient temperature inside the greenhouse	2
5	Flood basin irrigation	20 hectares	1
6	Weather station	At least for collecting precipitation, temperature, relative humidity, Eto, among others.	3

13. SOIL AND WATER LABORATORY

Item	Designation	Quantities	Observation
I. LIST OF FIRST AID MATERIALS			
1	Gloves	3cx	
2	glassesprotectors	10	
3	Beat	6	
4	Burrows	200	
5	Thermometer	3	
6	Borified water	20l	
7	Alcohol 100%, 99%, 75%	15l	
8	Hydrogen peroxide	15l	
9	hydrophilic cotton	500g	
10	iodine solution	5l	
11	Savloon	5l	
12	Sterile gauze	3	
13	I think quickly	5cx	
14	table salt	1kg	
15	Saline solution	5l	

Item	Designation	Quantities	Observation
16	Colirioneutral	5l	
17	Analgesicoemgota	1l	
18	Ether	2l	
19	Antispasmodicemgout	2l	
20	Scissors	5	
21	Ligatures	3 rolls	
22	Stickers	3rolls	
II. MATERIAL LIST			
2.1. Books/ Literature:			
1	**Soil analysis methods manual**. 2nd editionRevista… Embrapa, 2011	2	In Portuguese
2	Motsara, MR & Roy, RN (2008).Guide to laboratory establishment for nutrient analyses. FAO. Rome 2008	2	English
3	Weaver, R. W. Angel, J. S. Bottomley, P. S. (1994). Methods of Soil Analysis. Part 2- Microbial and Biochemical Properties. SSSA, Inc. Pp. 1097	1	English
4	Saparks, DL Page, AL Helmke, PA Loeppert, RH Soltanpour, PN Tabatabai, M. A Johnson, CT Sumner, ME (1996). Methods of Soil Analysis. Part 3 – Chemical Methods. SSSA, Inc. Pp. 1097.	1	English
2.2. List of materials			
1	Perchloroethylene Distiller	1	
2	Ceramic filters for distillers	1 box	
3	Probe	3	5cm in diameter
4	Centrifuges/ Mixers	2	01 - Cytological Centrifuge for 12 Slides 26 x 76mm Model: ALB 12 CC... 01 - Benchtop Centrifuge Specifications: Maximum RPM 100-4000rpm; RCF Maximum 1.5-220gSpeed accuracy ± 10rpm; Maximum Capacity According to the rotor; LCD display; Timer 0 to 99 minutesNoise level ≤ 45db; AC voltage 110/220 VFrequency 50-60 Hz; Power= 200 WWeight 23 kg; Dimension (W x L x H) 483 x 320 x 265 mm
5	Bunsen burner / Bunsen burner	4	
6	Graduated cylinder (100, 500 and 1000ml)	1 box of 100 units each	

Item	Designation	Quantities	Observation
7	Pipettes vs Graduated Pipettes	200 unit	
8	Saforada pipettes	100 unit	
9	Cleaning brushes/tubes (Escobillion)	1cx	
10	Moisture meter	2	
11	Precision scale (100g, 500g, 1000g and 5000g)	7	
12	Test tube	1000	
13	Conductivity meter	2	
14	Bench and portable phmeter	2	benchtop digital multiparameter meter pH, Conductivity, ORP, temperature, CF, TDS
15	Rectangular and circular sieves	10	
16	Funnel	100	
17	Cones	100	
18	Metal pycnometer (Collection of surface soil samples in flooded soils)	100	Metallic pycnometer with ASTM D1475 lid in stainless steel, aluminum, brass and bronze 25ml/50ml/100ml
19	GPS	2	Garmin
20	Tapemetrics	5	
21	Bottlewashers	100 unitseach	
22	Gibson Embudo	100	
23	EmbudoConico	100	
24	Test tube rack	100	
25	Burette	4 with a capacity of 25 units	
26	Precipitation vessel and agitator	100	
27	White porcelain mortar (500g)	25	
28	Erlenmeyer Matraz	100	
29	Flat-bottomed flask (100, 500 and 1000ml)	100 unit	
30	Matrazaforado (100, 250, 500 and 1000ml)	100 unit	
31	watch glass	20	
32	Petri dishes	100	
33	Burette tweezers	15	

Item	Designation	Quantities	Observation
34	Test tube clamps	15	
35	Laboratory tweezers	15	
36	Tripods (Tri-pe base for mounting the Kjedahl method distiller)	4	(Basec tri-pe for mounting Kjedahl method distiller)
37	Wooden vs metal supports	100 unit	
38	Spatulas	25	
39	PVC bottles for mixtures (100ml, 250ml, 500ml and 1000ml))	250 unit	
40	Graduated vessels (50ml, 100ml, 250ml, 500ml and 1000ml)	100unit	
41	Dropper bottles	10	
42	Dryers	10	
43	Glass embudo	100 unit	
44	Decanting embudo	100 unit	
45	Filter paper	15cx	
46	Thermometers	5	Digital thermo-hygrometer with internal and external temperature and humidity measurements
47	Permeameters for variable load, equivalent of sand and diluted asphalt distillation	3	
48	Densiometer	10 unit	Hydrometer for ethyl alcohol volume percentage 0.1% – 330mm – • Calibrated at 20°C
49	air extractors	2	
50	Sieves for granulometric analysis	15	
51	Presses	10 unit	
52	Fire extinguishers (9kg)	2	Chemical powder extinguisher
53	Oven muffle / muffle furnece (high temperature - 800oC)	1	
54	Plant drying oven (up to 80oC)	2	
55	Plant crusher/electric stainless steel grinding/grinding electric stainless steel	2	
56	Automated Microwave Digestion System	1	Digestion of soils and plants (to liquid state) for nutrient analysis (cem.com/en/blade)
57	Block Digestion Systems	1	For temperatures above 600oC
58	Chlorophyll meter (SPAD)	6	chlorophyll meister in the plant
59	benches for soil and water laboratory	5	

Item	Designation	Quantities	Observation
60	reagent shelves	3	
III. LIST OF REAGENTS (CONSUMPABLES)			
1	2N & 2M KCl	20l	To determine the amount of exchangeable nitrogen and available nitrogen respectively(NH4 + - N and NO3 - - N)
two	H2SO4 (Concentration - 2N)	20l	Digestion (Soil and plant)
3	Sodium hydroxide (1.7%)	20l	

FIELD MATERIAL

Description	Amount
Hand hoes	200
Scythes	200
bags	200
Ropes (100 m)	30
Nameplates	500
Pruning shears	30
Machetes	50
Pickaxes	30
Shovel	30
Hand truck	15
GPS	5
Rake	20
Hand spatula	20
Dorsal spray	15
Graduated cylinder (500 ml)	20
Canvas	20
Boards (30x60)	1000
Magueiras Watering Cans	250
Portable Moisture Meter	5
Portable PH Meter	5

Description	Amount
Dorsal fertilizer (Mayfield)	100
Pesticide Mixing Drums	5
Funnel	15
Individual protection equipment	300
Binoculars	5
Hand probe	10
Pulviometer	300
Plastic packaging	1000
Ream of cardboard	600
Marker packaging	500
Tape measure 100 m	30
Portable 10 m tape measure	30
Boar 8	30
Hammer	5
nail packaging	50
500W-1900W Mini Angle Grinder	4
Portable Moisture Meter	5
Portable Photosynthetic Radiation Meter	5
Portable scale	5
Switchblade	20
Raincoat	100
Boots (pairs)	200
Disposable mask packaging	250
Liquid soap box	200
First aid kit	10
Camera	5
Portable anemometer	4

LIST OF MATERIALS AND ACCESSORIES FOR EQUIPPING THE OFFICES OF THE PLANT HEALTH LABORATORY

Order	Item	Amount
1	Secretary	7
2	Chair	20
3	Instant	6
4	Waiting seat	6
7	Air conditioning	1
8	Humidity controller	1
9	Light emitter	1
Ductless Exhaust Machine		
Analog water bath		
Block for PCR plates (96 wells)		
Agarose electrophoresis system with accessories		
UV light transilluminator		
Centri leaks (Eppendorf)		
Mini plate spinner		
Vortex Shaker		
UPS backup		
Analytical balance		
Precision scale		
Stirring machine (with heating option)		
Laminar flow cabinet, horizontal with UV binder		
Ice machine		
Hand sprayer with compressor		
Distributor (set of media pump tubes)		
Look at flames		
UV Sterilizer		
Generator (powerful)		
Shelves		
Compound microscope		
Incubator (30°C)		
400l refrigerator		
Vertical freezer (-20°C) with separate compartments and automatic defrosting (2)		

