DIGITAL AGRICULTURE COUNTRY STUDY ANNEX: BOTSWANA

Supplement to the Situational Analysis Report | Assessment of Digitalization in the Agricultural Systems of the SADC Region

Centre for Coordination of Agricultural Research and Development for Southern Africa | World Bank Group

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SUPPLEMENT TO THE ASSESSMENT OF DIGITALIZATION IN THE AGRICULTURAL SYSTEMS OF THE SADC REGION: SITUATIONAL ANALYSIS REPORT

Centre for Coordination of Agricultural Research and Development for Southern Africa | World Bank Group

2021/2022

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ACRONYMS AND ABBREVIATIONS

AI	Artificial Intelligence
AIDI	Africa Infrastructure Development Index
APPSA	Agricultural Productivity Program for Southern Africa
AR4D	Agricultural Research for Development
AU	African Union
B2B	Business-to-Business
B2C	Business-to-Consumer
CCARDESA	The Centre for Coordination of Agricultural Research and Development for Southern Africa
COVID-19	Coronavirus pandemic
DACS	Digital Agricultural Country Study
DE4A	Digital Economy for Africa Initiative
DIAL	Digital Impact Alliance
EGDI	E-Government Development Index
FANR	Food, Agriculture and Natural Resources Directorate
FAO	Food and Agriculture Organization of the United Nations
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GII	Global Innovation Index
GIS	Geographic Information System
GNI	Gross National Income
GPS	Global Positioning System
GSMA	Global System for Mobile Communications
HDI	Human Development Index
ICDL	International Computer Driving License
ICKM	Information, Communication and Knowledge Management
ICT	Information Communication Technology
ICT4AG	ICT for Agriculture
IDIA	International Development Innovation Alliance

IOT	Internet of Things
IS	Information Society
IT	Information Technology
ITU	International Telecommunications Unit
KII	Key Informant Interview
MSMES	Micro, Small and Medium Enterprises
NGO	Non-Governmental Organization
NREN	National Research and Education Networks
OECD	Organization for Economic Co-operation and Development
OSI	Online Service Index
R&D	Research and Development
RCOL	Regional Centers of Leadership
RUFORUM	Regional Universities Forum
SAAS	Software as a Service
SADC	Southern African Development Community
SME	Small and Medium Enterprise
SMS	Short Message Service
SSA	Sub Saharan Africa
TOR	Terms of Reference
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
USSD	Unstructured Supplementary Service Data

1 INTRODUCTION

1.1 INTRODUCTION TO THE STUDY AND THE STRUCTURE OF THE DACS

The Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) is a sub-regional organization that was approved by the Council of Ministers of the Southern African Development Community (SADC) in 2010 and launched in 2011. CCARDESA promotes innovative research, technology generation and adoption of sustainable agricultural development through partnership and capacity development. CCARDESA also coordinates the Agricultural Productivity Program for Southern Africa (APPSA), a regional program supported by the World Bank to promote collaboration and to encourage technology generation and dissemination across national borders of participating countries of SADC. CCARDESA has appointed IMC Worldwide to carry out a situation analysis of the status of digitalization in the agricultural systems of SADC member states.

Aligned with the Terms of Reference, a separate report has been produced by the study team, the *Situational Analysis Report: Assessment of Digitalization in the SADC Region* which addresses the assignment objectives (Section 2.2 in the Situational Analysis Report).

This Digital Agricultural Country Study (DACS) for Botswana is an annex to the *Situational Analysis Report* and provides a snapshot of the general digital ecosystem, the policy environment of digital and agricultural policies, relevant digital agricultural innovations, and an overview of digital agricultural skills and digital entrepreneurial skills development in universities, incubators, and accelerators within an ecosystem. This document is not intended to provide a full analysis of the ecosystem in this country but provides an early baseline in gathering data and information collected from voluntary respondents on these topics for possible further study.

The baseline data collected provides insights into the extent to which Botswana has enabled and encouraged digital technology solutions, such as the use of digital data in agricultural research, education, extension, and market access. In specific terms and to the extent possible:

- The DACS identified available public national policies and legislation which provide a conducive environment for agricultural digital innovations to thrive. The study team also reviewed the context in which digitalization is linked to agriculture to enhance the agricultural innovation ecosystem.
- The DACS provides a catalogue of relevant agricultural digital innovations and where available, their availability, affordability, usability, and potential for scalability (adoption by smallholder farmers). These innovations were characterized in use cases according to a suitable framework and mapped to the roles they play in providing solutions within fragmented agriculture value chains.
- The DACS also maps syllabi at Agricultural Universities, Colleges, Incubators, and Accelerators which have embraced digital and entrepreneurial skills training to encourage and empower young people to become digital entrepreneurs in the future.

The study has assembled a wide array of evidence and research using qualitative and quantitative methods and approaches. Data collection on digital tools reflects the extent to which they have been embraced, but it

is important to note that this study is not exhaustive in identifying every digital tool available. The report has the following structure:

Chapter 1:	Introduction to Botswana, including the general digital ecosystem, agriculture sector, digital infrastructure, and benchmark assessment results.
Chapter 2:	The Broader Policy Environment
Chapter 3:	Digital Agricultural Innovations
Chapter 4:	Digital Agricultural Skills and Entrepreneurship Training
Chapter 5:	Insights and Reflections

All the information compiled for Botswana will be combined with data from the other 15 SADC member states and presented on a platform hosted by CCARDESA.

1.2 METHODOLOGY

IMC Worldwide, CCARDESA and the World Bank agreed to the framework, approach, and methodology for the assignment. CCARDESA facilitated the introduction to the Information, Communication and Knowledge Management (ICKM) Focal Point in Botswana: Ms. Lorato Bailang. The study team also worked with a National Consultant in Botswana Dr. Kebatenne Hulela (BUAN).

Further information on the methodology for this assignment is provided in the *Situational Analysis Report* (Section 3) along with the data collection tools used, including the key informant guides and the surveys (Annex 6-13 in the *Situational Analysis Report*).

GENERAL ECOSYSTEM

The study team collected key digital ecosystem figures for each country through a desk review of country reports and industry websites (World Bank, ITU, GSMA, etc.). These figures are presented in section 1.3 and 1.4 below.

BENCHMARK ASSESSMENT

The team completed a benchmark assessment across the 16 SADC member states. The assessment sought to provide a context to the findings of this study, and not to determine each SADC country's development of a digital economy. The approach was adapted from Unlocking the Digital Economy in Africa: Benchmarking the Digital Transformation Journey by SMART Africa and the Digital Impact Alliance (DIAL). SMART Africa's mandate is to encourage Africa's transformation into a knowledge economy through the usage of ICTs, and therefore this assessment would be most compatible to the SADC member states. Other frameworks and toolkits were reviewed in preparation for the benchmark with more information in the *Situational Analysis Report.* The assessment areas in the SMART Africa/ DIAL report are based on the five foundational pillars of the Kenyan Digital Economy Blueprint, illustrated in figure 1, and are similar in nature to the African Union's Digital Transformation Strategy foundation pillars, illustrated in figure 5, (Enabling Environment; Policy and Regulation; Digital Infrastructure; Digital Skills and Human Capacity; Digital Innovation and Entrepreneurship).

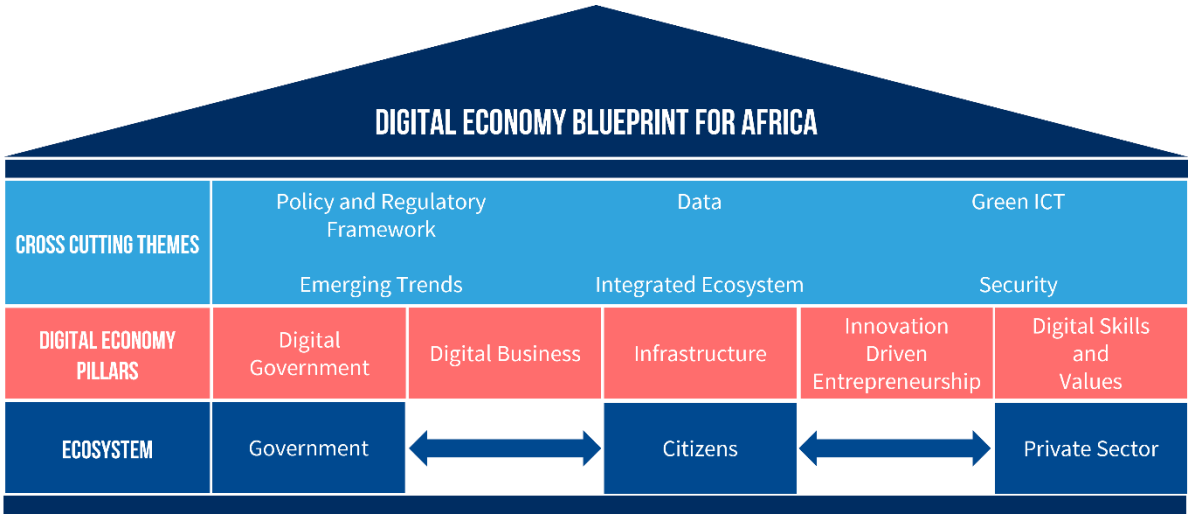

FIGURE 1 OVERVIEW OF KENYAN DIGITAL ECONOMY BLUEPRINT

A sixth pillar was added to the benchmark to include Policy and Regulatory Frameworks to align it with this study and as this was a regular cross-cutting area mentioned in other frameworks. These six pillars are presented in Table 1.

TABLE 1 PILLARS FOR THE BENCHMARK ASSESSMENT

Digital Government	Digital Business	ICT Infrastructure	Innovation Driven Entrepreneurship	Digital Skills	Policy and Regulatory Frameworks
The presence and use of digital services and platforms to enable public service delivery	The development of a robust marketplace for digital trade, digital financial services and digital content.	The availability of affordable, accessible, resilient and reliable infrastructure.	The presence of an ecosystem that supports homegrown firms to generate world-class products and services that help to widen and deepen digital economic transformation.	The development of a digitally skilled workforce that is grounded on sound ethical practices and socio-cultural values.	The presence of policies and regulations that are dynamic, flexible and promote the digital economy.

Assessing the pillars has provided a picture across all 16 countries and forms the basis of the specific indicators that were selected for the benchmark assessment. The indicators used were based on the SMART Africa/DIAL report. Changes were made to some of the indicators for this study to focus more specifically on the digital elements. For example, the ICT Infrastructure pillar uses the ICT Composite Index score, rather than the general Infrastructure indicator from the Africa Infrastructure Development Index (AIDI) that included elements such as roads. For the Digital Skills pillar, only the digital skills among active population score was used for this benchmark rather than the general score in the Global Competitiveness Index (GCI) which includes factors not related to digital. The indicators and data stream used and the maximum score available is illustrated in table 2.

Each SADC country received a total score based on the specific scores of each pillar, outlined above. These figures were then compiled into an index (this was done by dividing the scores by the maximum possible score). The benchmark is based on a mix of indicators from 2019-2021, outlined in Table 2.

TABLE 2 INDICES AND DATA STREAM USED FOR THE BENCHMARK ASSESSMENT AND MAXIMUM SCORE AVAILABLE

Benchmark Pillar	Index	Data Stream	Maximum Score
Digital Government	E-Government Development Index (EGDI) 2020	Online Service Index (OSI)	1
Digital Business	GCI 2019	Business Dynamism Component	100
ICT Infrastructure	AIDI 2020	ICT Composite Index	100
Innovation Driven Entrepreneurship	Global Innovation Index (GII) 2021	N/A	100
Digital Skills	GCI 2019	Digital skills among active population	100
Policy and Regulatory Frameworks	ITU G5 Benchmark 2021	N/A	100

POLICIES

For the broader policy section, the study team identified available policies, strategies, and legislation around Information Communication Technologies (ICT), digitalization, data, cybersecurity and privacy, e-commerce and transactions and agricultural sector policies through desk-based research and discussions with in-country consultants. The team undertook key informant interviews (KIIs) with available CCARDESA ICKM focal points to identify additional policies, including draft versions that may be unavailable online and to understand practical challenges around the policy environment within ministries.

