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 Abridged Report

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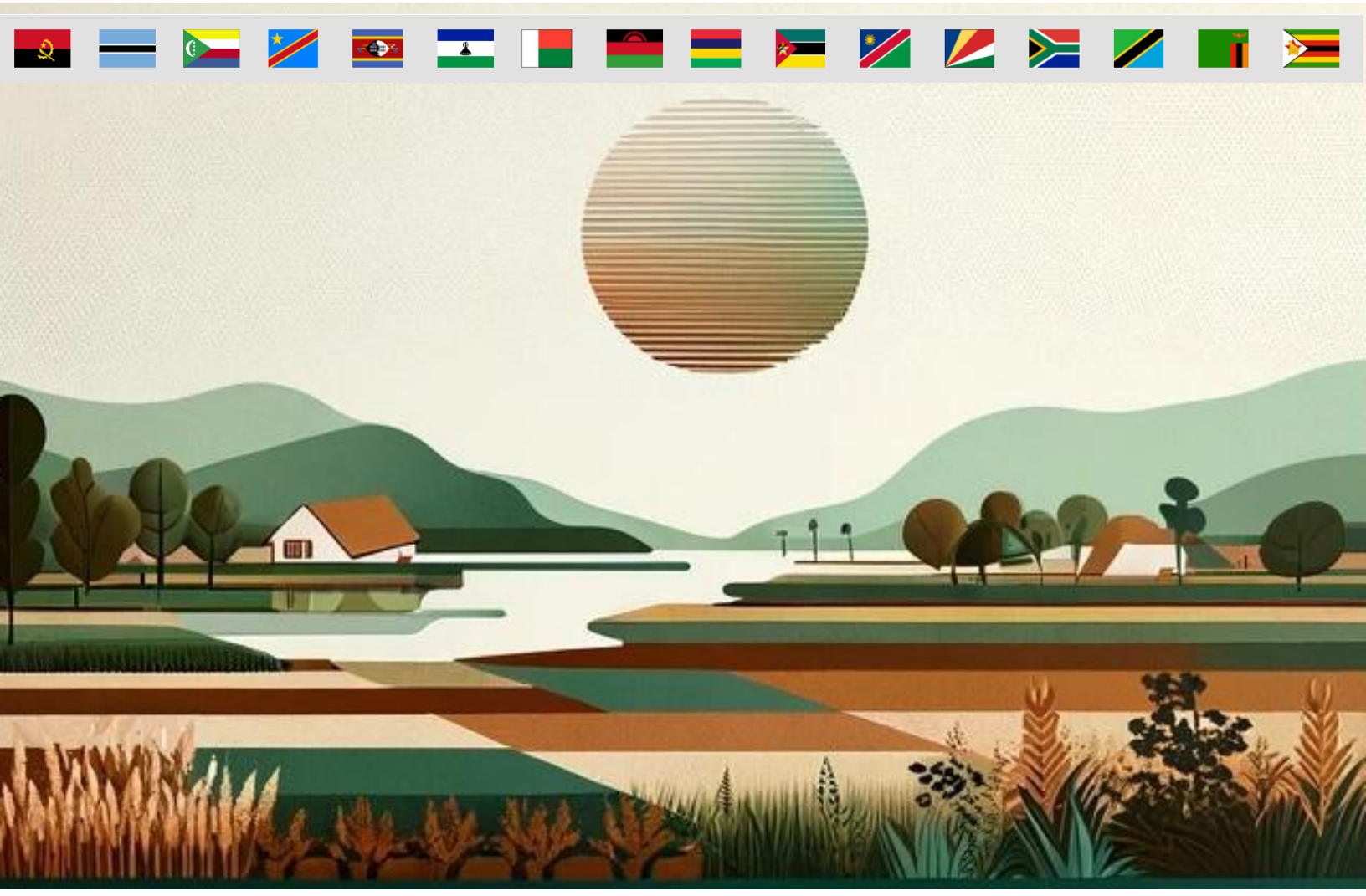

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Executive Summary

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 to assess the remaining gaps or challenges faced by those countries that have already been supported. The targeted gaps were in the areas of (1) human resources; (2) infrastructure; (3) finance; and (4) climate-related challenges. Furthermore, these countries were assessed regarding high-level policy gaps, initiatives, institutional arrangements and even budgeting decisions that have cross-cutting relevance to food systems resilience. For countries yet to establish Regional Centers of Leadership (RCoLs), the study sought to Identify the priority research and development commodities for the National Agriculture Research and Extension Systems (NARES) based on the country's preferences and regional competitiveness. This included assessing the country's needs and gaps covering the abovementioned areas. The study also analysed CCARDESA's role in strengthening the RCoLs' response to food security and resilience challenges.