Pressure Sterilizer (Autoclave)
Microwave
Benchtop PH Meter
Oven
Freeze-drying
II. CONSUMABLES
PCR Plates
96 well plates (autoclavable)
Pipettes
P1000 (100-1000μl)-Gilson
P200 - Gilson
P100- Gilson
P20- Gilson
P10- Gilson
P2
Pipette Tips
for P1000 (50-1000μl)
for P200 and P20 (20-200μl)
for P100
for P10 and P2 (0.1-10μl)
Chopper (50ml, 100ml, 200ml, 250ml)
50ml
100ml
250ml
alcohol lamp
Filter Paper (Disc Paper) (Box) (Pkt)
Pasteur pipette (Box)
Small bottle of pyricularia with silica gel
Silica gel (dessicateur + 1kg of silica gel) (1kg)
Slanter
Ray
Drying rack

Refill Boxes
Ependorf tubes
1.5ml (eppendorf safe lock) (1000pcs)
2 ml (eppendorf) (1000pcs)
0.5ml (eppendorf) (1000pcs)
0.2 ml (eppendorf, plain) (1000pcs)
Reversible racks 1.5 and 0.5ml
Reversible racks 15 and 50ml
Racks for 0.2ml
Microtube storage box (96 places)
Containers (Pyrex bottles)
1L
500ml
250ml
100ml
Balloons (1liter, 500ml, 250ml, 100ml)
1L
500ml
250ml
100ml
Cups (1L)
500ml
250ml
100ml
Measuring Cylinders (2liters, 1 liter, 500ml, 250ml, 100ml, 50ml, 10ml)
2L
1L
500ml
250ml
100ml
50ml
10ml

Gloves
Large, Medium and Small
To pick up hot containers
Others
Plastic sceller (Saran packaging)
Water Bath Floats
Sceller for autoclave
Permanent markers
Magnetic Stir Bars
Whatman filter paper
Spatulas + tongs set
Mortars and pestles
Ice Buckets
Water reserve tanks
Oven thermometers (50 - 200°C)
Plastic Trays
Cotton (500 mg)
Hang tags
Aluminum foil
Scissors
Parafilm
nylon mesh
Hemacytometer (Mallessez cell)
Ependolf Rack
Isolation well
Sterile wire loop (wooden stick) (Box)
L-shaped glass rod
Tweezers
Petri dishes
Transfer needles
Test tubes

Fertilizer warehouse

- Washbasin
- Platforms
- Identification for products
- Paramedic kit
- Soap
- Fire extinguisher
- Sand bag
- Brooms for cleaning the floor
- Log books
- Decree regulating the use and registration of fertilizers in Mozambique
- Alternative folder
- Protective suits and gloves
- Mask
- Helmet
- Glasses
- Boots
- Painting
- 1 secretary and two chairs

Pesticide warehouse

- pesticide
- Platforms
- Label for each product or identification
- Doctor's kit
- Soap
- Fire extinguisher
- Sand bag
- Brooms for cleaning the floor
- Sponge
- Entry and exit log books
- Decree regulating the use and registration of pesticides in Mozambique
- Alternative folder
- Alarm
- Protective suits and gloves
- Mask
- Helmet
- Glasses
- Boots
- Painting
- 1 secretary and two chairs

Seed warehouse

- Platforms
- Hygrometer (degree moisture content meter)
- Scales (1-1000 grams and 5-100 kg)
- cuzersack machine
- Cracks in the warehouse floor
- Not perfect straighteningfrom the sweat

HUMAN RESOURCE PROJECTIONS (Only Scientists)

Technical Area	5 years	10 years	15 years
Agricultural economists	2	2	4
Agronomists	3	3	6

Technical Area	5 years	10 years	15 years
Breeders/geneticists/biotechnologists	4	5	9
Data scientists/biometrician/statistics	2	2	4
Entomologists	3	3	6
Technology transfer (experts)	4	4	8
Food Scientists	2	2	4
Nutritionists	1	1	2
Plant pathologists	3	3	6
Mechanical Engineer	1	2	3
Entomologists	3	3	6
Postharvest technologists	2	3	5
Seed scientists	3	3	6
environmental scientist	2	2	4
Social scientists	2	2	4
Hydraulic and rural construction scientist	3	2	5
Soil scientists	3	3	6
TOTAL	**43**	**45**	**88**

Proposal for long-term courses /CLiPA						
Or	Full name	Course Proposal	Degree	Master's degree	Doctorate	Post-Doctorate
1	Hermino Abbot	Plant breeding			x	
2	Leonel D. Moiana	Genome-wide selection and Bayesian analysis				x
3	Malissa Doliz Nhandlema	Agrarian Economy		x		
4	Linelthe A.R. Pinho	Sustainable Environment and Technology		x		
5	Vânia Manuel Malimue Mendes	Agrarian Economy		x		
6	Blessing Abrão Eduardo	Soil Sciences and Plant Nutrition		x		
7	Guilhermina O.J. Saúte,	Molecular biology		x		
8	Leonardo J.A. Niquisse,	Agricultural machinery		x		

Proposal for long-term courses /CLiPA						
Or	**Full name**	**Course Proposal**	**Degree**	**Master's degree**	**Doctorate**	**Post-Doctorate**
9	Jacinto Manuel Andreque	Plant genetic improvement		x		
11	Edson Miguel Matavele	Plant protection		x		
12	Nelma Fernando Nunes	Climate changes		x		
13	Jose Popisky	Seed production technologies		x		
14	Nilza Munguambe	Plant breeding		x		
15	António Manuel Mendes	Water Resources Management			x	
16	Calado Amaral	Agronomy		x		
17	Maulito Uachave	Agronomy	x			
18	Ótilia José	Agrarian Economy		x		

15.8 Annex 8: Transcript of the CLiPA Data Collection Questionnaire

As you know, CCARDESA has been working with your country to facilitate the implementation of the Agricultural Productivity Program for Southern Africa (APPSA) in the context of the National Agricultural Research and Extension Systems (NARES), through the establishment of Regional Leadership Centers (RCoLs) functional and sustainable.

As a follow-up to this, Mr. Daniel Chiwandamira of DPC & Associates was recruited to review the work that has been done, document lessons, challenges and remaining gaps that may need to be addressed. It is hoped that such lessons will be useful to our region as we strive to strengthen existing RCoLs and to guide the establishment of new ones, as directed by SADC political bodies.

Accordingly, we request that you complete this Questionnaire.

This won't take more than 10 minutes out of your busy schedule.

PART 1: GENERAL INFORMATION

1.1	Name of the country	Mozambique
1.2	Name of the Ministry	Ministry of Agriculture and Rural Development
1.3	Department	Mozambique Agricultural Research Institute
1.4	Title of the Respondent	Center Manager and Plant Breeder
1.5	Defendant's name and surname	Herminio Abbot
1.6	Other specify)	

PAER 2: GAP ASSESSMENT

Using a scale ranging from (1) to (5), indicate the extent to which the following factors have improved since support was given time to establish RCol in your country, with (1) = Negligible improvement (5) - Very significant (Marking).

	Variable	1	two	3	4	5
2.1	Potential for greater value addition					**X**
2.2	Potential for increased exports				**X**	
2.3	Import level of agricultural technologies to support productive activities				**X**	
2.4	Level of training and dissemination of the state of agricultural technologies					**X**
2.5	Management styles used to handle the product					**X**
2.6	Institutional arrangements that support the commodity					**X**
2.7	Human Resources, leadership and Governance supporting the product				**X**	
2.8	Level of capacity in terms of research, knowledge and technology generation			**X**		
2.9	Level of infrastructure for carrying out research and production (laboratory, transport, equipment, etc.),		**X**			
2.10	Infrastructure level for marketing and distribution		**X**			
2.11	Level of collaboration between stakeholders to share knowledge.			**X**		
2.12	Level of investment in agricultural research.		**X**			
2.13	Level of capacity to deal with climate change and other natural disasters			**X**		
2.14	**Other (elaborate)**					

PART 3: AREAS FOR IMPROVEMENT

Briefly, what do you think still needs to be addressed specifically to improve the situation related to the following variables?