The team reviewed available public policies to understand their complexity, basic goals and strategies and the relationship with agriculture within the public sector. The team took stock of relevant digital laws, although the list included in this report is not exhaustive but focused on electronic transactions and electronic commerce, cyber security, data protection and open data. Findings from stakeholder interviews were then analyzed to provide a deeper understanding of the challenges faced within the public sector and to what extent digitalization is being prioritized by Government.

The approach sought to provide an audit of the policies in the public domain illustrating to what extent digitalization is embraced by government, and the relationship and implication for the agriculture sector. The report did not seek to analyze the content of policies or strategies or assess whether they are effective or have achieved their objectives.

INNOVATIONS

Digital agricultural innovations were identified through a desk review of international reports, internet searches, local networks supplied by the CCARDESA ICKM focal point in the country and the national consultants. In some countries, innovations were identified that were also implemented in other countries (regional innovations), this is reflected in Chapter 3: Digital Agricultural Innovations. The national consultants validated all identified innovations available (national and regional innovations in that country) and identified contact information of the innovators which was then uploaded into a Google Sheet. Some regional innovations which claimed they were implemented in Botswana could not be fully validated, but this was insufficient to suggest they did not exist and so are included in the lists.

Each identified innovator was sent a survey by email, requesting more detail on their innovations related to the maturity, numbers of users and scale as well as more detailed characterizations of their unique innovation. Survey participants provided the survey responses voluntarily through Google Sheets which were converted

into excel files. All innovators were pursued rigorously for some weeks, by email and by phone, to encourage them to fill out the survey.

Survey answers were self-reported and where there were outlier responses, follow-ups were made to ensure conformity of information. The survey results were cleaned by combining duplicate answers (when submitted from more countries), clustered (in cases of open answers, for example with “other”) and names between identified and survey results were aligned. In some cases, the answers were coded for better analysis of the data. An analysis spreadsheet was developed to analyze the data in more depth and to create the graphs. All innovations received a unique number and were uploaded to the database. The database forms the basis for the interactive web portal of CCARDESA, further information on the portal can be found in the *Situational Analysis Report*. Alongside the survey, several KIIs with innovators took place both with regional innovations and with national innovations that have reached a certain level of scale.

This DACS has characterized use cases based on a model and framework created by GSMA based on different use cases and sub use cases and is represented below in figure 2. These broadly fall into access to services, access to markets and access to assets.

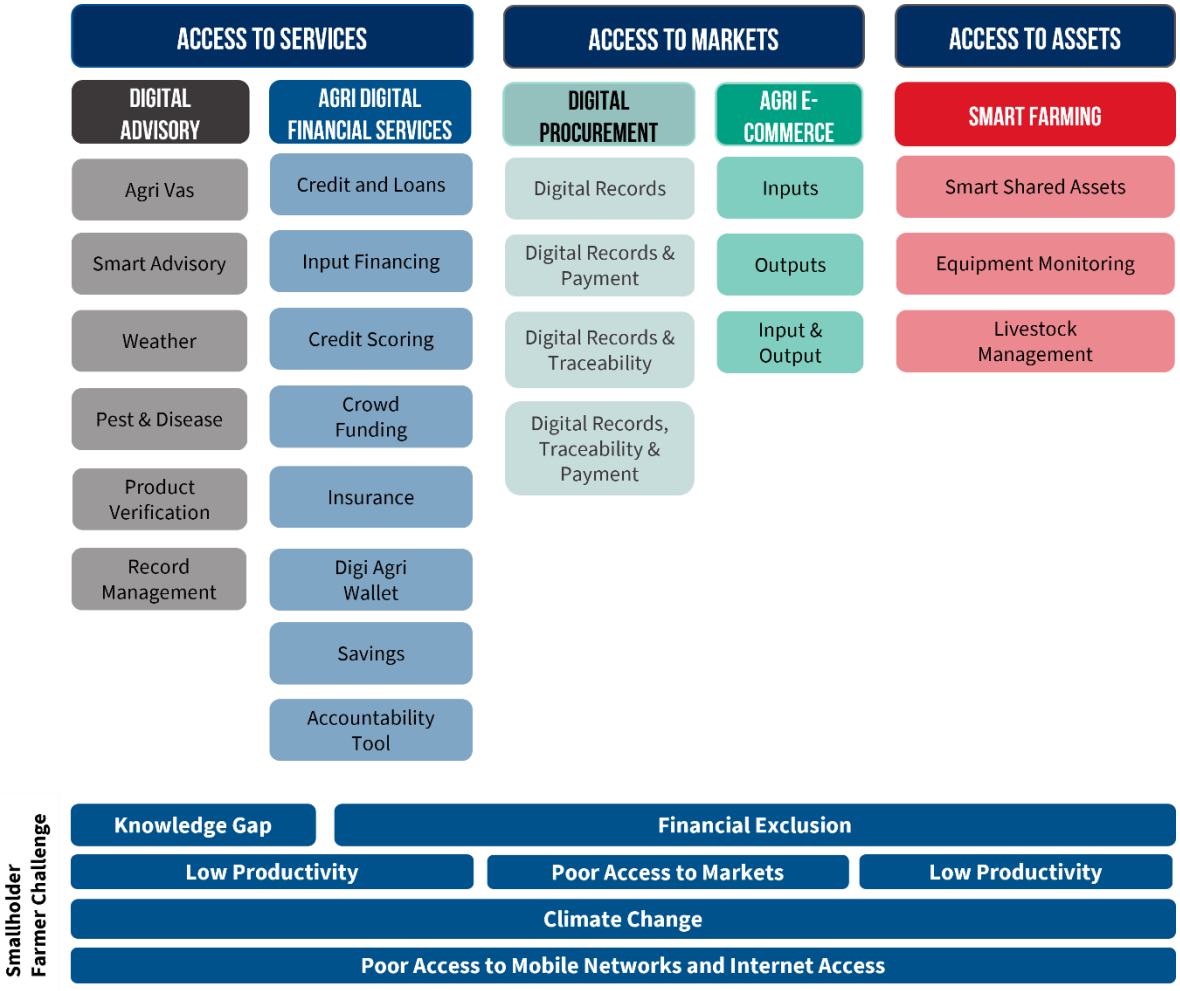

FIGURE 2 USE CASE MODEL BASED ON GSMA FRAMEWORK

In graphs and tables included in this DACS, the following color coding was used to illustrate the different use-cases:

DIGITAL SYLLABI

Digital and entrepreneurial skills training was assessed through a quantitative Survey Monkey tool sent to 54 Universities, the majority of these were Faculties of Agriculture that are part of the Regional Universities Forum (RUFORUM) network, but some institutions were contacted that were not strictly agricultural to try and provide a complete picture in the region (a total of 58 different faculties were contacted). The names and addresses of these University contact points was facilitated via collaboration with the RUFORUM University membership in the SADC member states. The study team also carried out KIIs with representatives of faculties of agriculture at selected Universities and Incubators. The full list of universities and incubators approached, tools used, and stakeholders interviewed can be found in annex 3-4 and 8-10 in the *Situational Analysis Report.*

LIMITATIONS TO THE METHODOLOGY

The planning, data collection, analysis and reporting of this study was completed between April to December 2021. Due to the Covid-19 pandemic much of the data collection and delivery of this assignment was completed remotely across the 16 SADC member states. The inability of some national consultants to conduct in-person meetings or interviews, and restrictions around national travel due to Covid-19 protocols limited the data collection and led to delays in some areas.

The data collection for this study was entirely voluntary and self-reported. Every effort was made by the study team to engage a representative sample of stakeholders under each theme and encourage completion of surveys and interviews, there are cases within some of the DACS where the data may be more limited than in others due to the maturity of the digital agricultural ecosystem. Therefore, while the data collected for each country provides a reasonable baseline of the current landscape, this overview is not exhaustive and must not be seen as such. The intention of the data collection was to address the assignment objectives which sought to understand regional trends, themes, and opportunities around digitalization in agricultural systems. The DACS are supplemental documents which present the country data collected, some of which was used in the *Situational Analysis Report*, but they should not be interpreted as providing a detailed analysis of the country ecosystem.

POLICIES

There were several challenges in obtaining policy documents and determining if they were accurate, final, or valid and implemented. The impact of the Covid-19 pandemic has affected the priorities of governments and implementation of their related policies. Furthermore, the pandemic has constrained open and full consultation of policies that have been drafted and may have delayed their finalization. Additionally, much of the documentation the team found is split between ministry websites and illustrates the siloed nature of policy formulation in this space. If documents were unavailable online then the ICKM focal points were asked for access where possible, national consultants also tried to source documents locally. Unverified versions of documents available online were also used for review.

Innovations

The current DACS is a snapshot in time as new digital innovations are in development in Botswana and some may be declining because of the Covid-19 pandemic. Due to various Covid-19 restrictions, physical meetings could not always take place. People had to work from home which significantly affected their ability and willingness to participate in online interviews and survey instruments. The efforts of the national consultants to convince innovators to participate in the survey required significant energy and effort and, in some cases, took longer than expected. Many innovators are very busy and mentioned that participating in another survey or interview did not equate to new opportunities for their innovation. There was also suspicion and caution by innovators and public sector stakeholders to engage with consultants and share proprietary data.

Digital Syllabi

Across the region, the response rate of universities to the survey tool and interviews was 47% which was a reasonable response rate. However, the response rate is variable between countries and the number of participating universities in some countries was much lower than expected given their diversity and maturity and contrasted highly with smaller nations in the region. This is believed to be due to the enormous additional workload on staff at Universities as a direct result of the pandemic forcing many to move all activities online and the time and pressures this entailed. As a result, University staff struggled to find available time for the survey.

The level of digital skills represented in the study is believed to be much lower than the reality for the region. In part, this can also be explained by the intentional targeting of Agricultural Faculties and Universities in the region rather than conducting a wider survey across Universities and Colleges more widely. During the KIIs it was also established that some Universities and Faculties struggled to see their role as part of an ecosystem actor in providing for agricultural digital skills building specifically.

1.3 COUNTRY CONTEXT

FIGURE 3 MAP OF BOTSWANA IN SADC

Botswana is a landlocked upper-middle income country with a population of 2.3 million[1]. The UNDP's Human Development Indicators[2] rank Botswana as 100th out of 190 countries and 3rd out of the 16 SADC countries. The country scores on the higher scale in the region for gender equality with a Gender Development Index of 0.998[i]. It is one of the richest countries in the SADC region with a Gross National Income per capita of $17,100 (compared to an average of $8,050 in the region)[3]. Although 17.2% of the population falls under the UN Multidimensional Poverty Index,[4] 19.3% live below the poverty line according to the World Population Review[5]. This is below the average rate of the SADC region of 40.8%. The median age of Botswana's population is also slightly older than the average in SADC with 24 years (versus 22.1 years).

AGRICULTURE ENVIRONMENT

In the case of urbanization, Botswana is significantly above average in the SADC region with 70.20% living in urban areas. Although only 2.14% of GDP is earned in agriculture, 19.90% of the population works in the agriculture sector (lower than the average of the SADC region of 43.37%). On the Global Food Security Index, Botswana ranks as the 74th country with an overall score of 36.6—making it 2nd after Zambia in the SADC region alone[6].