This report presents the summary findings of the assessment done. Using a literature review, questionnaire surveys with focal persons in each country and field visit outcomes, the study found several capacity gaps in human resources, infrastructure, financing, and institutional policies among established RCoLs in Malawi, Mozambique and Zambia. It also determined priority research and development commodities for National Agricultural Research and Extension Systems (NARES) in other SADC countries. Additionally, the assessment examined relevant needs and policies for supporting the sustainable management of RCoLs and agriculture and CCARDESA's value proposition in supporting RCoLs.

Key recommendations include targeted capacity building, infrastructure upgrades, sustainable financing mechanisms, policy harmonisation, and strengthening CCARDESA's coordinating role. Implementing these recommendations will enhance the effectiveness of RCoLs in driving agricultural innovation and resilience across the SADC region. This abridged version of the report is accompanied by a detailed report highlighting specific methods and findings for each country and accompanying recommendations.

List of Acronyms and Abbreviations

APPSA	Agricultural Productivity Programme for Southern Africa
ARC	Agriculture Research Council
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
DRC	Democratic Republic of Congo
ICT	Information and Communication Technology
IoT	Internet of Things
IPR	Intellectual Property Rights
M&E	Monitoring and Evaluation
NARES	National Agriculture Research and Extension Systems
NARD	National Agricultural Research and Development
NSTIP	National Science, Technology and Innovation Policy
PPP	Public-Private Partnership
RAP	Regional Agricultural Policy
RCoL	Regional Centre of Leadership
SADC	Southern African Development Community
SPGRC	SADC Plant Genetic Resources Centre
SPS	Sanitary and Phytosanitary
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TVET	Technical and Vocational Education and Training

1 Introduction

The Southern African Development Community (SADC) region faces numerous agricultural productivity and food security challenges. This has been exacerbated by climate change-induced droughts due to erratic water supplies and infrastructure destruction. To address these challenges, the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) has facilitated, established and strengthened Regional Centers of Leadership (RCoLs) to drive agricultural innovation and knowledge sharing across SADC Member States. CCARDESA has since 2013 been facilitating the implementation of the Agricultural Productivity Programme for Southern Africa (APPSA) in collaboration with development partners such as the World Bank in Malawi, Mozambique, and Zambia. The primary aim of APPSA has been to enhance agricultural productivity and resilience by strengthening research capacities, improving infrastructure, and fostering regional collaboration. The three countries have been designated RCoLs, focusing on maize, rice-based, and legume-based farming systems. 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 strengthen existing ones. The study identifies the needs of and addresses the diverse challenges faced by the agricultural sector in Southern Africa, such as climate change, inadequate infrastructure, limited financial resources, policies, and institutional challenges. It also identifies priority research and development commodities for NARES across the remaining SADC Member States based on the regional competitiveness of these commodities.

The study also explored the actions and resources needed for CCARDESA to strengthen the research system's response to these challenges. The findings will guide CCARDESA and its partners in making informed decisions to enhance the region's agricultural research, technology generation, and overall food systems resilience.

The report has a section that presents the findings of the Gap Assessment done for Malawi, Mozambique and Zambia RCoLs. This report component provides information on gaps identified for each of the three countries based on the 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.

The other component of the report outlines the findings on the Needs Assessment for establishing 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 report summarised the methodology used in the need identification process under each country regarding 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.

2 General Methodology

The assessment employed a mixed-methods approach, combining quantitative and qualitative data collection and analysis techniques. Firstly, a desk review of relevant documents, including project reports, national agricultural policies, and regional frameworks, was done. Secondly, a structured and semi-structured Questionnaire was prepared and distributed online to the National Agricultural Research and Extension Systems (NARES) focal person to complete in consultation with other relevant stakeholders involved in the project at the country level. 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. Returned questionnaires were followed by clarification through emails and phone calls to increase the response rate. 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.

Key informant interviews were held with RCoLs staff, policymakers, researchers, and other stakeholders across the 12 target countries. This was accompanied by Field visits to established RCoLs in Malawi, Mozambique, and Zambia to observe facilities and operations directly.

The report also benefitted from policy analysis in identifying instruments supporting the sustainable management of RCoLs and agriculture at regional and national levels. A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was also done to identify some areas that needed strengthening. At the same time, emerging risks, particularly those related to climate change, were also addressed. A series of discussions were held with CCARDESA staff to understand more about the role of the CCARDESA Secretariat in coordinating and supporting RCoLs.

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 evaluating the entry points for building a resilience focus into national planning mechanisms and policies. Guided by the literature review, the interview questions mentioned above comprised variables such as availability of inputs for production, infrastructure for production, distribution and marketing, availability of warehousing, including management of post-harvest/production logistics, export market potential, Governance of the commodity, level of government support for the commodity, resistance to climate change, availability of opportunities for research and technology transfer and levels of skills and other human resources within the commodity.