	Variable	Indicate specific problems
3.1	Strengthen value addition	1) Problem of understanding the actors in the chain 2) Lack of image construction in relation to RCoL 3) Poor problem solving 4) Poor identification of partners! 5) Poor use of the Feedback received
3.2	Promote exports	1- Lack of production surpluses for exports 2- Unattractive prices 3 Weak industrialization 4- Low production, products with poor quality for market competitiveness
3.3	Access agricultural technologies to support productive activities	1- Restricted access to technologies, lack of massive dissemination of them. 2- Quantity and quality of extension services 3- Weak investment for the promotion of agricultural technologies
3.4	Improve the level of training and dissemination of the status of agricultural technologies	1- Weak investment and 2- quality and quantity of extension services 3- Non-comprehensive policies for participating in training
3.5	Improved management styles used to handle the product	1- Poor training 2- Weak institutional development
3.6	Improved institutional arrangements that support the commodity	Poor processing and sealing of products
3.7	Improved human resources, leadership and governance supporting the product	1- Weak conception of policies that meet reality and benefit the national product. Laws that marginalize the sector
3.8	Improve the level of capacity in terms of research, knowledge and technology generation	1- Weak institutional development in terms of training in the short, medium and long term 2- Talk about improving infrastructure (irrigated area, assembly of equipment, training in the use of equipment
3.9	Improved infrastructure for carrying out research and production (laboratory, transport, equipment, etc.),	1- Lack of transport, inappropriate equipment, unequipped laboratories, irrigation systems…..
3.10	Improved infrastructure for marketing and distribution	1- No existence of advertising boards or funds to hire companies for advertising services
3.11	Improve collaboration between stakeholders to share knowledge.	1- Little collaboration with similar institutions at the CGIAR or National level
3.12	Improve investment in agricultural research.	**1-**Lack of perception that Agricultural Research is the key to boosting the National and Regional economy. There is no country where there is peace while its people are starving.
3.13	Improve the ability to deal with climate change and other natural disasters	1- Weak development of technological packages that minimize/mitigate the effects of climate change
3.14	**Other (elaborate)**	

PART 4: Adequacy of policies and institutional configurations

Using a scale ranging from (1) to (5), indicate to what extent the following regional policies and regulatory framework have favored or hindered the performance of Agricultural Productivity in your country and the good functioning of the Regional Leadership Center (RCoL) . Use a range of (1) = Not at all conducive to (5) – Very conducive (Tick).

	Variable	1	two	3	4	5
4.1	Policies to Strengthen the Institutional and Favorable Environment for Technology Adoption		x			
4.2	Technology Import Policies and industrial re-equipment/upgrade		x			
4.3	Policies that facilitate collaboration between researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders			x		
4.4	Policies to facilitate trade in high-quality seed varieties in SADC Member States			x		
4.5	Policies to support agricultural research	x				
4.6	Policies to facilitate training	x				
4.7	Policies that guarantee easier access to financing and an innovative review of public expenditure	x				
4.8	Policies that favor the development of infrastructure	x				
4.9	Policies that reduce trade barriers	x				
4.10	Existence of a regulatory framework that supports production and exports	x				
4.11	**1) Other (indicate)**					

PART 5: LESSON/RISK AND RECOMMENDATIONS

In establishing and operating your RCoL, what are the risks you faced and how did you overcome them or what is your recommendation for overcoming them?

	RISK	REMEDIAL ACTION/RECOMMENDATION
5.1	Lack of Organic	Establishment of an organization in order to make various processes more flexible and better internal organization
5.2	Poor provision of basic services (electricity, water and sanitation)	Financing, use of the prepaid system (credilec), for better control of consumption
5.3	Lack of manpower	Maximization of production areas
5.4	Lack of transportation for employees and maintenance of agricultural equipment	The movement of employees in order to meet the goals established for each activity Maintain equipment
5.5	Lack of an irrigation system for trials and seed multiplication. Lack of assembly of purchased equipment and staff training	Establish a 20 ha irrigation system for rice cultivation and another 15 ha system for different crops Assemble equipment, train laboratory personnel in biotechnology, plant health, soil and other laboratories

15.9 Annex 9: List of Documents Consulted

- Director, Zambia Agricultural Research Institute (ZARI)
- Assistant Director for Research Services, ZARI
- Assistant Director for Technical Services, ZARI
- Chief Agricultural Research Officer - Plant Protection, ZARI
- Chief Agricultural Research Officer - Crop Improvement and Agronomy, ZARI
- Chief Agricultural Research Officer - Soil and Water Management, ZARI
- Researchers, ZARI (7 individuals)
- Lecturers and Researchers, University of Zambia (3 individuals)
- Director, Plant Quarantine and Phytosanitary Service (PQPS)
- PQPS Staff (2 individuals)
- Acting Chief Agricultural Research Officer - Farming Systems and Social Sciences, Kabwe Research Station
- Director, Seed Control and Certification Institute (SCCI)
- SCCI Staff (2 individuals)
- Chief Agricultural Research Officer - Region I & II, ZARI
- Programmes Officer, ZARI
- Co-founder and CEO, Private Seed Company

15.10 Annex 10: List of Entities and Stakeholders Consulted

- APPSA Project Appraisal Document
- APPSA Progress Reports
- APPSA End-of-Project Evaluation Report
- ZARI Strategic Plan
- National Agricultural Policy
- National Agricultural Research Policy
- National Agricultural Investment Plan
- Transcripts of interviews and meetings conducted during the needs assessment

15.11 Annex 11: List of Specific Gap of the RCoL

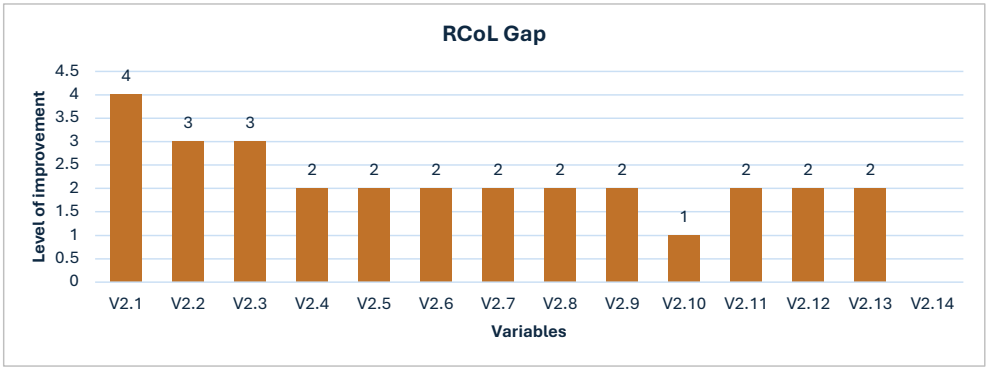
- Semi-structured interview guides for different stakeholder categories (ZARI management, researchers, beneficiaries, partners)
- Observation checklists for site visits (research stations, laboratories, irrigation facilities)
- Questionnaire for key informants covering various aspects of the RCoL's capacity, performance, and needs

15.12 Annex 12: Transcript of the RCoL Data Collection Questionnaire

1 Assessment of indicative remaining Gaps:

As part of gap assessment, countries were asked to indicate the extent to which the following factors did improve since the time support was given to establish the RCoL in their countries. The responses ranged from low value (1) indicating **insignificant improvement** and high value (5) indicating **very significant improvement**.

For Zambia, the indicative assessment is shown below:



Notes:

V2.1	Opportunities for strengthening value addition
V2.2	Opportunities for promoting exports
V2.3	Access to agricultural technologies to support production activities
V2.4	Level of training & dissemination of agricultural technologies status
V2.5	Management styles used in dealing with the product
V2.6	Institutional arrangements supporting the commodity
V2.7	Human Resources, leadership, and Governance supporting the product
V2.8	Level of capacity in terms of research, knowledge, and technology generation
V2.9	Infrastructure for conducting research and production (Lab, transport, equipment etc),
V2.10	Infrastructure for marketing and distribution
V2.11	Collaboration among stakeholders to share knowledge.
V2.12	Investment in agricultural research.
V2.13	Ability to deal with climate change and other natural disasters

Indicating some gaps, insignificant to moderate improvements were observed for the following variables:

- Level of training & dissemination of agricultural technologies status
- Management styles used in dealing with the product
- Institutional arrangements supporting the commodity
- Human Resources, leadership, and Governance supporting the product
- Level of capacity in terms of research, knowledge, and technology generation
- Infrastructure for conducting research and production (Lab, transport, equipment etc),
- Infrastructure for marketing and distribution
- Collaboration among stakeholders to share knowledge.
- Investment in agricultural research.
- Ability to deal with climate change and other natural disasters

2 Areas of improvements

Countries were requested through focal points to briefly recommend areas that they required to be addressed specifically to improve the situation related to the performance of RCoL.