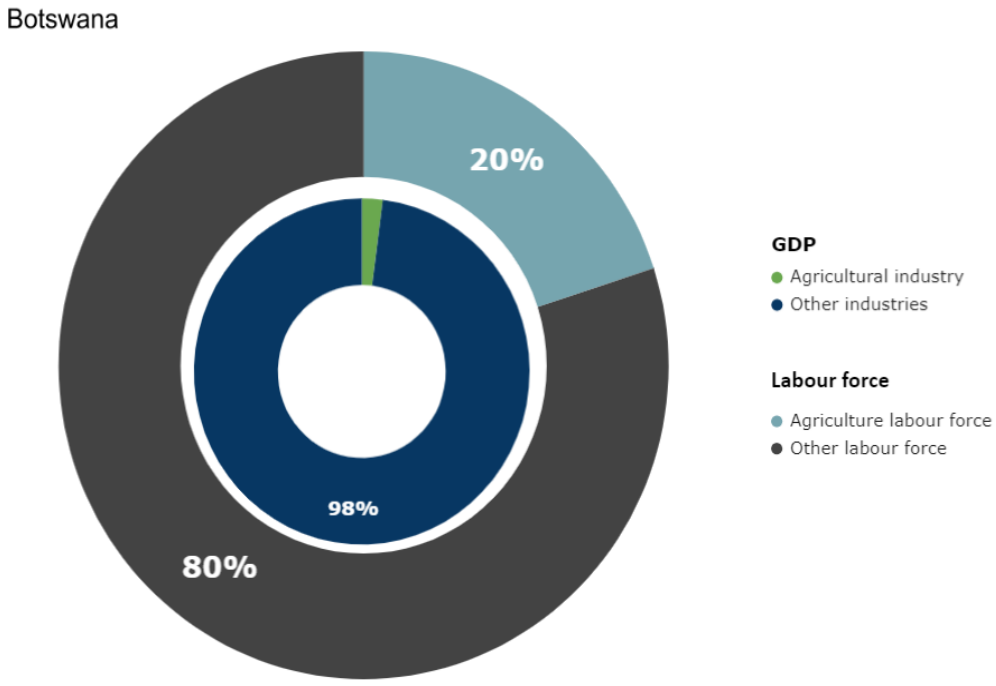

FIGURE 4 BOTSWANA'S AGRICULTURAL INDUSTRY SHARE OF GDP AND THE SHARE OF THE AGRICULTURAL LABOR FORCE

1.4 THE GENERAL DIGITAL ECOSYSTEM

In 2020, the African Union (AU) adopted the Digital Transformation Strategy for Africa (2020-2030) which presents a vision of an integrated and inclusive digital society and economy in Africa. It recognizes the digital economy as a key factor in stimulating economic growth and jobs, reducing inequality, and promoting

[i] The Gender Development Index (GDI) measures gender inequalities in achievement in the three basic dimensions of human development.

sustainable growth[7]. The Strategy, illustrated in figure 5, is based on foundational pillars, critical sectors to drive the digital transformation, and cross cutting themes to support the digital ecosystem.

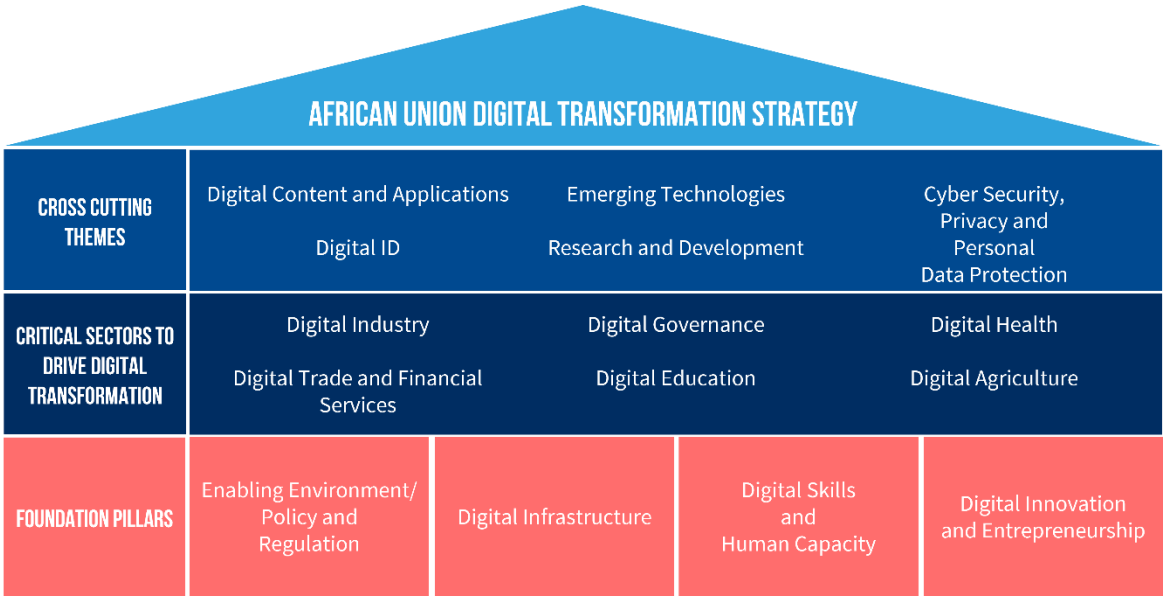

FIGURE 5 OVERVIEW OF THE AFRICAN UNION DIGITAL TRANSFORMATION STRATEGY

The transition to, and importance of, a digital economy is illustrated in the prevalence of this agenda within regional institutions, donors, and multilateral organizations. Where agendas previously focused on ICTs, providing hardware and universal access, the focus is now on enabling a digital economy with a more holistic view of digital and ICTs. The digital economy considers sectors beyond the ICT industry and encourages a whole-of-government approach to have more emphasis on the overall ecosystem and economy[8].

Benchmark Assessment Findings

The purpose of the benchmark is to provide a context to the findings and identify where SADC countries are progressing or where they may be behind or not developing in terms of a digital ecosystem. The benchmark assessment and the overall rankings illustrate some key front-runners in the region that are perceived to have better foundational pillars required for a digital economy. Most of these front-runners are less dependent on agriculture for economic growth and to some extent employment. Further information on these groupings, the assessment results and regional trends can be found in the *Situational Analysis Report*.

The results for Botswana are illustrated in table 3.

TABLE 3 BENCHMARK PILLAR SCORES: BOTSWANA

Botswana	Score	Maximum Score
Digital Government (OSI, 2020)	0.365	1
Digital Business (GCI, 2019)	53.840	100
ICT Infrastructure (AIDI, 2020)	30.905	100
Innovation Driven Entrepreneurship (GII, 2021)	22.900	100
Digital Skills (GCI, 2019)	44.893	100
Policy and Regulatory Frameworks (ITU, 2021)	57.830	100

The benchmark assessment identified four clusters of countries:

Group 1: South Africa, Mauritius, and the Seychelles.
Group 2: Eswatini, Tanzania, and Botswana.
Group 3: Zimbabwe, Namibia, Lesotho, Zambia, Malawi, and Madagascar.
Group 4: Angola, Mozambique, the Democratic Republic of Congo (DR Congo), and Comoros.

TABLE 4 OVERALL BENCHMARK ASSESSMENT RESULTS AND RANK FOR ALL SADC MEMBER STATES

Country	Benchmark Index Score (Adjusted)	Overall Benchmark Ranking
South Africa	0.5891	1
Mauritius	0.5839	2
Seychelles	0.5155	3
Global Median	0.5064	
Eswatini	0.4222	4
Tanzania	0.4138	5
Botswana	0.4114	6
Zimbabwe	0.3895	7
Namibia	0.3809	8
Lesotho	0.3802	9
African Median	0.3595	
Zambia	0.3506	10
Malawi	0.3483	11
Madagascar	0.3005	12
Angola	0.2985	13
Mozambique	0.2919	14
DR Congo	0.2782	15
Comoros	0.2497	16

BENCHMARK ASSESSMENT: BOTSWANA

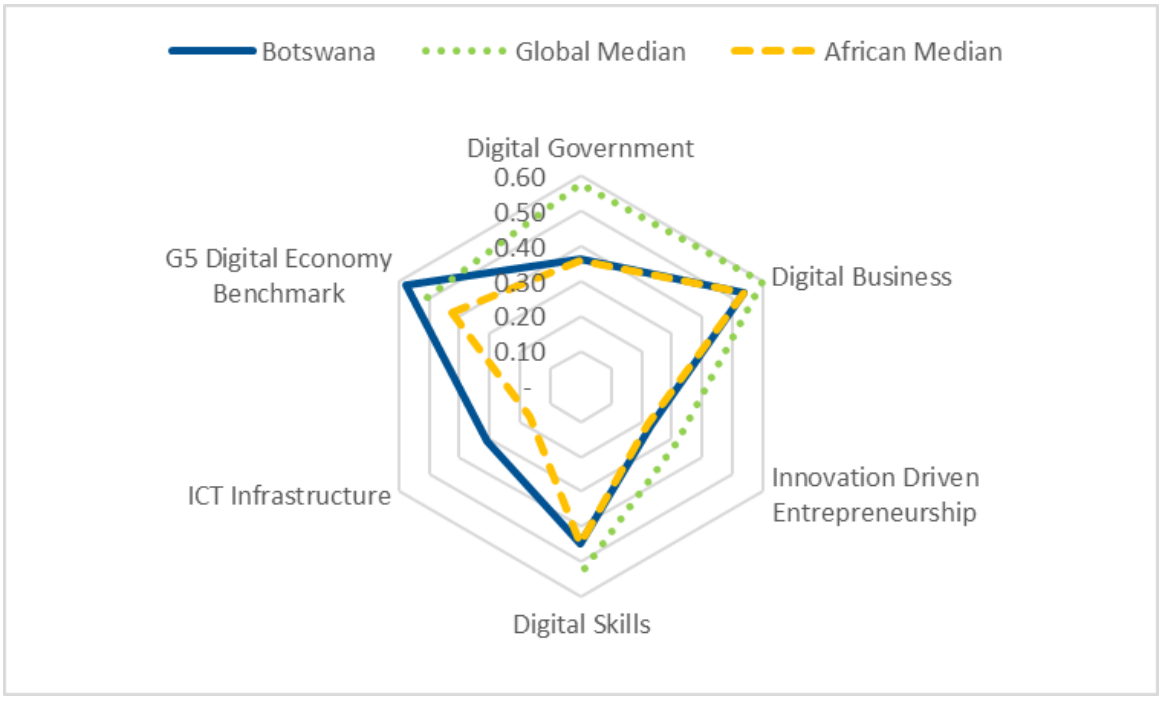

FIGURE 6 RESULTS FROM BENCHMARK ASSESSMENT FOR BOTSWANA

In the benchmark assessment Botswana ranked sixth out of the 16 SADC member states. Figure 6 below, illustrates the results of the benchmark in comparison to the global and African medians. Botswana is ahead of the African median in two indicator areas, ICT Infrastructure, and the G5 Digital Economy Benchmark. In the other four assessment areas it is on par with the median. The benchmark suggests that Botswana has some key foundational elements necessary for a robust digital economy.

Botswana scored lowest in the Digital Government pillar, where it ranked eleventh. In all other pillars it scored in the top five of the SADC members states. Table 5 below, illustrates the ranking for each individual pillar for Botswana.

TABLE 5 RANKING OF ALL SADC MEMBER STATES PER BENCHMARK ASSESSMENT PILLAR

Rank	Digital Government	Digital Business	Innovation-Driven Entrepreneurship	Digital Skills	ICT Infrastructure	G5 Digital Economy Benchmark
1	South Africa	Mauritius	Mauritius	Seychelles	South Africa	South Africa
2	Mauritius	South Africa	South Africa	Mauritius	Mauritius	Mauritius
3	Seychelles	Seychelles	Tanzania	Zimbabwe	Seychelles	Botswana
4	Tanzania	Zambia	Namibia	Tanzania	Botswana	Malawi
5	Namibia	Botswana	Botswana	Botswana	Namibia	Eswatini
6	Zimbabwe	Tanzania	Malawi	Namibia	Zimbabwe	DRC
7	Mozambique	Madagascar	Madagascar	Zambia	Eswatini	Tanzania
8	Angola	Namibia	Zimbabwe	Lesotho	Zambia	Zambia
9	Eswatini	Eswatini	Zambia	Eswatini	Lesotho	Lesotho
10	Malawi	Lesotho	Mozambique	South Africa	Tanzania	Zimbabwe
11	Botswana	Malawi	Angola	Madagascar	Mozambique	Angola
12	Lesotho	Mozambique		Malawi	Angola	Madagascar
13	Madagascar	Zimbabwe		Mozambique	Comoros	Namibia
14	Zambia	DRC		Angola	Malawi	Comoros
15	DRC	Angola			DRC	Mozambique
16	Comoros				Madagascar	Seychelles

DIGITAL INFRASTRUCTURE

Despite ranking fourth and exceeding the African median score for ICT Infrastructure, only forty-seven percent (47%) of the total population is using the internet[9]. This is higher than the regional average of 29.94%. The GSMA Mobile Connectivity Index shows an 85% access to the 3G network,[10] which complements the HDI report of mobile cellular subscriptions at 150 per 100 people[11]. Botswana also ranks as 94th on the Inclusive Internet Index[12] which details the accessibility, affordability, and relevancy of internet in 120 countries. In light of the Covid-19 pandemic, many people are pushed towards remote working and moving business and communications online, the poor inclusive internet index may have negative implications for agricultural digitization. However, according to the Mobile Connectivity Index,[13] Botswana is ranked number 3 in terms of overall mobile connectivity in the SADC countries with an overall index of 51.3—which qualifies it as a transitioning country (above 50). It scores above average for consumer readiness, affordability, availability of infrastructure and content and services.[ii] In terms of ICT adoption, Botswana scores position 98 (out of 140). The government is considered future orientated based on the position 38 (out of 140), but it scores lower on the innovation capability index as number 101 out of 140[14]. However, it scores higher with 3.69 out of 7 points on the GCI 4.0 Digital Skills Among the Population Index,[15] which surpasses the SADC average.