Countries were also asked to indicate the extent to which Policies, institutional and regulatory frameworks were enabling technology and industrial retooling/upgrading, research, technology acquisition, training and infrastructure development.

3 Key Findings

3.1 Capacity gaps amongst established RCoLs

3.1.1 Human capacity

The assessment revealed significant human capacity gaps across the established RCoLs in Malawi, Mozambique, and Zambia. While these centers have made progress in building their research teams, several challenges persist:

In Malawi, the maize-based farming systems RCoL face a shortage of experienced senior researchers, particularly in specialised fields like molecular breeding and bioinformatics. Staff retention is a significant issue, with many trained personnel leaving for better opportunities in the private sector or international organisations.

Mozambique's rice-based farming systems RCoL struggle with a lack of doctorate-level scientists in key disciplines such as plant pathology and agricultural economics. Language barriers also hinder effective collaboration with regional and international partners.

Zambia's legume-based farming systems RCoL has made strides in building a multidisciplinary team, but gaps remain in areas like soil microbiology and climate-smart agriculture. Limited opportunities for continuous professional development hamper the center's ability to stay at the forefront of research innovations.

Across all three RCoLs, enhanced skills and capacity in research management, proposal writing, and scientific communication are needed to improve competitiveness for funding and dissemination of research outputs.

3.1.2 Infrastructural capacity

Infrastructure challenges vary across the established RCoLs but generally impede their ability to conduct cutting-edge research and respond effectively to emerging agricultural challenges:

The RCoL's laboratory facilities in Malawi require significant upgrades, particularly for molecular work and soil analysis. Unreliable power supply and internet connectivity hinder research activities and data management. Additional training facilities, including accommodation and catering facilities, are still needed to accommodate potential trainees from the region.

Mozambique's RCoL faces acute challenges with irrigation infrastructure, limiting its capacity to conduct year-round field trials. The center also lacks modern phenotyping facilities, constraining its ability to characterise rice varieties precisely.

Zambia's RCoL has relatively better laboratory infrastructure but struggles with outdated field equipment, affecting the scale and precision of field experiments. Limited cold storage facilities also pose challenges for germplasm conservation.

Across all centers, there is a pressing need for improved data management systems and high-performance computing capabilities to handle large-scale genomic and phenotypic data analysis. There is also a gap in state-of-the-art laboratory equipment across the three RCoLs.

3.1.3 Financial capacity

Financial constraints emerged as a cross-cutting issue affecting the sustainability and impact of all three established RCoLs:

Malawi's RCoL faces severe budgetary limitations, with heavy reliance on short-term project funding leading to discontinuity in research programs. Limited core funding from the government affects the center's ability to maintain basic operations and retain key staff.

In Mozambique, the RCoL struggles with inefficient financial management systems, which lead to delays in fund disbursement and procurement processes. This hinders the timely implementation of research activities and collaborations.

Zambia's RCoL has made progress in diversifying its funding sources but still faces challenges securing long-term, programme-based funding. Limited financial planning and reporting capacity affect the center's ability to attract and manage large grants.

All three RCoLs must develop more robust resource mobilisation strategies and improve their financial management capacities to ensure sustainable operations and impactful research programmes. The national budgetary systems must support the RCoLs' operations. Each RCoL should also seek regional allocation within the overall SADC budgetary annual allocation framework for joint regional programmes.

3.1.4 Institutional Policies

The assessment identified several policy-related challenges affecting the RCoLs' effectiveness in responding to their mandates and addressing resilient agricultural production in the face of climate change:

In Malawi, rigid institutional policies on staff recruitment and promotion hinder the RCoL's ability to attract and retain top talent. Cumbersome procurement policies often delay the acquisition of essential research supplies and equipment.

Mozambique's RCoL faces challenges related to unclear intellectual property policies, which hamper effective partnerships with the private sector and the commercialisation of research outputs. The center also lacks a comprehensive policy framework for climate-smart agriculture research.

Due to Zambia's centralised governance structures, the RCoL struggles with limited autonomy in decision-making. This affects the center's agility in responding to emerging research priorities and funding opportunities.

Across all three countries, there is a need for more supportive policies to facilitate regional collaboration and the exchange of genetic materials, which are essential for the RCoLs to fulfil their regional mandates effectively. There is also a need to domesticate and implement some of the regional frameworks and policies contained in various SADC protocols and policies at the national level. For example, implementing the provision of the SADC Protocol on Science, Technology and Innovation that encourages Member States to allocate at least 1% of their budget towards scientific research, technology and innovation. Other relevant policy and regulatory frameworks include the Regional Innovation and Technology Transfer Framework and Action Plan, the SADC Regional Comprehensive Africa Agriculture Development Programme - CAADP Compact (the Regional Agricultural Policy - RAP), the implementation of Climate adaptation and mitigation actions as outlined in National Adaptation Plans, Intended Nationally Determined Contributions as well as under the provisions of the Paris Agreement and the Glasgow Climate Pact, the Regional Sanitary and Phytosanitary (SPS) Regulatory framework and the implementation of Regional Framework on Intellectual Property Rights.