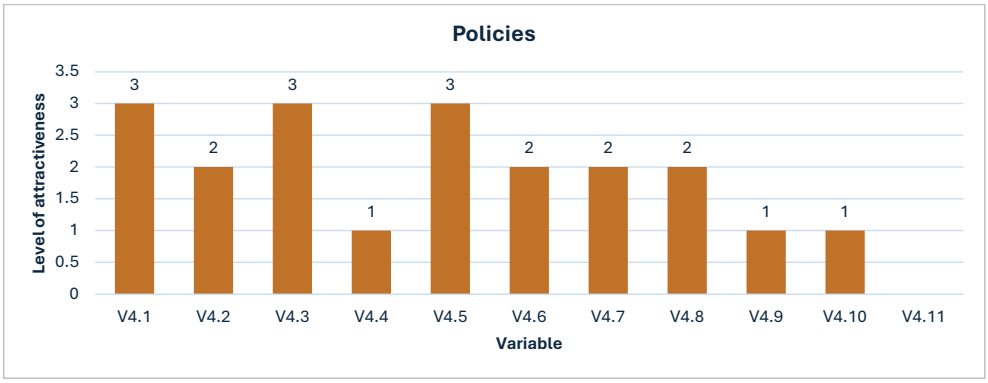
For Zambia, the following areas of improvements were recommended:

Variable that needs strengthening	Proposed intervention
Strengthen value addition	There is need for increased capacity building and investment in value addition for most commodity crops.
Promote Exports	Strengthen market linkages through capacity building on sanitary and phytosanitary standards including good agricultural practices. Intervention can be targeted especially at producers.
Access to agricultural technologies to support production activities	Strengthen research-extension linkages.
Improved Level of training & dissemination of agricultural technologies status	There is a still a need to train more staff in dissemination of agricultural technologies. More specifically extension staff.
Improved Management styles used in dealing with the product	Additional training is required in plant breeding.
Improved Institutional arrangements supporting the commodity	There is a need for specific policy interventions aimed at strengthening intuitional arrangements e.g., variety licensing arrangements between public research and seed companies.
Improved Human Resources, leadership, and Governance supporting the product	Over the years a number of staff who benefitted from training have retired, thus there is a need to train more staff especially at PhD level.
Improved Level of capacity in terms of research, knowledge, and technology generation	There is a still a human resource gap in areas of plant breeding and soil sciences. There number of researchers with post-graduate training is comparatively low.
Improved infrastructure for conducting research and production (Lab, transport, equipment etc),	There is need for additional laboratory, transport and equipment in research centres located further away from the capital.
Improved infrastructure for marketing and distribution	There is still a need to build capacity for marketing and distribution e.g., warehousing.
Improved collaboration among stakeholders to share knowledge.	Some progress has been made, however, there is a need to strengthen collaboration among stakeholders. For example, during the project ZARI developed an IP policy but this has not been operationalized.
Improved investment in agricultural research.	There is a need to lobby for increased investment in agricultural research. Currently, the research budget is less than 5% of the total agricultural budget.
Improved ability to deal with climate change and other natural disasters	Capacity needs to be built in development of climate smart technologies. Although Zambia has mechanism for early warning and disaster risk reduction in place.

3 Assessment of the level of supportive policies:

Countries were asked to indicate the extent to which the following **regional policies and regulatory framework** favoured or hindered the performance of their Agricultural Productivity and the well-functioning of the Regional Centre of Leadership (RCoL). Responses from lower codes (1) indicating “Not Conducive at all” to higher codes (5) indicating “Very Conducive”.

For Zambia, the following outcomes were observed



Notes:

V4.1	Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption
V4.2	Policies on Importation of Technology and industrial retooling/upgrading
V4.3	Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders
V4.4	Policies to facilitate the trading of high breed seed varieties within the SADC Member States
V4.5	Policies to support to agricultural research
V4.6	Policies to facilitate training
V4.7	Policies that ensure ease access to finance and innovative Public Expenditure review
V4.8	Policies that favor infrastructure development
V4.9	Policies that reduce trade barriers
V4.10	Existence of regulatory framework that support production and exports

For Zambia, the following policies were found to be less conducive and hence warranting some attention:

- Policies on Importation of Technology and industrial retooling/upgrading
- Policies to facilitate the trading of high breed seed varieties within the SADC Member States
- Policies to facilitate training
- Policies that ensure ease access to finance and innovative Public Expenditure review
- Policies that favour infrastructure development
- Policies that reduce trade barriers
- Existence of regulatory framework that support production and exports

4 Risk and Recommendations

Countries were asked to indicate some of the risks they faced and how they did overcome them as they strengthened their RCoL including recommendations to overcome them?

For Zambia the following were observed:

Risk	Remedial Action/Recommendation
Delayed implementation of activities	Leveraging on institutional capacities from stakeholders
Exchange losses	Beyond our control
Budget overruns	Effective monitoring and evaluation

Annexes - Part 2

15.13 Annex13: Response to Questionnaire Data summaries

Botswana

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
1	1	1	5	5	5	5	2	5	5	2	2	1	1	1

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
1	1	1	2	2	2	1	2	2	2	3	1	1	1	1

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
5	5	5	2	5	5	5	5	1	3	5	2	1	1	1

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
1	1	1	2	1	1	3	2	4	4

Democratic Republic of Congo

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
1	5	5	1	5	5	3	1	1	5	1	3	1	1	1

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
1	5	4	1	5	3	3	1	1	5	1	3	1	1	1

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
1	5	5	1	5	3	3	1	1	5	1	3	1	1	1

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
5	5	5	5	5	5	5	5	5	5

Eswatini

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
3	3	5	1	2	1	1	1	1	2	1	1	1	1	2

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
3	3	4	1	1	2	1	1	1	2	1	1	1	2	2

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
2	1	3	1	2	1	1	1	1	1	1	1	1	2	1

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
2	2	1	1	1	1	1	1	1	1

Mauritius

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
2	0	2	4	2	0	2	3	5	2	5	0	2	2	2

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
3	2	2	4	2	2	2	4	3	2	3	3	2	5	2

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
3	2	2	4	2	2	3	3	3	2	3	2	2	4	2

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
3	2	3	3	2	1	4	1	2	3

Namibia

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
2	3	3	3	4	3	3	3	2	3	2	2	3	4	2

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
3	3	3	2	3	3	3	2	3	3	3	4	4	3	3

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
3	3	4	2	3	4	4	3	3	3	3	2	2	3	3

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
3	3	3	3	2	2	3	3	3	2

South Africa

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
0	0	2	2	4	4	4	2	2	4	2	3	2	4	2

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
1	1	1	2	2	2	2	2	2	4	2	2	2	4	2

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
4	4	4	4	4	3	4	2	3	4	3	2	2	5	4

Policy issues

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
4	4	4	4	4	3	4	2	3	4	3	2	2	5	4

Tanzania

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
2	2	3	1	3	2	3	1	1	1	2	1	1	2	1

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
2	2	3	1	4	3	3	1	1	1	1	1	1	3	3

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
1	1	2	1	3	2	2	1	1	1	1	1	1	1	2

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
1	1	1	2	1	2	2	2	1	1

Zimbabwe

Product 1

V.3.1	V3.2	V3.3	V3.4	V3.5	V3.6	V3.7	V3.8	V3.9	V3.10	V3.11	V3.12	V3.13	V3.14	V3.15
5	5	5	0	4	4	2	2	0	2	0	0	3	2	0

Product 2

V.4.1	V4.2	V4.3	V4.4	V4.5	V4.6	V4.7	V4.8	V4.9	V4.10	V4.11	V4.12	V4.13	V4.14	V4.15
4	4	2	1	4	2	1	1	1	3	2	2	2	2	2

Product 3:

V.5.1	V5.2	V5.3	V5.4	V5.5	V5.6	V5.7	V5.8	V5.9	V5.10	V5.11	V5.12	V5.13	V5.14	V5.15
4	4	4	2	4	2	2	2	2	3	2	2	2	2	1

Policy issues

V.6.1	V6.2	V6.3	V6.4	V6.5	V6.6	V6.7	V6.8	V6.9	V6.10
1	1	1	2	1	1	3	2	4	4

Notes

- V3.1 Availability of inputs for production
- V3.2 Supportive infrastructure for production
- V3.3 Availability of warehousing, including management of post-harvest/production logistics
- V3.4 Export market potential
- V3.5 Access to finance
- V3.6 Availability of infrastructure for distribution
- V3.7 Availability of marketing infrastructure
- V3.8 Ease of exporting across the SADC region
- V3.9 Potential for growth in sales or profitability
- V3.10 Governance of the commodity
- V3.11 Attractiveness of the commodity in terms of the External environmental
- V3.12 Level of government support for the commodity
- V3.13 Availability of opportunities for research and technology transfer
- V3.14 Resistance against climate change
- V3.15 Level of skills and other human resources within the commodity

Notes: Existence of enabling Environment/policies that deal with

- V6.1 Technology adoption
- V6.2 Technology and industrial retooling/upgrading
- V6.3 Collaboration in researchers, private sector, civil society, farmers and other stakeholders
- V6.4 Trading of high-breed seed varieties within the SADC MS
- V6.5 Agricultural research
- V6.6 Facilitation of training
- V6.7 Ease access to finance and innovative Public Expenditure review
- V6.8 Infrastructure development
- V6.9 Reduction of trade barriers
- V6.10 Regulatory framework that supports production and exports

15.14 Annes 14: Questionnaire

Group 2: Countries

Data Collection Instrument

As you are aware CCARDESA is implementing a second phase of the Agricultural Productivity Programme for Southern Africa (APPSA) in the context of the National Agriculture Research and Extension Systems (NARES). In this regard, CCARDESA is exploring the establishment of new, well-functioning and sustainable Regional Centres of Leadership (RCoLs).

Pursuant to this, I hereby kindly request that you assist Mr Chiwandamira and his Associates to carry out a needs assessment by liaising with relevant officers that deal with agriculture and agricultural research, climate, and natural resources in the context of NARES.

You are hereby kindly being requested that you complete the attached Questionnaire.

This will not take more than 10 minutes of your busy schedule.

PART 1: GENERAL INFORMATION

1.1	Country Name	
1.2	Name of the Ministry	
1.3	Department	
1.4	Title of the Respondent	
1.5	Other (Specify)	

PART 2: COMMODITY PRIORITIZATION

Which Agriculture commodity in your Country do you think has a **comparative advantage** in the SADC region and international markets in terms of Export potential. List 3 of them in terms of priority starting with Number 1 priority in that order:

	Product Name	Main Comparative advantage (List)
2.1		
2.2		
2.3		

PART 3: CHALLENGES AFFECTING THE OPTIMAL PERFORMANCE OF PRODUCT 1 ABOVE

Using a scale ranging from (1) to (5) indicate the level of challenges being faced by the product to perform optimally with (1) Very minor Challenge and (5) Significant Challenge.

	Variable	1	2	3	4	5
3.1	Availability of inputs for production					
3.2	Supportive infrastructure for production					
3.3	Availability of warehousing including management of post-harvest/production logistics					
3.4	Export market potential					
3.5	Access to finance					

	Variable	1	2	3	4	5
3.6	Availability of infrastructure for distribution					
3.7	Availability of marketing infrastructure					
3.8	Ease of exporting across the SADC region					
3.9	Potential for growth in sales or profitability					
3.10	Governance of the commodity					
3.11	Attractiveness of the commodity in terms of the External environmental					
3.12	Level of government support for the commodity					
3.13	Availability of opportunities for research and technologies transfer					
3.14	Resistance against climate change					
3.15	Level of skills and other human resources within the commodity					

PART 4: CHALLENGES AFFECTING THE OPTIMAL PERFORMANCE OF PRODUCT 2 ABOVE

Using a scale ranging from (1) to (5) indicate the level of challenges being faced by the product to perform optimally with (1) Very minor Challenge and (5) Significant Challenge.

	Variable	1	2	3	4	5
4.1	Availability of inputs for production					
4.2	Supportive infrastructure for production					
4.3	Availability of warehousing including management of post-harvest/production logistics					
4.4	Export market potential					
4.5	Access to finance					
4.6	Availability of infrastructure for distribution					
4.7	Availability of marketing infrastructure					
4.8	Ease of exporting across the SADC region					
4.9	Potential for growth in sales or profitability					
4.10	Governance of the commodity					
4.11	Attractiveness of the commodity in terms of the External environmental					
4.12	Level of government support for the commodity					
4.13	Availability of opportunities for research and technologies transfer					
4.14	Resistance against climate change					
4.15	Level of skills and other human resources within the commodity					

PART 5: CHALLENGES AFFECTING THE OPTIMAL PERFORMANCE OF PRODUCT 3 ABOVE:

Using a scale ranging from (1) to (5) indicate the level of challenges being faced by the product to perform optimally with (1) Very minor Challenge and (5) Significant Challenge.

	Variable	1	2	3	4	5
5.1	Availability of inputs for production					
5.2	Supportive infrastructure for production					
5.3	Availability of warehousing including management of post-harvest/production logistics					
5.4	Export market potential					
5.5	Access to finance					
5.6	Availability of infrastructure for distribution					
5.7	Availability of marketing infrastructure					
5.8	Ease of exporting across the SADC region					
5.9	Potential for growth in sales or profitability					
5.10	Governance of the commodity					
5.11	Attractiveness of the commodity in terms of the External environmental					
5.12	Level of government support for the commodity					
5.13	Availability of opportunities for research and technologies transfer					
5.14	Resistance against climate change					
5.15	Level of skills and other human resources within the commodity					

PART 6: APPROPRIATENESS OF POLICIES AND INSTITUTIONAL SETUPS

From a scale ranging from (1) to (5) indicate the extent to which the following **regional policies and regulatory framework** favour or likely to hinder the performance of Agricultural Productivity in the region and the well-functioning of your Regional Centre of Leadership (RCoL). Use a range from (1) Very Conducive = to (5)- Not Conducive al all (Tick).

	Variable	1	2	3	4	5
5.1	Policies towards Strengthening the Institutional and Enabling Environment for Technology Adoption					
5.2	Policies on Importation of Technology and industrial retooling/upgrading					
5.3	Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers, and other stakeholders					
5.4	Policies to facilitate the trading of high breed seed varieties within the SADC Member States					
5.5	Policies to support to agricultural research					
5.6	Policies to facilitate training					
5.7	Policies that ensure ease access to finance and innovative Public Expenditure review					
5.8	Policies that favour infrastructure development					
4.9	Policies that reduce trade barriers					
5.10	Existence of regulatory framework that support production and exports					
5.11	Other (indicate)					

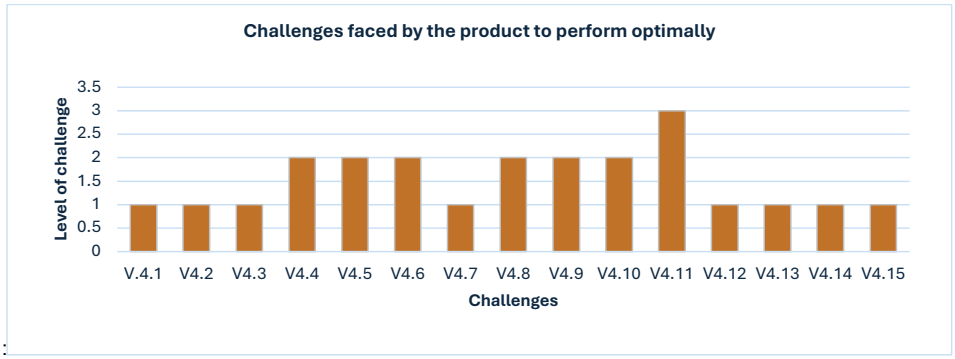
15.15 Annex 15: List of Entities and Stakeholders Consulted