[ii] The enablers of mobile internet connectivity that inform the indicators: 1. Infrastructure, 2. Affordability, 3. Consumer readiness and 4. Content and Services.

2 THE BROADER POLICY ENVIRONMENT

In the benchmark assessment Botswana ranked sixth out of 16 in the region, scoring well in all but the digital government pillar. The high scores and ranking in the assessment pillars indicate that Botswana is unlocking the digital economy and that there is likely a supportive enabling environment for a digital economy. In the *Situational Analysis Report* the clusters of SADC countries identified from the benchmark are discussed in more detail but Botswana forms part of Group 2 which is made up of countries that scored well in the benchmark.

The purpose of this section is as follows:

- Take stock of available public policies, strategies, and legislation to understand their scale and scope and assess whether digitalization has been generally embraced by Governments.
- Understand the degree to which these policies provide an enabling environment for a digital economy that includes the agriculture sector.

It is important to recognize that the presence of policy, regulatory or legal frameworks may not always translate into awareness, effectiveness, or enforcement of these frameworks. Policies provide one part of the wider ecosystem needed for enabling innovations. The ability of an innovation to demonstrate value and a viable business model underpinning their innovation, progress towards investment readiness, sustainability and the level of scale that is achievable is likely to play a more important role in enabling innovations rather than policy frameworks[16]. Concurrently, a lack of policies or legislation does not inhibit the creation of digital innovations and technologies. The OECD highlights the common pacing problem, whereby digital technologies and innovations are advancing much faster than regulations and policies[17]. The inherent risks of rushing policies and regulations into effect must be weighed up against the benefits, as getting the pacing wrong could ultimately lead to greater barriers to innovation and risks creating regulations that could be outdated[18].

2.1 GENERAL DIGITAL POLICIES

The stock take of available policies, strategies and legislation indicates that there this prioritization of digital transformation but more needs to be done to incorporate emerging technologies and data.

POLICIES, STRATEGIES AND PLANS

The **Maitlamo National ICT Policy 2007** was one of the initial documents to prioritize the importance of ICT in Botswana. Maitlamo intended to guide all ICT initiatives in Botswana, focus on creating an enabling environment for growth of an ICT industry in Botswana, establish universal service and access to ICT facilities in the country and for Botswana to become a regional ICT hub and make the service sector globally competitive. It proposed several programs under the following priority areas:

- E-Government
- Developing and strengthening infrastructure and increasing access
- Establishing a robust ICT legal framework, with a particular focus on e-Commerce
- E-Education
- E-Health

- Economic Diversification (e-Commerce, e-Agriculture, and e-Tourism)

Since this initial document, Botswana has produced a small number of additional sector specific strategies including the **National e-Government Strategy 2011-2016,** the **National Broadband Strategy 2018** and the **National Cybersecurity Strategy 2020** which aim to:

- Increase connectivity between the Botswana government and citizenry and increase and strengthen the Internet infrastructure. The e-Government Strategy is made up of five major programs including interoperability of services across government and increasing training and skills for the e-Government environment.
- Increase accessibility of broadband services through the country and improve its affordability. The Broadband Strategy recognizes that greater access to and affordability of broadband services is through increased competition.
- Build Cyber Security capacity and capability, raise awareness among the general public, enhance collaboration and cooperation of cyber security issues regionally and internationally, and make Botswana secure and resilient to Cyber-attacks.

These strategies build on the objectives and priorities identified in Maitlamo and complement some of the initiatives put in place, such as the Broadband Strategy. The sector specific strategies are encouraging to see and suggest that digitalization has been embraced within Botswana. This prioritization is reflected in the **Vision 2036** and the **National Development Plan 11 2017-2023 (NDP11)** where "ICT will continue to play a pivotal role in the development and diversification of the economy". The NDP11 sets out clear and ambitious goals to integrate ICTs into all sectors, placing specific focus on e-services to stimulate the economy, ensuring promulgation of laws and policies to create an enabling environment for them. There is also greater emphasis on unlocking a digital economy through the development of a digital data framework to provide a platform for open data, "Smart Botswana" to drive forward smart cities and further sectoral strategies around digitalization to be produced. Botswana scored quite highly on the benchmark assessment, suggesting that there has been some drive for greater digitalization across the indicator areas. This is somewhat reflected in the available strategies and policies identified as they address several foundational pillars of a digital economy.

2.2 LEGISLATION

Below are the four key pieces of legislation within this sector for Botswana but this is not an exhaustive list:

- **Communications Regulatory Authority Act 2012**, which creates an independent regulatory authority, the Botswana Communications Regulatory Authority (BOCRA) and provides for the regulation of the communication sector, comprising telecommunications, Internet, Radio communications, Broadcasting and Postal services.
- **Electronic Communications and Transactions Act 2014** which provides for the facilitation and regulation of electronic communications and transactions. It is to provide specifically for electronic commerce and electronic signatures.
- **Cyber Crime and Computer Related Crimes Act 2018** which attempts to combat cybercrime and computer related crimes, to repress criminal activities perpetrated through computer systems and to facilitate the collection of electronic evidence; includes offences such as unauthorized access to a

computer or computer system, and unauthorized access to computer service, access with intent to commit an offense, unauthorized interference with data, etc.

- **Data Protection Act 2018** attempts to regulate the protection of personal data and to ensure that the privacy of individuals in relation to their personal data is maintained; and to establish the Information and Data Protection Commission.

Botswana generally has a strong legal framework around issues of consumer protection, although these are not specifically inclusive of e-commerce. There are foundational laws in place around cybersecurity and electronic transactions, but it is likely that additional laws will be required to enhance the focus on e-commerce which has attracted much attention in the strategies outlined above. It is unclear whether the Data Protection Act, which was approved in 2018 has been implemented, although it is available from the BORCA website under Draft Documents and Legislation[19]. The stock take of available strategies and legislation suggests that digitalization has been embraced generally in national plans and that there has been an emphasis to integrate it to achieve developmental goals.

2.3 DIGITALIZATION IN AGRICULTURE

Currently there is no evidence of a specific digitalization strategy, policy, or plan for the agricultural sector. The **National Master Plan for the Arable Agriculture and Dairy Development (NAMPAADD)** was the only document available for review and there is no identification of a date provided. There is no specific mention of digital technologies within NAMPAADD, but reference is made to modern technologies that should be disseminated to farmers to increase productivity and growth. It is likely this is not related to digital technologies and that the document is fairly dated.

Vision 2036 outlines the importance of the agricultural sector, its ability to contribute to revenue and export earnings if supported well through greater utilization of technologies and modern farming techniques. The **National Broadband Strategy** does include a section on Agricultural Broadband Infrastructure which aims to increase infrastructure in agricultural areas specifically, but this is dependent on the type of farm and farming and what infrastructure or connectivity is specifically required. This risks creating a further digital divide between smallholder rural farmers and more commercial or urban farmers. Funding for this infrastructure is intended to come from the Ministry responsible for agriculture. This initiative seems at odds with the national strategies which aims to achieve universal access and eliminate the digital divide between urban and rural areas. It is outside the scope of this study to determine whether this initiative was implemented and to what extent it was amended.

2.4 CHALLENGES

A key challenge is the divide within the Ministries from different Departments that seem to be moving at different paces without a cohesive vision. For example, the Department of Vet Services has a successful and modern traceability system on livestock[20] but this is not evident in other agricultural sub sectors. This divide is likely a result of a lack of policy at government level to guide the strategy of digitalization within the whole agricultural sector and without this it is likely that Departments will continue to work at different paces and disjointedly. Farmers, especially rural small-scale farmers, are still heavily reliant on extension services and while these have been heavily invested in to improve services (such as supplying laptops to extension workers) gaps remain in

disseminating information to farmers. Furthermore, extension officers require retraining for digitalization and emerging technologies to effectively impact knowledge to farmers.

Radio remains a popular tool to reach farmers of all abilities but innovative platforms such as social networks have been used, such as Facebook and YouTube so there is scope to try and increase uptake of digital technologies and services[iii]. Amongst farmers there seems to be slow uptake of technologies and innovations and this could be due to the poor digital technology access in rural areas. There is potential within the sector to increase skills and the use of digital solutions as more young people join the sector which may trigger an increase in uptake of digital approaches, as has been experienced since 2020, according to an interviewed stakeholder.

[iii] The Facebook platform had to be closed due to the explicit nature of the slaughter of animals.

3 DIGITAL AGRICULTURE INNOVATIONS

This chapter provides a stocktaking analysis to assess the numbers, scope, trends, and characteristics of digital agricultural innovations in Botswana.

3.1 MAPPING DIGITAL AGRICULTURE INNOVATIONS

The DACS for Botswana presents use cases according to a typology and framework developed by GSMA (Figure 2). The broad areas include access to services, access to markets and access to asset classes. The diagram below represents the type of GSMA use cases in identified innovations in Botswana. A total of 15 innovations were identified in Botswana that had a mix of use cases as illustrated in Figure 7 below.

From the identified innovations, six were developed for a single use case and nine for multiple use cases (one for 5 use cases, one for 4 use cases, four for 3 use cases and three for 2 use cases). Seven identified innovations were specific to Botswana only, and eight were identified as innovations for multiple countries including Botswana. Figure 7 below illustrates the division per use case for the identified innovations. Smart Farming is the most common use case in Botswana which tends to rely on more advanced technologies and tools.

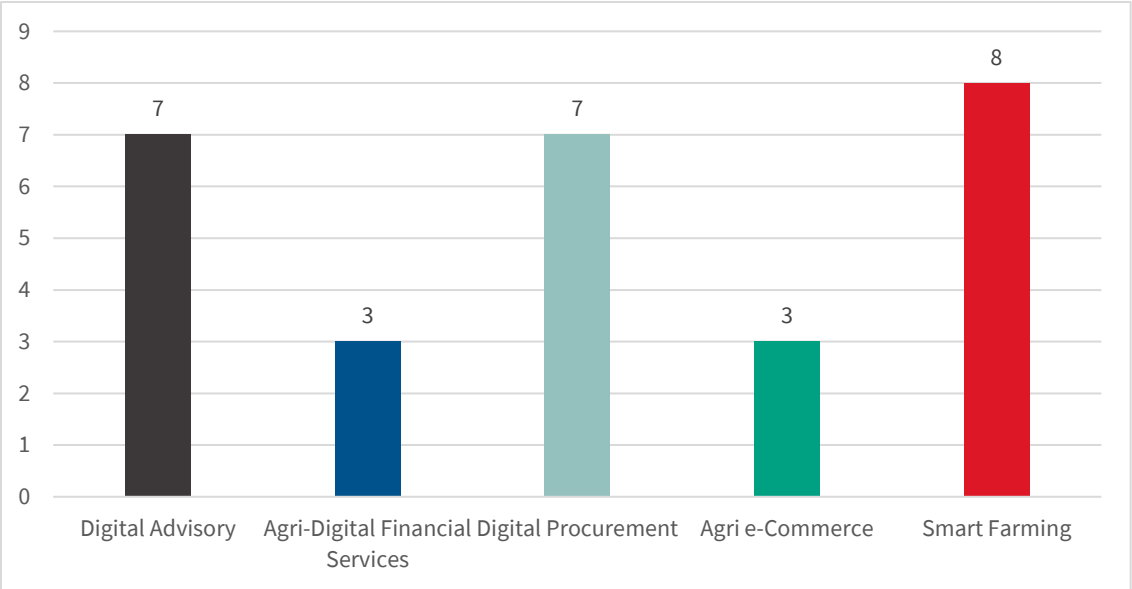

FIGURE 7 IDENTIFIED USE CASES FROM INNOVATIONS IN BOTSWANA

The table below presents an overview of all identified innovations with their use cases, a brief description of the innovation and company, and where the innovation is operational in SADC member states.