To address these gaps, key recommendations include the following:

- The development and implementation of comprehensive human resource development plans for each RCoL, including targeted recruitment strategies, competitive remuneration packages, and structured career progression pathways.
- Prioritise infrastructure upgrades based on strategic research priorities, with a focus on energy-efficient and climate-resilient facilities. This includes operationalising a SADC Regional Disaster

Preparedness Fund. This includes preparing contingency plans for floods and/or droughts that may affect the SADC Region and impact productive infrastructure.

- Establish sustainable financing mechanisms, including exploring public-private partnerships and developing robust resource mobilisation strategies.
- Harmonise institutional policies to enhance operational efficiency and foster an enabling environment for innovation and regional collaboration.
- Strengthen monitoring and evaluation systems to track the impact of RCoLs better and inform adaptive management strategies.

Implementing these recommendations will require concerted efforts from national governments, regional bodies, and development partners to ensure the RCoLs can effectively drive agricultural innovation and resilience across the SADC region.

3.2 Priority Research and Development Commodities for NARES

The assessment identified priority research and development commodities for National Agricultural Research and Extension Systems in the remaining SADC Member States, excluding Angola, Lesotho, Malawi, Mozambique, and Zambia. These priorities were determined based on regional competitiveness, food security importance, and potential for value addition. The priority Research and Development Commodities are shown in table 1 below:

Table 1: Priority Research and Development Commodities and proposed RCoLs

#	Country	Priority Commodity	Proposed Institution to act as RCoL
1	Botswana	Cow Peas	The National Agricultural Research and Development Institute's (NARD)
2	DRC	Green Coffee	The Plant Protection Directorate falls under the Ministry of Agriculture
3	Eswatini	Wheat	Agriculture Research and Specialist Services under the Ministry of Agriculture
4	Madagascar	Sorghum	Ministry of Agriculture, Livestock and Fisheries
5	Mauritius	Sugar Cane	Agriculture Research and Extension Institute under the Ministry of Agro-industry & Food Security

#	Country	Priority Commodity	Proposed Institution to act as RCoL
6	Namibia	Beef	Department of Agriculture Development under the Ministry of Agriculture water and land reform
7	South Africa	Citrus	The Agriculture Research Council (ARC)
9	Tanzania	Rice	Tanzania Agriculture Research Institute
10	Zimbabwe	Horticulture	Agriculture Research Department under the Ministry of Lands Agriculture and Fisheries

3.2.1 Common Challenges and recommendations

Across all the countries, common challenges that emerged included: (1) Lack of availability of quality inputs; (2) Weak supportive infrastructure for production, marketing and distribution; (3) Post-harvest challenges; (4) Limited access to finance; (5) Weak export market potential and difficulties in exporting across the SADC region; (6) Limited human resource and skill base within the commodity value chains; (7) Weak access to research and technology transfer; and (8) Climate change challenges.

To support these priority commodities, it is recommended that the following be done:

- Develop commodity-specific research and innovation strategies aligned with national agricultural development plans.
- Strengthen partnerships between research institutions, extension services, and private sector actors to ensure research outputs reach farmers and markets.
- Invest in capacity building for researchers and technicians in relevant disciplines, including climate-smart agriculture and value-addition technologies.
- Establish or upgrade specialised research facilities and equipment to support priority commodity research.
- Enhance regional collaboration and knowledge sharing on common challenges and opportunities related to priority commodities.

By focusing on these priority commodities and implementing targeted research and development initiatives, SADC Member States can enhance their agricultural competitiveness, improve food security, and drive regional economic growth.