Country	Institutions	Name of Contact & Positions	Remarks
Botswana	Ministry of Agriculture Research & Development Institute	Lorato Bailang	Completed
Botswana	Ministry of Agriculture Research & Development Institute	Keneilwe Bungile	Completed
DRC	Ministry of Agriculture Plant Protection Department	Jean-Louis Tshisambu Mamba	Completed
DRC	Ministry of Agriculture Plant Protection Department	Csihgui Murhula Justin	Completed
Eswatini	Ministry of Agriculture	Bongani Mvubu	Completed
Madagascar	Ministry of Agriculture	Mr Raharimis Vonjy	Completed
Mauritius	Ministry of Agro-Industry & Food Security/Research & Extension	Goolaud Akhilandjee	Completed
Namibia	Ministry of Agriculture, Water & Land Reform	Ms Benita Tonateni Elago	Completed
Namibia	Ministry of Agriculture, Water & Land Reform	Dr Maliata Athon Wanga	Completed
Seychelles		Sandra Sinon	Pending
South Africa	Agriculture Research Council	Mthokozisi Kwazi Zuma	Completed
Tanzania		Vidah Mahava	Completed
Tanzania	Ministry of Agriculture	Dr Richard Kasunga	Completed
Zimbabwe	Ministry of Agriculture /Research Department	Lloyd Sondayi	Completed

15.16 Annex 16: Indicative challenges for Priority 2 and 3 in graphical format

Botswana

Priority 2



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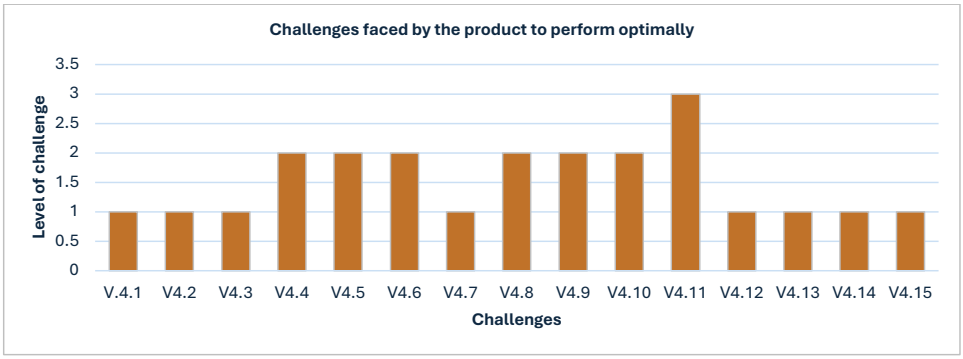
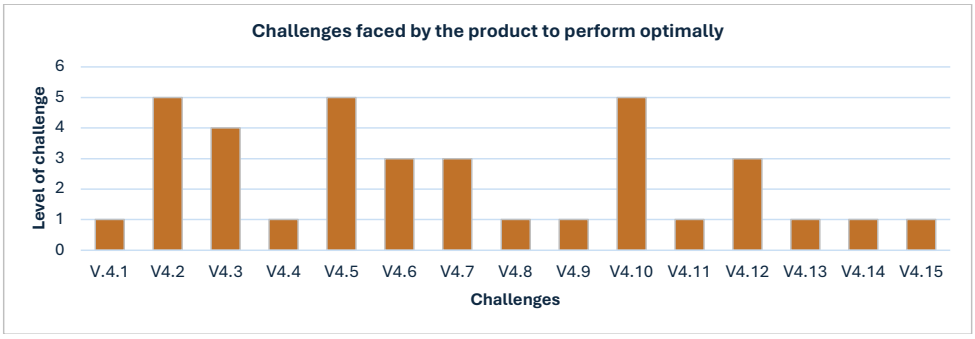
Priority 3:



Democratic Republic of Congo

Priority 2



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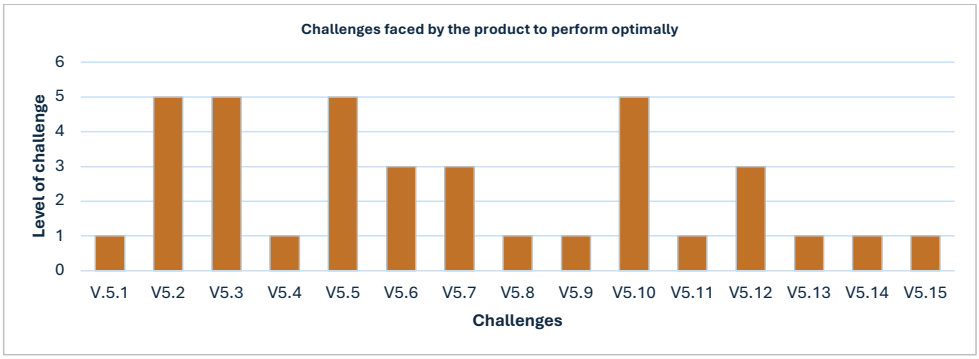
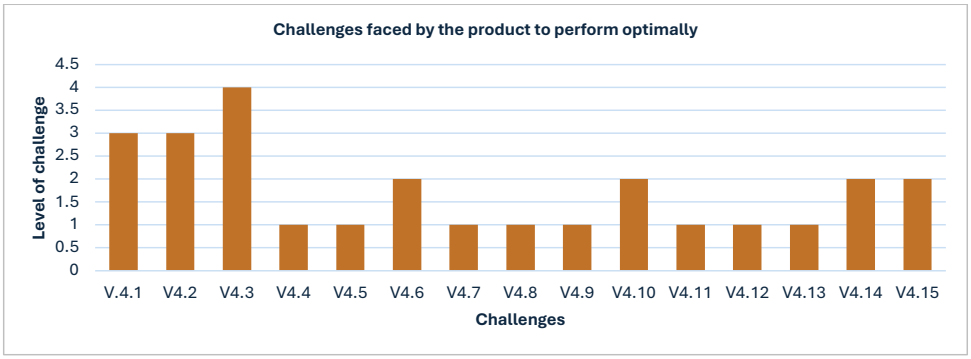


Eswatini

Priority 2:



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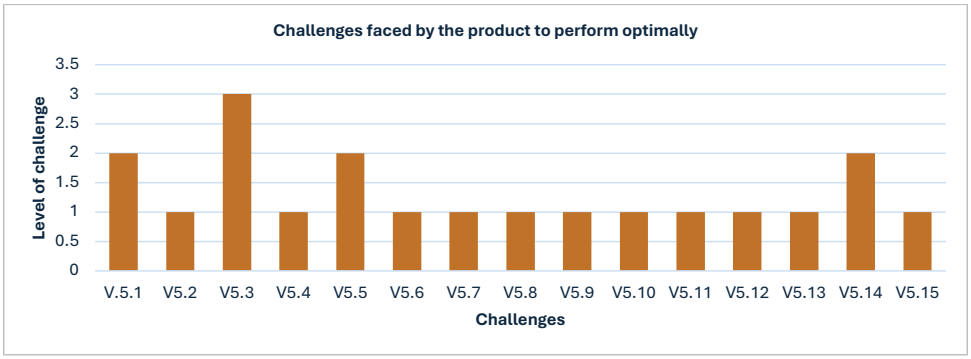
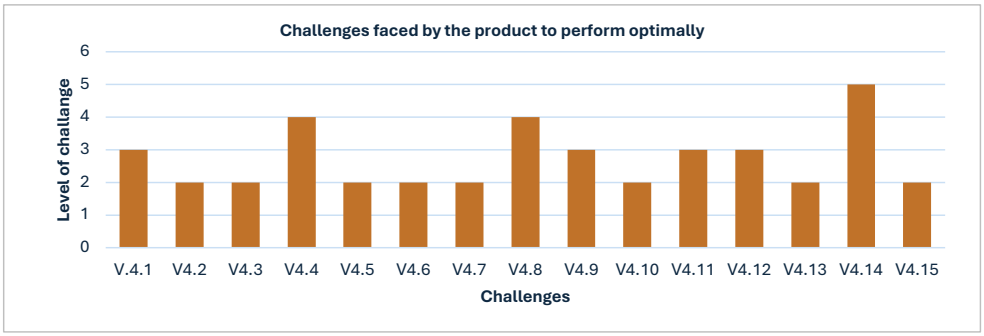
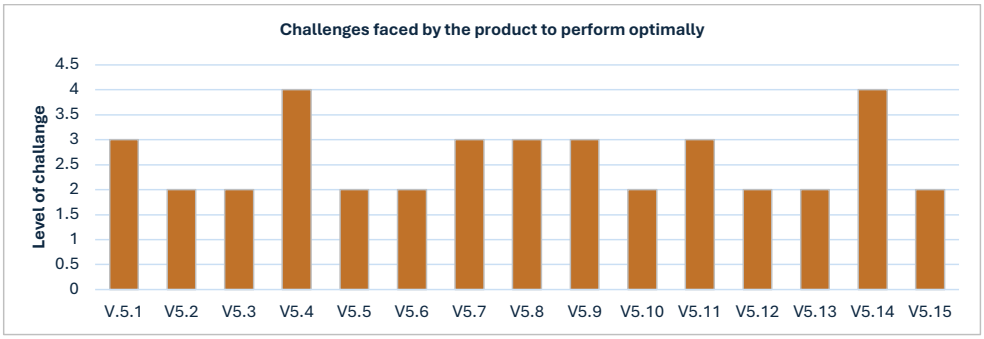