3.2 IDENTIFIED AGRICULTURAL INNOVATIONS OPERATIONAL IN BOTSWANA

In the first four columns the following color coding is used for the different use-cases:

DIGITAL ADVISORY | AGRI-DIGITAL FINANCIAL SERVICES | DIGITAL PROCUREMENT | AGRI E-COMMERCE | SMART FARMING

TABLE 6 OVERVIEW OF IDENTIFIED AGRICULTURAL INNOVATIONS OPERATIONAL IN BOTSWANA

					Name of innovation	Name of the company	Survey ✓/X	Description of innovation	Operational Countries in SADC
	■				AgriTask GIS	AgriTask	✓	AgriTask GIS by Hollard is a digital innovation and digital insurance solution for Index/Parametric Insurance connected to Meteosat satellite GIS platform and can remotely activate a smartphone to collect GPS data or points of agricultural plots and finally estimate the plot size. Using this innovation Hollard remotely get information about the size of agricultural plot and use this information to assess farmer eligibility for agricultural credit or insurance access and can enroll farmers. It addresses farmers being able to plan effectively and ensure that they can produce efficiently and gain access to markets. The company Hollard operate in Botswana, Lesotho, Mozambique, Namibia and South Africa and launched AgriTask in 2020. They have 10 active users so far and 34,000 registered users. The service enables access to insurance products and in doing so access to financial services. The digital innovation relies on GPS, Smartphones and GEO data. It uses spreadsheets (Excel, to cloud-based SQL, third party SaaS software providers and IBM Watson AI platforms. The innovation is transitioning to scale and was developed using donor grants from government or foundations. Currently still dependent on program support Swiss Capacity Building Facility. Their recent feasibility study on livestock insurance in Namibia, Botswana and Mozambique looks at index-based insurance and agricultural loans and their	Botswana, Lesotho, Mozambique, Namibia, South Africa

								bundling as part of a potential public sector program focused on areas prone to drought. Their technology is inclusive of disadvantaged groups.	
					Botswana Animal Information and Traceability System (BAITS)	Ministry of Agricultural Development and Food Security	X	Botswana Animal Information and Traceability System (BAITS) of Ministry of Agricultural Development and Food Security. BAITS is used for animal registration, transfer of ownership, arrival of livestock, veterinary drug treatments and removal of dead/fallen stock. The technology is used with ear tags. Implemented in Botswana only.	Botswana
					Carbon Calculated	Carbon Calculated	X	The Carbon Calculated team helps companies understand their carbon footprints as the first step. They provide business leaders with appropriate tools they need to reduce the impact of greenhouse gas (GHG) emissions and, at the same time, provide the business-side advantages of carbon management.	Botswana, South Africa
					Food Processing Software	Matrix Software	✓	Matrix Software is a meat and food matrix software solution for stock control, yield management, traceability, productivity, and cost margin management. Matrix Software is a service-led private company that provides software services predominantly to the livestock and meat industry and established in 2019. These are digital, mobile, and tablet-based systems for yield and stock control and statistics leading to costings and profitability. Matrix software utilizes android mobile scanners and their associated applications, RFID integrated solutions, automated weighers, and third-party integration. This reduces the initial capital outlays and good implementation support for feedlots, abattoirs, deboning plants, and meat processing plants including others such as fish, poultry, butcheries and retail outlets. Matrix Software has been located/incubated in the AgVentures Hub in South Africa. This regional solution is deployed in 10 SADC countries (Botswana, Eswatini, Lesotho, Mauritius, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe), but also in counties as Australia and New Zealand. Matrix Software solutions have reached a stage of replication and adaptation in other geographies and are in the Scaling state of development.	Botswana, Eswatini, Lesotho, Mauritius, Namibia, Seychelles, South Africa, Tanzania, Zambia, Zimbabwe

■		■		■	GeoFarmer	GEOTERRAIMAGE (Pty) LTD	✓	GeoFarmer at GEOTERRAIMAGE Ltd is established in 2017 and has combined innovations in smart farming and digital advisory and e-commerce and are regional in their deployment across the entire SADC region. Whilst GeoTerraImage is a private sector company which provides actionable intelligence through monthly crop monitoring through GeoFarmer-©-Crop monitoring platform to support precision farming and accurate information to map crop trends and statistics by using a dashboard in a cloud-based environment. The innovative solution provides using computers, satellites and Earth Observation visual maps and illustrations, statistics and trends for each field or farm being analyzed (crop type, crop growth stages, land suitability, crop irrigation) and guiding decision making around farm management and practices for more efficient and sustainable production. GeoTerraImage have reached wide scale sustained adoption and operate in Angola, Botswana, Comoros, DRC, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia, and Zimbabwe. Through specialized software, proprietary algorithms, and application GeoTerraImage use remote sensed data to create spatial information. They combine advanced information and reporting to enable analysis, quantification and monitoring to support key decision making. They charge business subscription fees for their fully commercial product and believe their technology is inclusive of underrepresented groups.	Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia, Zimbabwe
■				■	KWIBI	Fox-Croft Holdings (Pty) Ltd	✓	KWIBI from Fox-Croft Holdings (pty) Ltd which is a private sector company active in Botswana and South Africa. Kwibi is a mobile tracking App that addresses problems facing modern conservation in situations of human-wildlife conflict. The App benefits local communities by providing livestock farmers with advance warning of predators in the area. The App also enables wildlife data collection, wildlife poaching and the illegal wildlife trade. It is still at the research and development phase but also provides digital advisory particularly on pest and disease management, including plant disease and advisory on strategies to treat diseased plants and mitigate future outbreaks. Most services are accessible via mobile and require farmers to upload pictures of an infected plant for diagnosis. Some services are accessible by USSD, and	Botswana, South Africa

								the information provided also includes national and regional level pest and disease early warning systems. Smart applications using digital tools enable farmers to monitor herds remotely to determine their location and track their health including when in estrus or about to calve. Also enabled are tracking and monitoring feeding habits of fish in aquaculture, disease detection, controlling water quality and automating feeding. The innovation uses Smartphones, a Smartphone App, website, Dashboard and Portal and local databases (MS Access). The innovations address low productivity and mitigating climate change in on-farm production. The innovations are for the primary user and company revenue is based on individual subscription fees, business subscription fees and donor support (which will continue to be required). Stakeholders such as business, entrepreneurs have been involved in its development and the innovations have taken no specific actions to ensure the inclusion of disadvantaged groups so far.	
■					m-Agri	Brastorne	X	Brastorne has developed a platform that gives users access to online applications through USSD technology, enabling simple phones to function as low-cost smartphones. There is need for a data connection, client software or SMS subscription; anyone can access advanced apps such as email, chat, Wikipedia, news, and marketplaces from anywhere and at any time. Moreover, because agriculture is essential for poorer communities, this platform offers specific mAgri functionality for accessing agricultural information (advice, health book for animals, training opportunities, alerts, commodity prices and weather warnings), markets and short-term financing. It also enables users to sell products and services throughout the country as well as update their profile and run an online business. Brastorne's USSD platform has created harmonization between social good and profitability. The platform has performed well in Botswana generating over 500,000 users who have tried the service and is currently in the process of internalization into additional African markets. The company did not participate in the survey but provided a brochure to provide some answers.	Botswana

■		■		■	Modisar	MODISAR NET	✓	Modisar of Modisar, founded in 2016. This is a Precision Livestock Farming (PLF) platform that helps farmers to keep accurate records & to continuously monitor their farm animals. It has a mobile app with the following modules: Animal Management, Farm Management, Financial, Intelligent Farm Assistant (#IFA), Inventory Management. The innovation addresses Knowledge gap, Low productivity, Poor access to markets and Poor access to internet. They use a subscription model (individuals and businesses) and have 2500 users.	Botswana
	■	■	■		Mukuru App	Mukuru Africa	✓	Mukuru Money Transfer Limited is a private sector company operating regionally (Botswana, DRC, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, South Africa, Tanzania, and Zimbabwe). The application addresses a knowledge and access gap and provides access to markets and financial services. The Mukuru App was launched in 2019 and allows customers to create orders for remittances individually and initiate a payment for the transfer to happen. The app can also be used to self-register a customer on the platform and verification takes 24 hours. This enables efficient access to financial services through smartphones. The innovation uses SMS, USSD, a Smartphone App, Website, Dashboard, Social Media Platform and (Fb, Twitter, WhatsApp, Messenger). The platform uses local and cloud-based databases (Excel, MS Access, SQL) and AI platforms (IBM Watson) for Machine learning. Regionally it has 500,000 users and 1M registered users. Also enables farmers to sell to consumers (B2C) and to enterprise customers (B2B) such as hotels, restaurants, and market retailers. Challenges include digital literacy, device sharing, lack of mobile coverage and financial sustainability of the business model in different locations. The application has reached sustainable scale and is focused on individual users. The business was supported by friends and family and development support and training grants. The revenue model is based on transaction fees and the in-house development of the App and platform which is believed to be inclusive of disadvantaged groups.	Botswana, Democratic Republic of Congo, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, South Africa, Tanzania, Zimbabwe

■				■	NDVI field surveys	Precision Drones	✓	NDVI field surveys of Precision Drones Botswana. Provide regular NDVI field surveys to farmers to assess crop health. They have 30 clients.	Botswana
			■		Plaas	Plaas	X	Plaas of Plaas. Plaas is a platform that enables the virtual market for agriculture that empowers the farmers of Africa to seamlessly trade their animals and crops at market price, which will boost their income and information provided by farmers to enrich the crops will help others to match the standards. The app will help empower the farmers of Africa to seamlessly trade their animals and crops at market prices, which in turn, will boost their income.	Botswana
■	■	■	■	■	SmartFarmer	Riskflow DBS	✓	Smart Farmer of Riskflow DBS. This is a private sector company, and this innovation was launched in 2019. Smart Farmer is an agriculture value chain connector, linking agricultural communities to value adding services through networks with markets, suppliers, service providers, other farmers, and relevant government departments. It achieves this through the provision of user friendly, efficient, and flexible ICT-based services which cut across many functions and access channels. The value of Smart Farmer is in assisting farming communities and other stakeholders in doing things smarter, with transparency, accountability, and efficiency, while driving profitability. As a response to the problems faced by agricultural communities, Smart Farmer provides the following services: Peer-to-Peer communication for Farmer-to-Farmer Interaction, Funder-to-Farmer Communication, Government-to-Farmer Communication, Price tracking and reporting, Agricultural alert systems (sending and receiving), Commodities offer and bid facilitation, Location services for service providers, Production information systems e.g., best practices, planning, E-extension services. The Agri-VAS service assist farmers throughout the production cycle and livestock information and market prices – from planning to sale stages, whether locally, regionally, or globally. Smart Farmer offers a new way through which information systems in agriculture are vastly improved. Agri VAS are delivered via voice channels (IVR, helplines), text channels (SMS and USSD) and via apps., Smart advisory: Data-driven advisory based on tailored, farm-level agro-climatic and crop	Botswana, Lesotho, Malawi, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe

								specific information to support decision making, maximize productivity and reduce costs. Most of the services are accessible via mobile applications and require a farmer to upload a picture of the infected plant for diagnosis. Some services are also accessible via USSD. Also includes national and regional-level pest and disease early warning systems., Record keeping: Digital tools that enable farmers to keep detailed records of livestock, including health and feeding data, to help mitigate diseases and avoid missed conceptions. Record keeping tools are also used to keep details of input usage, procurement, cost and revenue and sales records. The other product is the CashFlow Optimizer to deal with open integrated and adaptive web based platform with details of dealers, counterparties, making use of Intelligent Financial Performance Monitoring components. a) The Primary Outcome of this Innovations is improved access to Finance through providing each farmer an Income statement balance sheet and cashflow, to assist them in accessing loans as well as keeping their Bio Data digitally and open for appraisal to Financial Institutions. b) Improved Yields through use of 3rd Party software that we have partnered with on our Platform such as Skudu to provide fertilizer and Insuring Yields through an Area Yield Index based Insurance model from PULA, our insurance partner. The regional initiative is active in Botswana, Lesotho, Malawi, Mozambique, South Africa, Tanzania, Zambia, Zimbabwe with 15,000 active users and 300,000 registered users and is in the transition to scale stage.	
				■	Very Small Aperture Terminal (VSAT) for farmers	Botswana Telecommunications Corporation	✓	Very Small Aperture Terminal (VSAT) of Botswana Telecommunication Corporation (BTC). Very Small Aperture Terminal (VSAT), is a small telecommunication earth station that receives and transmits real-time data via satellite information that could be used by farmers	Botswana