3.2.2: Specific Country Gaps and recommendations

Some unique specific challenges were noted for each country, as presented in table 2 below:

Table 2: Specific Country Gaps

Country	Unique Gaps and Key needs	Unique actionable recommendations
Botswana	• Improved seed varieties • Water management infrastructure • Value addition technologies • Arid climate • Limited processing facilities	● Address the shortage of skilled cowpea farm labour required for land preparation, sowing, weeding, harvesting, and post-harvesting activities. ● Support the provision of water infrastructure to address perennial water shortages, including drilling of bore halls, given the scarcity of rains. ● Strengthen the resource mobilisation capabilities of the proposed RCol. ● Support acquiring technology and new equipment to improve farm operational efficiencies and effectiveness and increase productivity. ● Support to improve coordination and assist farmers in acquiring improved seed varieties and other inputs. ● Support with lobbying for appropriate resources to deal with drought incidences due to climate change. ● Address the gaps identified in operationalising agricultural extension services and transfer knowledge and practical skills to various farm initiatives. ● Address policy and regulatory barriers to importing chemicals and pesticides to control diseases and pests.
DRC	• Rehabilitation of coffee plantations • Quality control systems • Market linkages • Poor bean grading and harvesting techniques • Infrastructure gaps	● Support in developing post-harvest processing techniques to preserve bean quality. ● Address knowledge gaps regarding speciality coffee production methods. ● Support towards re-establishment of coffee mills following years of unrest and for other equipment and washing stations for coffee. ● Lobby for a robust resources mobilisation strategy to address financial gaps in the coffee sector. ● Facilitate research on common pests and diseases that affect coffee, such as coffee wilt disease (CWD), including information about the pathogen and its management.

Country	Unique Gaps and Key needs	Unique actionable recommendations
		• Enhance green coffee production's performance, as there are gaps related to the availability of quality production inputs. • Support with 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 • Research and knowledge generation in the coffee sector.
Eswatini	• Drought-resistant varieties • Irrigation systems • Storage facilities • Limited arable land • Competition with sugar industry	• Support coordination in acquiring specialised skills for small farmers, women, and young people. This should include support with skills and Technical and Vocational Education and Training (TVET). • Facilitate work by seed producers and other input suppliers to offer credit facilities for wheat farmers, including government subsidies on inputs. • Identifying opportunities in solar water pumping, including exploring pump retrofitting. • Supported the acquisition of proper handling and storage with appropriate temperature and humidity throughout the Wheat value chain • Invest in feed production technologies and conduct regular research to assess the needs of the farming community. • Strengthen capacity to improve the business environment and coordination and to facilitate policy dialogue and coordination. • Facilitate transfer of technology research results close to the farmers through exchange visits.
Madagascar	• Improved drought-tolerant varieties • Soil fertility management techniques • Post-harvest processing technologies • Frequent cyclones and droughts • Limited access to rural areas	• Develop more resilient cultivars, as well as research on sustainable production systems to protect biodiversity. • Identify high-quality inputs in the form of hybrid seed varieties and technology to address diseases and pests. • Address deforestation, habitat destruction, and wildfires while implementing measures to cope with the impact of climate change, such as drought preparedness and evacuation of the affected people. • Improve Malagasy farm workers' knowledge in terms of farming techniques. • Collaboration among researchers, private sector, civil society, farmers and other stakeholders.

Country	Unique Gaps and Key needs	Unique actionable recommendations
		• Promote public investment in expanding road infrastructure and encourage public-private partnership (PPP) in infrastructure delivery. • Facilitate the creation of an appropriate environment for the Sorghum industry to prosper, including the ratification of the SADC Industry Protocol signed by Madagascar in 2019.
Mauritius	• Mechanisation of harvesting • Diversification of sugar cane products • Climate-resilient varieties • Limited land availability • Competition from other sugar-producing countries	• Support 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, investing in human resources that cover agricultural operations, processing, and planning is important. • Enhancing and modernising production infrastructure and cane processing, including infrastructure to mechanise field operations, including small-scale growers. • Advocate for more investment in research that promotes the use of innovative and modern technologies that improve cane varieties and sugarcane co-products. This includes supporting efforts to innovate around sugarcane value-added products such as unique sugars, bagasse electricity, and fuel ethanol and their cost-effective scaling up. • Support 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. • Support the reduction of heavy reliance on fossil fuels. • Put in place incentives to promote collaboration in research. • Implement the regulatory provisions that promote the production of high-quality sugarcane varieties and the modernisation of farms.
Namibia	• Rangeland management techniques • Animal health and disease control • Value addition in meat processing • Arid climate and water scarcity	• Support to improve skills and provide training in extension services to address the challenges of cattle feed and diseases. • Train more extension agents to assist farmers in staying current with the latest information and skills on production methods and technology in Agriculture. • Support with access to water and electricity in rural areas to ensure bore hall drilling given the scarcity of rains. • Improve marketing and resource mobilisation capabilities of financial intermediaries.