Mauritius

Priority 2

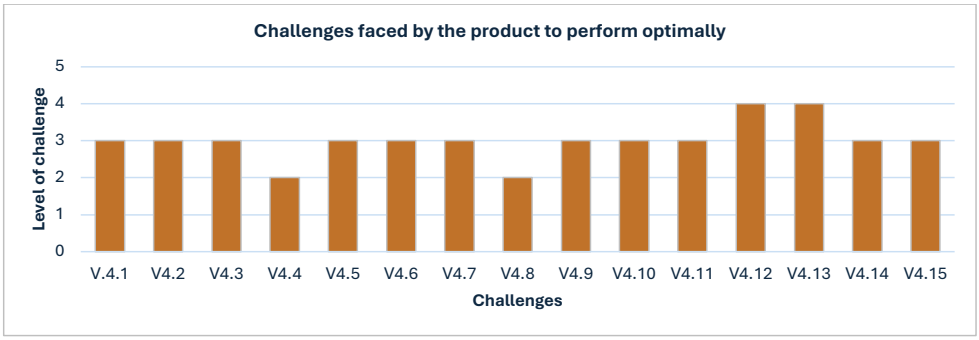


Priority 3



Namibia

Priority 2



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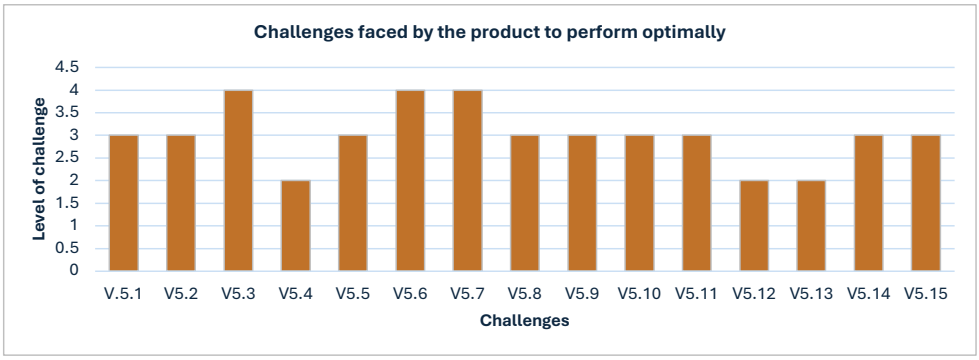
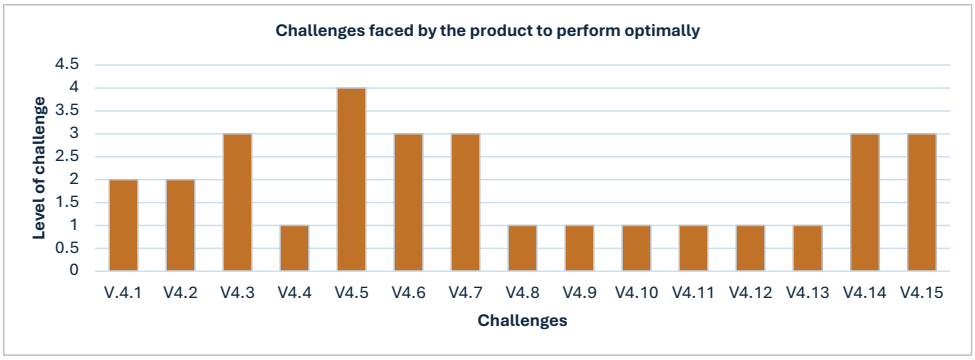


Tanzania

Priority 2



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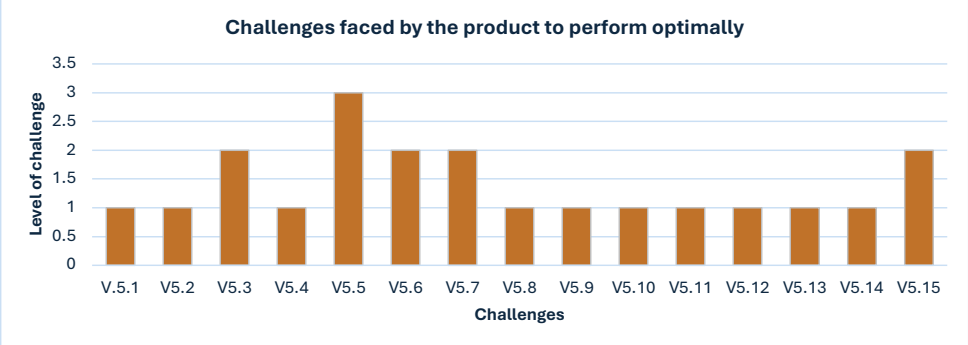
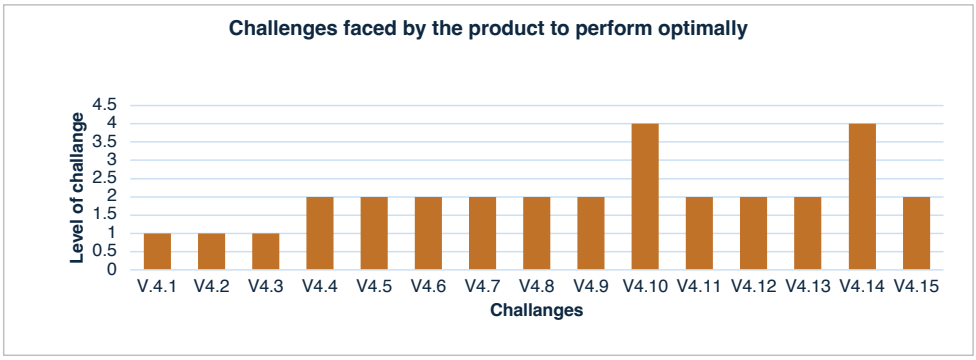