■		■	■	■	Virtual ranching farming program	VIRTUAL FARMING PTY LTD	✓	VRFP app of Virtual Ranging Ltd. Virtual Ranching Farming program (VRFP)is an app-based e-commerce platform where Individuals get in farming via mobile phone application and get to own and trade Livestock and Farm produce – Horticulture products. Through Agri business Insurance in reputable Insurance companies these farm products will be insured to avoid any loses and cover all risk through this program. This app manages Farmers produce' sellers and buyers' demand for livestock and Horticulture farm produce. Quality cows and farm produce will see Botswana becoming self-reliant on the national food security and international markets.	Botswana, Malawi, South Africa
■		■		■	Mobile Drone Crop Spraying Units	Precision Drones	✓	Mobile Drone Crop Spraying Units of Precision Drones Botswana. This is a solution with mobile drone spraying units around the country targeted at small commercial / emerging farmers and charging per hectare rates for specialist spraying services. They have 20 clients.	Botswana

3.3 RESULTS FROM INNOVATION SURVEY RESPONDENTS

All identified innovators received a survey and 11 innovations implemented in Botswana responded. The answers on the survey are self-reported. The response rate of the survey for Botswana was 73% (11 out 15 identified innovations responded). All identified innovators were reminded several times by email and by phone to complete the survey.

All but one innovation was developed by a private sector company, the outlier was a private-public partnership. One regional innovation was developed this year (2021), but the majority were developed in 2019 (4) and 2020 (3). An older innovation developed in 2002 is a regional innovation.

USE CASES AND SUB USE CASES

The division of GSMA use cases shows that in Botswana multiple use cases are most common. Eight out of 11 respondents provided multiple services and only three respondents provided a single use case. One respondent addresses all five use cases in their innovation, one address four use cases, four address 3 use cases and two addressed 2 use cases.

Figure 8 below presents the division of use cases provided. Smart Farming was the most common use case cited by all survey respondents (8). Digital Procurement and Digital Advisory were the next most common (7, respectively). Agri e-Commerce and Agri-Digital Financial Services were the least common and was only provided by three respondents each, all of which were regional innovations. Figure 8 also illustrates a comparison of use cases to the rest of the identified innovations in the SADC region, Botswana broadly follows the same trend but has a larger percentage of innovations that provide digital procurement and smart farming services.

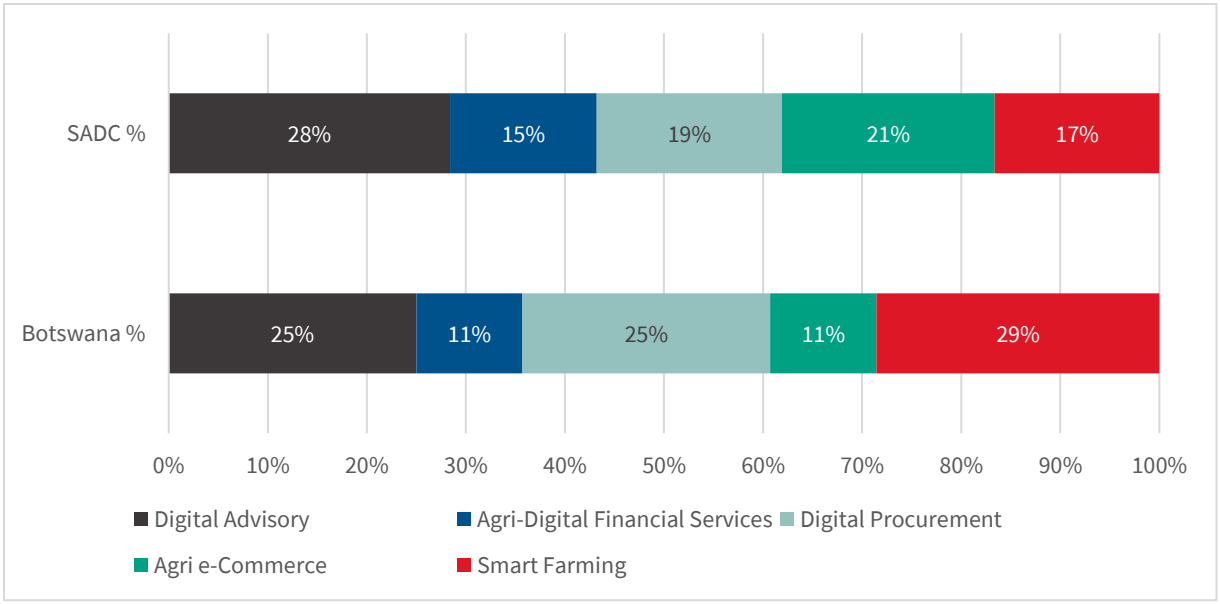

FIGURE 8 DIVISION OF USE CASES FOR SURVEY RESPONDENTS IN BOTSWANA VS. IDENTIFIED INNOVATIONS IN SADC

The innovations present in Botswana provide a large variety of sub use cases as presented in figure 9 below. For Digital Advisory, smart advisory and pest and disease information was the most common. For Smart Farming, smart shared assets and livestock management were most common.

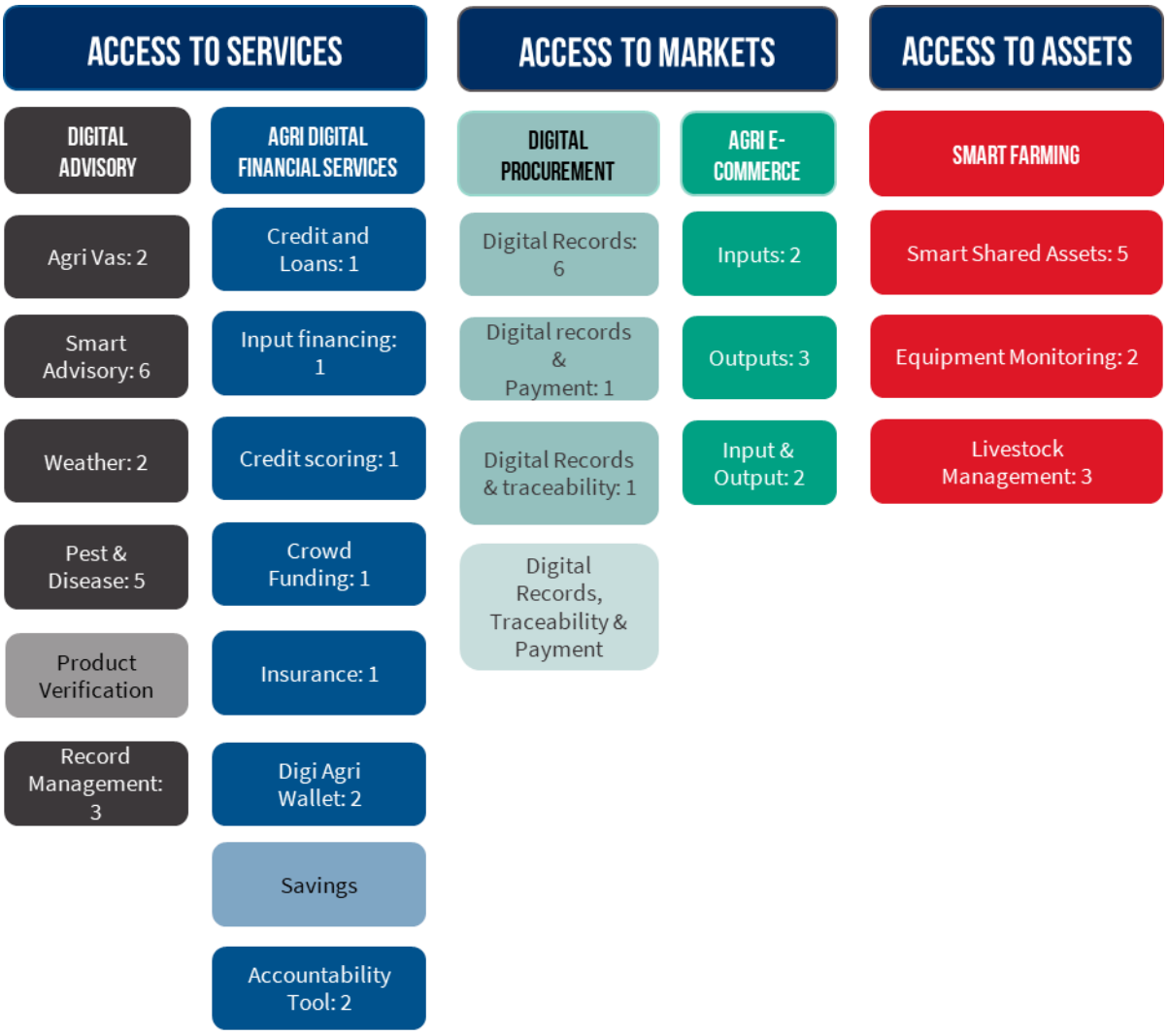

FIGURE 9 OVERVIEW OF SUB USE CASES PRESENT IN SURVEYED INNOVATIONS IN BOTSWANA

The anticipated outcomes of the innovations by the survey respondents reflect that livestock is important in Botswana: protection of livestock from predators, improved livestock production, herd records management and traceability of livestock. Other anticipated outcome focused on efficient use of water and chemicals to increase the yields of crop production.

CHALLENGES

In Botswana, innovations are trying to address a range of pain points within agricultural systems. Overall, the four key challenges being addressed are low productivity (8), the knowledge gap (7), poor access to markets (6) and climate change (6). The challenges of low productivity and the knowledge gap are most common, followed by financial exclusion, climate change and poor access to internet in innovations operating in Botswana alone.

In terms of challenges faced when implementing and applying the innovations, the overwhelming response was digital literacy (8), followed up farmer uptake and use (7). This is the same when applied to innovations in Botswana. Lack of mobile network coverage, lack of electricity, user affordability, and operational constraints were also frequently mentioned.

TECHNOLOGY USE AND CHANNELS

Smartphones and computers were the number one device (mentioned seven times) required for use of innovations. A notable finding is the high use of GPS solutions which was mentioned six times in the responses. In terms of types of digital channels, portal websites were mentioned the most (9), with smartphone apps second most common (7). Despite these more advanced channels, SMS was also mentioned five times. Blockchain technology was mentioned once by a regional innovation, Smart Farmer.

For analysis tools and technologies, respondents provided a mix of examples. Cloud-based database solutions and spreadsheets were the most cited at nine times each. Local databases and cloud-based software was the next most common, mentioned eight times each. More advanced analysis tools were also mentioned, including artificial intelligence (AI) platforms (6) and machine learning (5). The Virtual Ranging Platform uses AI and machine learning to improve the trade deals on the platform.

VALUE CHAIN PHASES COVERED

Surveyed innovations in Botswana addressed most stages of the value chain but more were tailored towards earlier stages of the value chain in terms of planning, on-farm production, and inputs. Figure 10 illustrates the different phases of the agricultural value chain that the innovations in Botswana address.