Country	Unique Gaps and Key needs	Unique actionable recommendations
	• Vast distances between production areas and markets	● 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. ● Assist towards improving the supply of feed to the beef industry. ● Support the promotion of 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. ● Support towards 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.
South Africa	• Disease-resistant varieties • Water-efficient irrigation systems • Cold chain management for exports • Meeting stringent export market requirements • Balancing commercial and smallholder farmer needs	● Promote more investment in integrated pest management strategies and developing disease-resistant varieties. ● 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. ● Support ARC in drafting position papers to lobby for infrastructure, including the challenges related to electricity shortages. ● The RCoL should be capacitated to design and implement a robust resource mobilisation strategy. ● Strengthen the capacity of ARC towards enhanced Research and Acquisition of new technologies. ● RCoL to be capacitated to assist stakeholders by providing them with price and market trend information to enable them to compare and buy cheaply. ● Promote agricultural practices that strengthen the resilience to climate change and deal with the frequency of climate-induced challenges.

Country	Unique Gaps and Key needs	Unique actionable recommendations
		• Enhancing policies towards strengthening the institutional and enabling environment for technology adoption.
Tanzania	• Improved rice varieties for different agro-ecological zones • Integrated pest management strategies • Mechanisation of rice production • Competition between rice and other crops for resources • Climate variability affecting irrigation water availability	• Improve the pool of workers who are knowledgeable about rice production. • Improve on alternative water infrastructure source such boreholes instead of maintaining a high dependence on rainfall water which is erratic due to climate change. • Facilitate research on new varieties and more rice value addition that should be adopted. • The identified RCoL should be supported to facilitate research into the production of better seeds and other inputs, such as fertilisers, that help enhance rice yield. • Formulation of policies that address weak Technology and training programmes to support rice industrial retooling.
Zimbabwe	• Greenhouse production technologies • Cold storage and preservation techniques • Market information systems • Economic instability affecting input supply • Power supply issues for cold chain management	• Strengthen practical training and extension services in horticulture production and marketing skills. • Support imparting practical skills to students and trainees in tertiary and vacation learning and research institutions. • Support towards lobbying for sufficient technical and financial support to improve infrastructure provision, such as electricity, water supply, and Farm feeder roads, in the horticulture sector. • Enhance farm infrastructure, such as boreholes, irrigation facilities, Water storage, warehousing, Pack sheds, cold rooms and refrigerated transport. • Encourage the private banking sector and development banks to finance the horticulture sector. • Support to enhance research and acquisition of new technologies, facilitate knowledge generation and sharing, and enhance engagement with stakeholders through developing collaborative research projects. • Assist farmers with information on various input suppliers and facilitate bulky purchases. The RCoL should also be capacitated to play a critical role in advocating and facilitating the improvement of an enabling environment for the chain actors to

Country	Unique Gaps and Key needs	Unique actionable recommendations
		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. ● Support programmes to promote agricultural practices that strengthen the resilience to climate change and variability to ensure food and livelihood. ● Advocating for the accreditation of qualified agricultural agents. ● Lobbying for the simplification of import and export procedures within SADC and the resolution of non-tariff barriers.

3.3 Policies for supporting sustainable management of RCoLs and sustainable Agriculture

3.3.1 Gaps in Regional policy implementation

Several regional policy instruments that are needed to play a crucial role in supporting the sustainable management of Regional Centers of Leadership (RCoLs) were found to be limited in terms of domestication and implementation across all the remaining SADC Member States. These include (1) Policies towards strengthening the institutional and enabling environment for technology adoption; (2) Policies on the importation of technology and industrial retooling/upgrading; (3) Policies that facilitate collaboration among researchers, extension agents, private sector collaborators, civil society, farmers and other stakeholders; (4) Policies to facilitate the trading of high-breed seed varieties within the SADC Member States (5) Policies to support agricultural research and training; (5) Policies that ensure ease of access to finance and innovative Public Expenditure Review; (6) Policies that favour infrastructure development; (7) Policies that reduce trade barriers; and (8) Policies meant support production of value-added products for exports.

According to the above gaps, the study recommends that Member States be supported to domesticate and implement the following:

- SADC Regional Agricultural Policy (RAP) to enhance sustainable agricultural production, productivity, and competitiveness; improve regional and international trade and access to markets; and reduce social and economic vulnerability in the context of food and nutrition security.

- SADC Harmonized Seed Regulatory System to facilitate the easier movement of quality seed within the region and support RCoLs in their seed research and dissemination efforts.
- SADC Plant Genetic Resources Centre (SPGRC) Treaty provision to promote conservation and sustainable use of plant genetic resources, which is essential for RCoLs' breeding programs.
- SADC's Climate Change Strategy and Action Plan will help improve responses to climate change, including in the agricultural sector, and inform RCoLs' research on climate-resilient farming systems.
- SADC Regional Agricultural Investment Plan (RAIP) to promote investments in agricultural research and development.