South Africa

Priority 2



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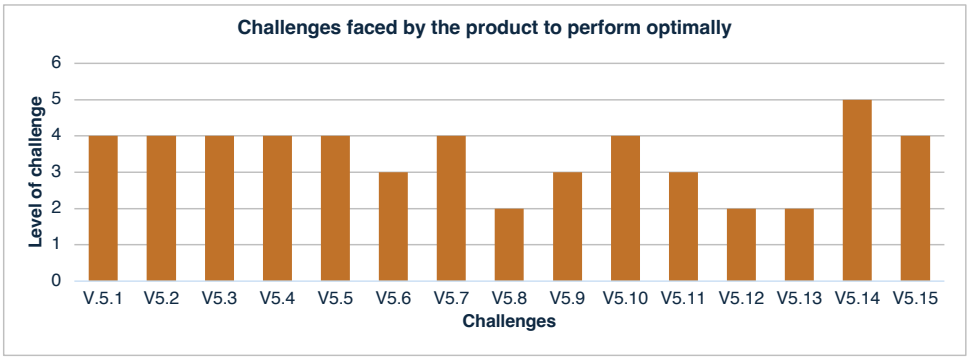
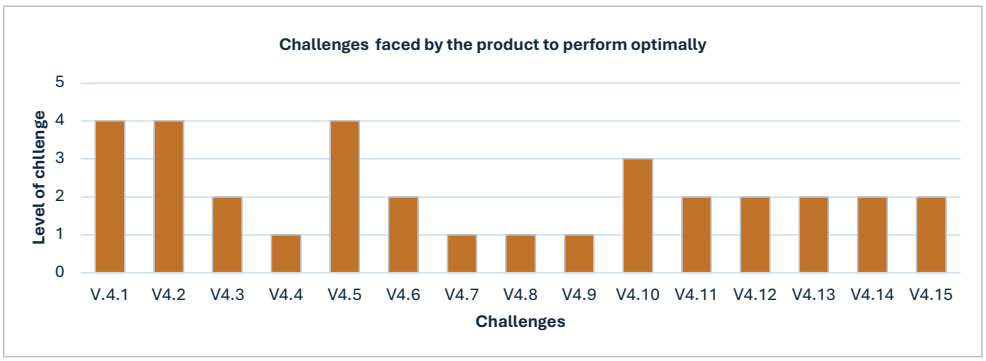
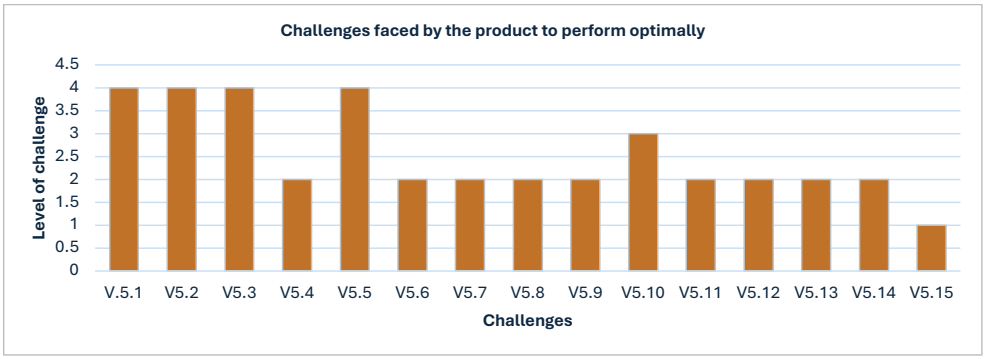


Zimbabwe

Priority 2



Priority 3



Notes

V4.*1* *Availability of inputs for production*
V4.2 *Supportive infrastructure for production*
V4.3 *Availability of warehousing, including management of post-harvest/production logistics*
V4.4 *Export market potential*
V4.5 *Access to finance*
V4.6 *Availability of infrastructure for distribution*
V4.7 *Availability of marketing infrastructure*
V4.8 *Ease of exporting across the SADC region*
V4.9 *Potential for growth in sales or profitability*
V4.10 *Governance of the commodity*
V4.11 *Attractiveness of the commodity in terms of the External environmental*
V4.12 *Level of government support for the commodity*
V4.13 *Availability of opportunities for research and technology transfer*
V4.14 *Resistance against climate change*
V4.15 *Level of skills and other human resources within the commodity*

15.17 Annex 17: References

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Other documents reviewed

i. APPSA Progress Reports
ii. APPSA End-of-Project Evaluation Report
iii. National Agricultural Policy
iv. National Agricultural Research Policy
v. National Agricultural Investment Plan
vi. Transcripts of interviews and meetings conducted during the needs assessment
vii. Product Country reports

15.18 Annex 18: Terms of Reference

REQUEST FOR EXPRESSION OF INTEREST: Consultancy for needs assessment for the establishment of new and strengthening of current regional centers of leadership

Job Description:

CONSULTING SERVICES – INDIVIDUAL CONSULTANT SELECTION

Reference No. (as per Procurement Plan): BW-CCARDESA-2023113-CS-INDV

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) has received financing from the World Bank toward cost of the facilitation of the implementation of the Food Systems Resilience Project (FSRP) and intends to apply part of the proceeds to engage an individual consultant to lead the needs assessment consultancy for the establishment of new and strengthening of current regional centers of leadership under Food System Resilience Programme for Eastern and Southern Africa.

The overall objective of this assignment is to assess the needs of the National Agriculture Research and Extension Systems (NARES) for them to be able to conduct agricultural research and extension services for use in supporting the establishment of new Regional Centers of Leadership (RCoLs) and strengthening the existing RCoLs.

The scope of methods should be selected to fit the purposes and context of the needs assessment and able to set priorities and criteria for solutions to be used by CCARDESA and partners for sound decision-making to improve the capacity of human, physical, and financial resources with the aim of improving the delivery of programs, services, organizational structure and operations, or a combination of these elements. The consultant will be expected to synthesise data and draft the assessment report and present the findings of the assessment during validation meetings and update the report based on comments received.

The consultant will be expected to, among others, undertake the following tasks:

Under needs identification, the consultant is expected to categorize the countries into two thus:

a) Identification of the capacity gaps for the RCoLs and NARES

Group 1: The countries with already established RCoLs. These countries were capacitated through CCARDESA to establish Regional Centers of Leadership based on their priority commodities. Malawi was capacitated to be the Centre of Leadership in maize-based farming systems, and Mozambique became a leader in rice-based farming systems. At the same time, Zambia was supported to become a leader in Legume based farming systems. The countries were supported in improving infrastructure and human capacity through long- and short-term trainings. The consultant is expected to analyze how the RCoLs utilize the facilities and identify the emerging challenges that will require further support to operationalize and sustain the RCoLs fully. In addition, the consultant is expected to generate lessons for use in supporting the establishment of the new RCoLs.

Group 2: The second category comprises the countries that have not established RCoLs in the priority value chains. This will target 13 SADC Countries, excluding the three Countries with already established RCoLs (Malawi, Mozambique, and Zambia) and the Countries currently being supported to establish the RCoL (Angola and Lesotho). The consultant will be expected to establish the priority commodities and determine the capacity needs of these countries to establish a Center of Leadership in the specific commodities.

The consultant is also expected to analyze the agricultural/farming technologies and services to identify gaps for supporting the upgrading of existing national centers through institutional linkages with regional and international networks and academic and research institutions; for coordinating specific knowledge and expert exchange programs working with national and regional centers.

b) Assessment of high-level policies, initiatives, institutional arrangements, and even budgeting decisions that have cross-cutting relevance to food systems resilience.

The consultant will review policies, assess entry points for building a resilience-focus into national planning mechanisms and policies, and develop a new-generation framework for carrying out agricultural public expenditure reviews (PERs) that offer insight into opportunities to better align public resources with resilience-informed policy priorities. The consultant will carry out policy and value chain analyses, needs assessments, and other analytical work, notably focusing on seed production and regulatory systems, intellectual property rights, and biosafety regulations to activities on regional policy dialogue.

c) Identify the actions and resources required for CCARDESA to strengthening the research system's response to the challenges of climate change.

The Centre for Coordination of Agricultural Research and Development for Southern Africa now invites eligible individual consultants to indicate their interest in providing the Services. Interested consultants should provide information (Comprehensive CVs that show description of similar assignments, experience in similar conditions) demonstrating that they have the required qualifications and relevant experience to perform the Services.

The shortlisting criteria are:

The consultant shall be well qualified and experienced as required and appropriate for execution of the assignment. The consultant should possess necessary technical capacity and resources to perform the assignment of such nature including relevant equipment and software. The Consultant shall have the following minimum qualifications and experience:

- Education: At least a Masters degree in Agriculture, Social Sciences, development studies, Strategic Management, or equivalent.
- Experience: At least fifteen (15) years of professional experience in conducting capacity gap assessment studies with emphasis in human, infrastructure, financial, and institutional policies.
- Experience: Minimum of ten (10) years' experience in leading assessment of policies at national and regional levels preferably in Agriculture.
- Language Requirements: English will be the working language. Knowledge of French and Portuguese will be an added advantage.
- Demonstrable ability to write concise technical papers and synthesis reports on subjects related to the assignment; and
- Experience in policy analysis will be an added advantage

The attention of interested Consultants is drawn to paragraph 1.9 of the World Bank's Guidelines: Selection and Employment of Consultants under IBRD Loans and IDA Credits & Grants by World Bank Borrowers ("Consultant Guidelines"), setting forth the World Bank's policy on conflict of interest.

Further information (terms of reference) can be obtained at the address below during office hours 0900 to 1630 hours.

Interested Individual Consultants should submit their expressions of interest, detailed curriculum vitae and a **brief technical proposal** to the address below (in person, or by mail, or by e-mail) not later than 01st February 2024. Applications should bear the **name of the assignment** in the subject field.