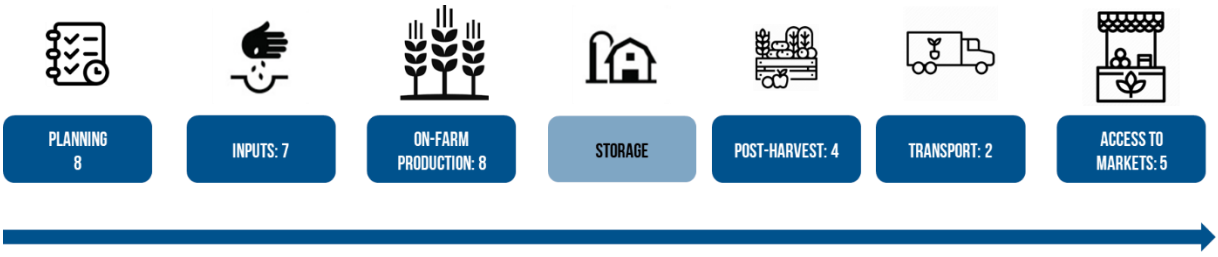

FIGURE 10 SURVEYED INNOVATIONS PRESENCE IN THE VALUE CHAIN IN BOTSWANA

SCALING, DEVELOPMENT, FUNDING AND REVENUE SCHEMES

Respondents answered differently based on the phase of scaling they related to. Only one regional innovation Mukuru app has 1,000,000 users (although it is not clear how many users they have in Botswana and if this is only used by farmers). Mukuru has a transaction-based revenue model. They see themselves in the sustainable scaling phase and do not require donor funding to be sustainable. Smart Farmer has a mixed revenue model (with a mix of individual subscriptions, business subscriptions, transaction fee, advertising, and monetizing data. They have 311,000 registered users but see themselves in the transition to scale phase. They still need donor grants and subsidies to grow. This is the same as the other 2 innovations with more than 1,000 users. AgriTask has 34,000 registered users but uses donor and project funding as a revenue model. Modisar with 2,500 users see themselves in the scaling phase (replicating to other geographical areas) with a revenue model that is a combination of individual subscriptions and business subscriptions. Virtual Ranging has only 450 registered users funded with donor and project support, but they see themselves also in the scaling phase (replicating to other geographical areas), because they have started a new NGO in Malawi to replicate the concept. GeoFarmer mentioned that they are in the sustainable scale phase but did not provide an answer on their number of users. In general, the innovations are already in a further stage of the development.

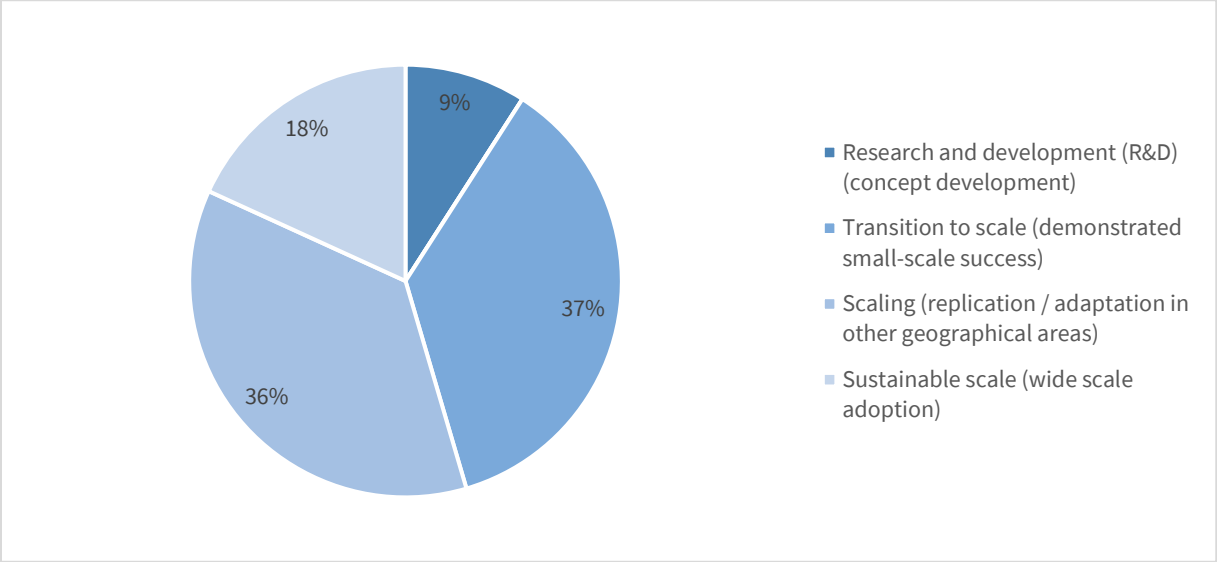

FIGURE 11 SCALING STAGES FROM SURVEYED INNOVATIONS IN BOTSWANA

Friends and family were the biggest financiers of innovations, (6x), followed by training support (4x). Friends and family were also the biggest funding source for innovations operational in Botswana only. Notably, the biggest innovation in terms of users, Mukuru, mentioned that it is funded by friends and family only. Virtual Ranching Farming had donor grants and project finance in their revenue model, but they have also received impact investment and have been incubated, just like Matrix Software. Smart Farmer is fully self-funded according to their survey.

INCLUSIVITY AND TARGET AUDIENCES

Most innovations target individual farmers (8) as primary users followed by farmers cooperatives (4). All other target audiences (other value chain actors, government agencies, extension workers and NGO staff) were mentioned three times, respectively. Cooperatives and government agencies (4, respectively) were seen as intermediaries' users. All the innovations surveyed were targeted at business level (11), followed by community and individuals (9, respectively).

Not all innovations focus on inclusiveness. Six innovations were already inclusive for the elderly and those with low literacy levels, five were already inclusive for women, people with disabilities and smallholder farmers. Only one innovation had taken explicit steps to be more inclusive of women, the elderly and those with limited or low literacy levels. The only survey respondent that mentioned that they take specific action to address the needs of women, elderly people, small holder farmers and those with low literacy levels is Smart Farmer.

4 DIGITAL AGRICULTURAL SYLLABI AND ENTREPRENEURSHIP TRAINING

The Maitlamo Botswana's National ICT Policy (2004) recognizes the importance of education and skills development as the basis for the generation of economic growth in the country. Digital literacy trainings should increase at all levels of education, including in universities, and the Maitlamo Botswana National ICT Policy targets the introduction of ICT education in the formal education system and the provision of digital infrastructure to learning institutions. On-the-job training and tertiary education in specialized ICT skills is seen as necessary to be able to include graduates in the skills demanding ICT sector.

The National Information and Communications Technology Policy (2007) highlighted the possibilities of ICT-driven transformation and development for economic growth in Botswana, including in the agricultural sector. The policy puts emphasis on the importance of ICT skills and ICT-related skills in the education system. The Thuto Net program is supposed to ensure digital connectivity and sufficient bandwidth in schools. Youth are expected to learn digital skills as early as possible, facilitating a student's acquisition of digital skills and preparation for jobs in the digital economy. Furthermore, the development of a second university in Botswana is planned and would focus on ICT-related skills and expertise. Adults would also engage in training in digital skills through centers providing community access. Local businesses and private sector training organizations are encouraged to offer more advanced ICT skills trainings. In addition, the Botswana Education Training Sector Strategic Plan (ETSSP 2015-2022) promotes fostering of skills development through the use and integration of ICT in the education system. Educators are expected to be trained to develop their digital skills.

The National Development Plan II - Volume 1 (April 2017-March 2023) states the efforts outlined for ICT sector development in the country. The Broadband Strategy fosters the long-term development of digital infrastructure for the population. One part of the strategy is a digital literacy education program. The training of ICT personnel is also envisioned.

4.1 AGRICULTURAL SYLLABI UNIVERSITIES

Two public Universities were contacted in Botswana:

- Botswana University of Agriculture and Natural Resources (BUAN)
- University of Botswana

The University of Botswana did not respond to a request to complete the survey. BUAN filled in an incomplete survey, further information was provided in a KII.

BOTSWANA UNIVERSITY OF AGRICULTURE AND NATURAL RESOURCES (BUAN)

BUAN offers digital education and ICT in more than ten of their syllabi (available on request). Digital agriculture innovations are integrated within subject in classroom teaching. In collaboration with a private sector university New Era University (not included in the survey) BUAN demonstrates digital technologies like robotics and drone technology. More general digital skills are taught at other faculties of this university (also available to agriculture students). The digital entrepreneurship trainings (Incuhive) work in collaboration with

Local Enterprise Authority (LEA) to prepare future entrepreneurs. During the Covid-19 pandemic BUAN started with digital learning based on Moodle. The university is currently adopting a blended learning.

TABLE 7 OVERVIEW OF RESPONDENTS FROM SURVEYED UNIVERSITIES IN BOTSWANA

BOTSWANA UNIVERSITIES	
Botswana University of Agriculture and Natural Resources (BUAN)	
Digital Agri Skills	Data for analytics in agriculture
Digital training courses updated	
Digital entrepreneurship trainings	Digital Advisory ICT-enabled advisory services
Type of Skills building	Not provided
Most important digital Agri skills	Not provided
Most important facility for digital trainings	Not provided
Aligned with institutional strategy	Not provided

4.2 INCUBATORS AND INNOVATION HUBS

A total of eight business support organizations were mapped in the country, out of which five are operating in the agricultural sector. The general business support organizations without focus or activity in the agricultural sector that were identified are First Steps Venture Centre (FSVC), Institute of Entrepreneurial Development and the Business Accelerators. For these organizations we did not find any evidence of trainings and incubation activities dedicated to agricultural entrepreneurs and therefore they were not targeted for the KIIs.

The agriculture-related business support organizations that have been identified and contacted are:

- Botswana Innovation Hub
- Nest Hubs
- Botswana University of Agriculture & Natural Resources (Incuhive)
- The Local Enterprise Authority (LEA)
- Citizen Entrepreneurial Development Agency (CEDA)

These organizations support entrepreneurs and youth in Botswana to build their digital and entrepreneurial capacities and skills in the agricultural sector. A total of three business support organizations responded to requests for KIIs.

BOTSWANA INNOVATION HUB

Established in 2012, the Botswana Innovation Hub is an incubator that is embedded in the Science and Technology Park and hosts an area of innovation which is linked with the Malaga Technology Park in Spain. They provide the following types of support: acceleration and incubation, managerial support, physical spaces, entrepreneurial and managerial training, ICTs and digital agriculture training, administrative and legal services, intellectual property, support in the development of networking relationships, support for technology scouting and development and support in fundraising and investment readiness. The Botswana Innovation Hub did not provide information on the agricultural start-ups that are currently in their portfolio or were supported in the past. Currently, they support 17 business projects.

The Botswana Innovation Hub does not have a tailor-made digital strategy for the digital skills training, but they organize capacity building sessions such as robotics and coding. Concerning the agricultural sector, they rely on external experts for the trainings. They use digital agricultural tools such as digital advisory, Agri e-commerce and smart farming, but they are not integrated in their curriculum. However, they mentioned that

these were included within trainings organized by external companies. Among the entities mentioned are Universities, private sector organizations and individuals. The target of their trainings are graduates, people from the communities and professionals.

The Hub is completely owned by the government to support the local entrepreneurial ecosystem and is funded by public funds and some partnership contributions (of up to 20%).

INCUHIVE OF BUAN

Established in 2021, the IncuHive incubator of the Botswana University of Agriculture & Natural Resources offers mentoring and training in technical and business skills such as record keeping, development of business plans, marketing, and branding. To date, they have assisted approximately 30 graduates at BUAN. They collaborate with the private sector and the quasi-public institution the Local Enterprise Authority (LEA) to deliver their training and mentoring programs.

Their partners from the private sector are: **The Neo Hub** that provides mentoring in financial technology, personal development (character building, emotional intelligence, leadership) and marketing; the **Drone Technology Center** for the provision of drones to BUAN for the application of herbicides, for foliar fertilizers and other services for livestock; and **Agrizor** which supplies seeds and conducts field trials. LEA provides the record keeping on the trainings and is the main partner of BUAN.

Their training includes digital skills, marketing and online marketing, information videos and communication courses. The students also learn record keeping and handling of information for production and financial records through ICT technology. Furthermore, they see the potential of Beyond Targets for marketing and Spot Malls to promote the products of incubates. Currently, they are developing a digital mall where incubees will sell their products which should have been finished by the end of October 2021.

They do not teach digital advisory because of lack of technology, and they do not teach digital procurement. Their system has the capability to do traceability characteristics, payments, purchasing and a database of clients. For smart farming, they have livestock (chicken, pigs) whilst drone technology is still new. Their program targets the graduates of the university with the intent to become entrepreneurs in commercial farming and in the natural resource sector. Eventually the program could be extended to graduates from other universities but currently BUAN does not collaborate with universities. BUAN's incubator is supported through government funding. If the project becomes sustainable, it could achieve the goal of providing a third-stream of income to the university.