3.3.2 Harmonisation of Country policy instruments with regional frameworks

The study observed the mismatch between national level policy instruments and regional initiatives towards supporting the operation of RCoLs and the promotion of sustainable agriculture. Key observations included:

- Some SADC countries do not have specific legislation governing agricultural research, which defines the mandate and operational framework of research institutions, including RCoLs.
- Some SADC countries have inward-looking national seed policies in terms of seed production, certification, and distribution. This affects RCoLs' ability to trade and disseminate improved varieties to other SADC countries.
- Policies to promote climate-resilient farming practices to guide the RCoLs' research priorities are still weak in some SADC countries.
- Biotechnology and Biosafety Regulations vary across countries, affecting the RCoLs' ability to conduct and apply biotechnology research regionally.
- The uptake of Intellectual Property Rights (IPR) Policies to protect and commercialise innovations within the SADC region is still weak.

3.3.3 General recommendations

To enhance the effectiveness of these policies in supporting RCoLs and sustainable agriculture, the following recommendations are proposed:

i. Harmonisation of national policies with regional frameworks to create a more conducive environment for cross-border collaboration and technology dissemination.
ii. Strengthening implementation mechanisms for existing policies, including adequate resource allocation and capacity building for relevant institutions.
iii. Developing more robust monitoring and evaluation systems to assess the impact of policies on RCoLs' performance and agricultural sustainability.
iv. Enhancing stakeholder participation in policy formulation and review processes to ensure policies address the needs of researchers, farmers, and other value chain actors.
v. Incorporating emerging issues such as digital agriculture and bioeconomy into policy frameworks to keep pace with technological advancements.
vi. Strengthening linkages between agricultural research policies and broader national development strategies to ensure sustained political support and funding for RCoLs.
vii. Developing specific policies or guidelines for establishing and operating RCoLs to clarify their mandate, governance structures, and funding mechanisms.

By addressing these policy-related challenges and implementing the proposed recommendations, SADC Member States can create a more enabling environment for RCoLs to thrive and contribute effectively to sustainable agricultural development in the region.

3.4 Value proposition of CCARDESA in supporting RCoLs

3.4.1 Roles of CCARDESA in supporting RCoLs

The Centre for Coordination of Agricultural Research and Development for Southern Africa supports Regional Centers of Leadership across the SADC region. Key roles include:

i. Coordination and Facilitation: CCARDESA is a regional hub coordinating research activities and facilitating collaboration among RCoLs, national research institutions, and international partners. This role helps avoid duplication of efforts and promotes synergies in research programmes.
ii. Resource Mobilisation: The organisation assists RCoLs in identifying and accessing funding opportunities, including preparing joint proposals for regional research initiatives. This support is critical for ensuring their financial sustainability.
iii. Capacity Building: CCARDESA organises training programmes, workshops, and exchange visits to enhance the technical and managerial capacities of RCoL staff. This includes support for postgraduate training and short-term skill development courses.
iv. Knowledge Management and Dissemination: Through its various platforms and networks, CCARDESA facilitates the sharing of research outputs, best practices, and lessons learned among RCoLs and other stakeholders in the agricultural sector.
v. Policy Advocacy: CCARDESA engages with policymakers at regional and national levels to create an enabling environment for agricultural research and development, including advocating for increased investment in RCoLs.
vi. Quality Assurance: The organisation develops and promotes standards and guidelines for agricultural research, helping to ensure the quality and relevance of RCoLs' work.
vii. Monitoring and Evaluation: CCARDESA supports the development of M&E frameworks for RCoLs and conducts periodic assessments to track their performance and impact.

3.4.2 Challenges that hinder CCARDESA from effectively discharging its roles

Despite its important mandate, CCARDESA faces several challenges in effectively supporting RCoLs:

i. Limited Financial Resources: Inadequate and unpredictable funding affects CCARDESA's ability to provide consistent support to RCoLs and implement long-term programmes.
ii. Human Resource Constraints: The organisation lacks sufficient technical staff in some key areas, limiting its capacity to provide specialised support to RCoLs across diverse agricultural disciplines.
iii. Political and Economic Instability: Frequent changes in leadership and economic challenges in some Member States affect the continuity of support for regional initiatives, including RCoLs.
iv. Weak Information Systems: Inadequate ICT infrastructure and data management systems hinder effective knowledge sharing and coordination among RCoLs and other stakeholders.
v. Limited Engagement with Private Sector: CCARDESA has not fully leveraged partnerships with the private sector to support technology commercialisation and scaling innovations from RCoLs.
vi. Overlapping Mandates: In some cases, there is a lack of clear delineation of roles between CCARDESA and other regional bodies, leading to potential duplication of efforts and inefficient use of resources.
vii. Language Barriers: The linguistic diversity in the SADC region (English, French, Portuguese) sometimes hinders effective communication and knowledge sharing among RCoLs and other stakeholders.