THE LOCAL ENTERPRISE AUTHORITY (LEA)

The Local Enterprise Authority (LEA) was established in 2008 and the horticulture started operating in 2011. LEA is partly owned by the government and thus a parastatal organization under the Botswana government and more precisely the Ministry of Trade and Investment. The incubation is managed and operated by LEA. LEA provides onsite mentoring, incubations, capacity development plans, developmental programs, BQA accredited courses (e.g., sales and marketing, record keeping and entrepreneur development training). To be abreast with the advancement of technology, LEA provides support through mentorship, a business working space, facilitating the growth of enterprise, quality improvement, market identification, assisting with identification of technology appropriate for the clients. LEA supports in the creation of network relationships through partnerships with organizations such as BUAN's IncuHive innovation program for graduate students.

LEA aids in the form of business management, as well as technical interventions. They provide entrepreneurs with support to scout for appropriate technology, and to ensure sustainability in their business.

To date, LEA has over 200 entrepreneurs and aspiring farmers who have graduated. The project targets youth to empower them and as a strategy to improve food security for the nation and to create employment for the youth to actively participate in the economy. LEA's graduates have been assisted with the opportunity to have access to fund applications to start their businesses as well as advice on how to set up a business project. They profited from BQA courses to develop their business plans. LEA supports in the starting of the projects. At least 40% of their graduates have established enterprises or projects. Recently, LEA has started a new commercialization project where LEA provides infrastructure to use on a lease project basis while the entrepreneurs are still developing their farms.

LEA's training program does not teach any digital skills or digital agriculture skills. They only use a financial model tool, or software, to monitor their activities, business performance and profit/loss accounts. They do not use smart farming, but they have greenhouses with climate control systems where the manipulation of temperature, humidity, radiation, and fertigation systems are computerized. They also have tunnels that are appropriate for winter production, net houses to protect from high temperatures, drip irrigation systems and hydroponics for growing vegetables. The training programs are executed by LEA and in case of a lack of expertise they rely on collaborators and universities (e.g., BUAN, the Department of Protection for Diseases, and other resource persons). In addition, they rely on BoB, CIPA and BURS as collaborators and service providers as well as organizations where they buy farm supplies such as fertilizers and seeds to provide training. LEA collaborates with BOTHO University, a local private owned university, to face the agriculture industry's challenges and to come up with solutions to address problems in the sector. LEA has also been used for benchmarking by other tertiary institutions and secondary schools, colleges (e.g., Baisago and BUAN). LEA benefits mostly from government funding but also gets funds through the services paid by farmers.

TABLE 8 OVERVIEW OF RESPONSES FROM INTERVIEWED INCUBATORS IN BOTSWANA

BOTSWANA INCUBATORS	
Botswana Innovation Hub	
Year of Establishment	2012
Agri start-ups incubated	N/A
Target of Digital Agri trainings	Graduate
Digital Skills trainings	Capacity building sessions on Robotics and Coding
Digital Agri Tools taught	- Digital Advisory - Agri E-Commerce - Smart Farming
Collaboration with Universities and Colleges	5 but not mentioned
Supported by the Government?	Yes
BUAN IncuHive	
Year of Establishment	2021
Agri start-ups incubated	N/A
Target of Digital Agri trainings	Graduate
Digital Skills trainings	- Online marketing - Communication - social media - ICTs for production records and finance
Digital Agri Tools taught	Digital Procurement
Collaboration with Universities and Colleges	None
Supported by the Government?	Yes

The Local Enterprise Authority (LEA)	
Year of Establishment	2008
Agri start-ups incubated	200
Target of Digital Agri trainings	- Student/ Pupil - Graduate - Researcher - Young agripreneur - Aspiring agripreneur
Digital Skills trainings	ICT for record keeping
Digital Agri Tools taught	None
Collaboration with Universities and Colleges	BUAN; BOTHO
Supported by the Government?	Yes

5 INSIGHTS AND REFLECTIONS

The following section outlines the key insights from the data collection of the DACS and towards the end of the report signposts some broader reflections relevant to this country from the *Situational Analysis Report*.

It is important to note that digitalization is a gradual process, which requires a broad and well understood internal rationale, adjustment of organizational culture and adequate investments over time and of resources to align actors, processes, and capacity. This section acknowledges that the data collected is not exhaustive but has enabled some insights and reflections to be shared that are more country specific. To capitalize on these results multi-stakeholder processes to define clear approaches based on agreed priorities will be necessary.

5.1 INSIGHTS

BENCHMARK RESULTS

Botswana ranked sixth out of 16 in the benchmark assessment for SADC, suggesting that it has some key foundational elements necessary for a robust digital economy. The benchmark assessment enabled the identification of countries within SADC that are unlocking positive pathways towards a digital economy and a vibrant ecosystem of different actors. Botswana ranked in the top half of the SADC member states for all pillars except digital government (which identified the presence and use of digital services and platforms to enable public service delivery).

Four clusters of countries at different points in their progress were identified in applying the benchmark. The clusters formed through the benchmark help to identify the progress countries have made and where greater efforts may need to be directed. Botswana makes up part of Group 2, these countries ranked in the top half of the benchmark but are not the front-runners in the region, based on the data collected.

POLICY ENVIRONMENT

The benchmark assessment suggested that Botswana is unlocking the digital economy and that there is likely a supportive enabling environment. The stock take of national policies, strategies, and legislation identified that digitalization is being prioritized but more needs to be done to incorporate emerging technologies and data. Four key documents were available for review that focused on a general approach to integrating ICTs, cybersecurity, and e-Government. Two national plans were reviewed that also prioritized the importance of digitalization across the economy.

No specific sectoral strategy or policy on digitalization within agriculture was identified. It seems that digitalization within the agriculture sector in Botswana is inferred in broader national policies and strategies and is still at a preliminary stage. Some digital innovation is apparent, such as the livestock initiative referenced in Chapter 2, but the impetus for this was likely an external influence from the EU to align to certain standards and increase trade. The same benefits could be realized across the wider agriculture sector, especially in trade, if digitalization is better integrated into the sector with a clear strategy and plan to signal to investors and businesses the opportunities available in the sector. However, improving on uptake and digital literacy of the workforce would be paramount, as well as improving networks and infrastructure to

increase access to these rural areas. Digitalization in agriculture within the public sector is lagging. The key challenges identified from research, stock take review and key informant interviews is the lack of a guiding policy or strategy specific to agriculture, the divide within ministry departments and the level of digital literacy among farmers. There has also been pressure from the youth to digitalize more works and services, but this will need to be balanced with greater skills and training for the older generations of farmers. Covid-19 has also highlighted the need for greater improvements in the sector, specifically the benefits of digital platforms and greater online financial transactions to limit the movement and travel of farmers into urban areas. Many of these challenges require greater stakeholder collaboration including the private sector and civil society as they fall outside the remit of the Ministry of Agriculture.

DIGITAL AGRICULTURE INNOVATIONS

A total of 15 innovations were identified in Botswana and 11 responded to the survey. All use cases were present in Botswana: digital advisory, agri-digital financial services, digital procurement, agri e-commerce and smart farming. Smart farming was most common and prevalent in all respondents, but there was a clear gap around agri e-commerce and agri-digital financial services where only regional innovations responded to these use cases. Smart farming is an unusual use case to be most common in Botswana and was unexpected due to the level of maturity required. The technology being utilized such as blockchain, AI and machine learning, shows also that Botswana is further in their development than most SADC countries.

The surveyed innovations addressed most stages of the value chain and are more tailored for the earlier stages with planning, inputs, and on-farm production most common. There was a clear gap in storage solutions, with no innovations citing this in the survey. These results are reflective of the main pain points innovations are attempting to address such as low productivity, the knowledge gap and poor access to markets.

The results from Botswana suggest there is a clear challenge when it comes to the users of the innovations. Digital literacy was cited as a challenge by most innovations when applying their solutions, which was followed by farmer uptake, use and behavior. In addition to these key challenges, for the innovations operational only in Botswana, key challenges were also noted around connectivity and infrastructure.

In terms of scalability, most innovations surveyed are in the more developed levels of scaling. However, access to finance is still an issue as most of the survey respondents fund their innovations by themselves or through support from friends and families. If you are not a Botswana citizen, it is also difficult to get access to government funding, grants or other forms of finance making the environment less attractive to foreign innovators.

DIGITAL AGRICULTURAL SYLLABI AND ENTREPRENEURSHIP TRAINING

Several policies exist to foster digital skills education in Botswana, yet digital infrastructure is limited in terms of its implementation, especially in rural zones. The government must provide digital infrastructure to enhance digital skills training and provide job opportunities in the agricultural sector. The results also suggest that incubators provide a better environment for digital skills training, although both universities approached did not complete the survey fully.

Business support organizations are largely funded through government funds. A closer collaboration with the private sector could provide additional funds for training youth. Greater efforts should be made to foster youth entrepreneurship through the development of a robust capacity platform to train youth, the identification of

opportunities in agriculture for youth, the development of Labs, the provision of incubation facilities for the AgriTech sector and equipping the greenhouses that leverage technologies.

CCARDESA should link different experts in and outside the region with the various countries so that the countries can profit and address their knowledge gaps through the existing knowledge from other countries, ensure an increased agricultural output, share experiences among member states and ensure the usage of appropriate methods.

The regional research and education network of southern and east Africa, UbuntuNet Alliance, reports that the Botswana National Research and Education Network (BotsREN) has recently been established. It is recommended that BotsREN is strengthened so that it supports the development of affordable connectivity infrastructure and other value-added services for the benefit of research, education, and innovation-related institutions.

5.2 REFLECTIONS FROM THE SITUATIONAL ANALYSIS

This document has presented the available data collected for Botswana and provides detailed insights on the three main elements: policies, innovations, and digital skills. The country data collected is intended to be useful for a local context, however the *Situational Analysis Report* presents a much broader perspective which examines regional trends, provides analysis on the regional findings, and highlights potential areas for shared learnings across the SADC region.

This section briefly presents key regional reflections that are relevant for this country that are derived from the *Situational Analysis Report.* The intention is to direct the reader to the report where these points have been elaborated on and presented alongside other countries in the region to learn from.

The key reflections from the Situational Analysis Report relevant to Botswana include:

- A whole-of-government approach is necessary for a thriving digital economy that enables engagement of stakeholders in the policy process and can alleviate cross-sectoral challenges. Focus within the strategy should be on the cross-sectoral barriers such as infrastructure, connectivity, the cost of data and access to data, digital skills more generally at primary and secondary level and greater integration across sectors to break down the siloed nature of current policy making.

- **Low digital literacy hinders the adoption new technologies especially in an aging rural population.** If farmers have limited access to digital solutions or are unable to use them, because they lack digital skills further uptake is likely to be significantly impeded. Innovators should be encouraged to take deliberate actions to ensure innovations are inclusive of those with lower digital literacy and lower literacy levels to enable both a raised awareness of the benefits of digital agricultural innovations but also to enable their use. While low digital skills are an issue that needs to be addressed in a digital economy strategy, specific and explicit focus will be required for the aging rural farming population that consists largely of women, the elderly, and the illiterate.

- **The development of strong campus networks and the strengthening of national research and education networks are key to fostering higher education institutions and innovation hubs to effectively provide all types of digital services for teaching, digital agricultural training, digital**

agricultural entrepreneurship, and advanced research activities. In the field of digital agriculture, mutual learning will be significantly enhanced by providing complementary expertise where it is lacking and sharing IoT/precision agriculture equipment for students and entrepreneurs. It will also promote a greater "entrepreneurship culture" within the Universities.

- It is important to boost the digital agriculture entrepreneurship sector through the acquisition of advanced skills in the space and an alternative model of sustainability for the incubators (especially those who are not supported by the government). Involving the private sector will help a more entrepreneurship-oriented approach adapted to the current labor market where youth can innovate in a context where agriculture is still regarded as old fashioned.

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DIGITAL AGRICULTURE COUNTRY STUDY ANNEX TO THE SITUATIONAL ANALYSIS REPORT OF THE SADC REGION

Centre for Coordination of Agricultural Research and Development for Southern Africa

World Bank Group