3.4.3 Recommendations

To enhance CCARDESA's effectiveness in supporting RCoLs in each country, the following key interventions are recommended:

i. **Develop a Sustainable Financing Strategy**: CCARDESA should diversify its funding sources by exploring innovative financing mechanisms such as endowment funds, private sector partnerships, and service provision to Member States. This could include establishing a regional agricultural research fund with contributions from Member States and development partners. This fund should be accessible to all SADC Member States.
ii. **Strengthen Human Resource Capacity**: Invest in recruiting and retaining high-calibre staff in critical areas such as biotechnology, climate-smart agriculture, and agribusiness. Implement a robust capacity development programme for existing staff to keep them updated on emerging trends and technologies.

iii. **Enhance ICT Infrastructure**: Upgrade CCARDESA's information management systems, including developing a comprehensive regional agricultural research database. Invest in digital platforms to facilitate virtual collaboration and knowledge sharing among RCoLs and other stakeholders.

iv. **Intensify Private Sector Engagement:** Develop a clear strategy for private sector engagement, including establishing innovation platforms that bring together researchers, entrepreneurs, and investors. This could involve creating a regional agri-tech incubation programme linked to RCoLs.

v. **Clarify Institutional Mandates**: Work with the SADC Secretariat and other regional bodies to clearly define roles and responsibilities in supporting agricultural research and development. Develop formal cooperation agreements to ensure synergies and avoid duplication.

vi. **Implement a Multilingual Approach**: Develop multilingual communication strategies and tools to overcome language barriers. This could include investing in translation services and promoting multilingual proficiency among CCARDESA staff.

vii. **Strengthen Monitoring and Evaluation**: Develop a robust M&E framework for assessing the performance and impact of RCoLs. This should include regular peer review mechanisms and impact assessments to demonstrate the value of regional agricultural research investments.

viii. **Enhance Policy Support:** Strengthen CCARDESA's capacity to provide evidence-based policy advice to Member States on agricultural research and innovation issues. This could involve establishing a regional think tank on agricultural policy linked to CCARDESA.

ix. **Promote South-South Cooperation:** Facilitate increased collaboration between RCoLs and similar centers of excellence in other regions (e.g., Asia and Latin America) to promote knowledge exchange and technology transfer.

x. **Develop a Regional Research Infrastructure Plan:** Work with Member States to develop a long-term plan for upgrading and sharing key research infrastructure, including expensive equipment and facilities, across RCoLs.

By implementing these recommendations, across all SADC Member States, CCARDESA can significantly enhance its value proposition in supporting RCoLs and contributing to agricultural transformation in the SADC region. This will require sustained commitment from Member States, development partners, and other stakeholders to provide the necessary resources and enable an environment for CCARDESA to fulfil its mandate effectively.

4 General Conclusions

The assessment of Regional Centers of Leadership in SADC Member States has revealed significant progress and persistent challenges in strengthening regional agricultural research and innovation systems. Established RCoLs in Malawi, Mozambique, and Zambia have made strides in building research capacities and addressing key agricultural challenges but continue to face constraints in human resources, infrastructure, funding, and institutional policies.

Identifying priority commodities for new RCoLs in other SADC countries presents opportunities for targeted research and development efforts to enhance regional agricultural competitiveness. However, realising these opportunities will require addressing each country's specific technical, institutional, and policy challenges.

Regional and national policy frameworks generally support the sustainable management of RCoLs and promote sustainable agriculture. Still, better harmonisation, implementation, and adaptation to emerging challenges such as climate change and digital agriculture are needed.

CCARDESA is crucial in coordinating and supporting RCoLs but faces limited resources, capacity, and institutional arrangements that hinder its effectiveness. Addressing these challenges through targeted interventions can significantly enhance CCARDESA's value proposition in driving agricultural innovation across the SADC region.

i. Strengthening human and institutional capacities of RCoLs through targeted training programmes and improved research management systems.
ii. Investing in modern research infrastructure and technologies to keep pace with global advances in agricultural science.
iii. More broadly, it is important to develop sustainable financing mechanisms for RCoLs and agricultural research, including increased domestic funding and innovative partnerships.
iv. Enhancing regional collaboration and knowledge sharing among RCoLs and other research institutions to leverage comparative advantages and avoid duplication.
v. Aligning research priorities more closely with national and regional development goals, including climate resilience and inclusive growth.
vi. Strengthening linkages between research, extension, and private sector actors to accelerate the adoption of innovations and technologies.
vii. Empowering CCARDESA with adequate resources and mandate to coordinate and support RCoLs across the region effectively.

These priorities will require sustained commitment and collaboration among SADC Member States, development partners, research institutions, and the private sector. By doing so, the region can

harness the full potential of its agricultural research and innovation systems to drive sustainable agricultural development, enhance food security, and improve livelihoods across Southern Africa.