VALIDATION WORKSHOP ON THE DEVELOPMENT OF AN AGRICULTURAL MANAGEMENT DATABASE SYSTEM (AMDS)

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WORKSHOP REPORT

ACRONYMS

AFAAS	African Forum for Agricultural Advisory Services
AI	Artificial Insemination
AI	Artificial Intelligence
AICCRA	Accelerating Impacts of CGIAR Climate Research for Africa
AIIS	Agriculture Integrated Information System
AIMS	Agricultural Information Management System
AIS-PPI	Agricultural Innovation System-Policy Practice Index
AMDS	Agriculture Management Database System
AMIS	Agricultural Market Information System (Mozambique)
AnGR	Animal Genetic Resources
AP	Agricultural Productivity
APES	Agricultural Productivity Estimate Survey
AR4D	Agricultural Research for Development
ARC	Agricultural Research Council (South Africa)
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
AU-IBAR	African Union-Interafrican Bureau for Animal Resources
BAITS	Botswana Animal Identification and Traceability System
BQT	Bush Biomass Quantification Tool
BRICS	Brazil, Russia, India, China, South Africa
BUAN	Botswana University of Agriculture and Natural Resources
CAADP	Comprehensive African Agriculture Development Programme
CAADP-XP4	Comprehensive Africa Agriculture Development Programme EX Pillar 4
CCARDESA	Centre for Coordination of Agricultural Research and Development for Southern Africa
CIAT	International Centre for Tropical Agriculture
CORAF	Le Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles
COVID-19	Coronavirus Disease
CSA	Climate Smart Agriculture
DeSIRA	Development Smart Innovation through Research in Agriculture
DT	Design Thinking
EU	European Union

FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FGD	Focused Group Discussion
FMD	Foot and Mouth disease
GPS	Global Positioning System
HPAI	Highly Pathogenic Avian influenza
ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development
INTERGIS	Integrated Registration and Genetic Information System
IoT	Internet of Things
IP	Intellectual Property
IP	Internet Protocol
ITU	International Telecommunication Union
KII	Key Informant Interview
LIMS	Livestock Information Management System
LITS	Livestock Identification and Traceability System (South Africa)
Live2Africa	Sustainable Development of Livestock for Livelihoods in Africa Project
M&E	Monitoring and Evaluation
MCP	Mobile Cellular Phone
ML	Machine learning
MoU	Memorandum of Understanding
MS	Member State
NAMIS	National Agriculture Management Information System (Malawi)
NGO	Non-Governmental Organization
NLITS	Namibia Livestock Identification and Traceability System
NSA	Namibia Statistics Agency
NW	North West (South Africa)
R	Programming language
R&D	Research and Development
SADC	Southern Africa Development Community
SDG	Sustainable Development Goal
SIMT	Labour Market Information System (Mozambique)
SLITS	Eswatini Livestock Identification and Traceability System

SU	Stellenbosch University
TAD	Transboundary Animal Disease
TLU	Tropical Livestock Unit
TVET	Technical and vocational education training
UFH	University of Fort Hare
UN	United Nations
USSD	Unstructured Supplementary Service Data
WT	World Telecommunication

1. BACKGROUND AND OPENING REMARKS

The **Centre for Coordination of Agricultural Research and Development for Southern Africa** (CCARDESA), a SADC subsidiary, is mandated by Member States to coordinate regional cooperation in agricultural research and development. It is currently implementing the **Comprehensive Africa Agriculture Development Programme EX Pillar 4 (CAADP-XP4)** under the EU's ***"Development Smart Innovation through Research in Agriculture"*** (**DeSIRA**) initiative. The CAADP-XP4 Programme is funded by the International Fund for Agricultural Development (IFAD) for five years (2019–2024).

The CAADP-XP4 Programme supports a science-led, climate-resilient agricultural transformation in Africa. It seeks to strengthen CCARDESA's capacity to deliver on its Agricultural Research for Development (AR4D) mandate and to collectively support African countries in implementing CAADP-aligned programmes. This is achieved through inclusive partnerships, the production and exchange of climate-relevant knowledge, effective communication and M&E, promotion of innovation and evidence use, and representation at continental levels. One of the programme's five key outputs focuses on establishing and operationalizing multi-stakeholder partnerships for agricultural innovation. This directly underpins the development and validation of the **Agriculture Management Database System (AMDS).**

The SADC region continues to face persistent challenges in the agricultural sector, largely due to the lack of reliable, accurate, and real-time farm-level data. This gap in data availability, accessibility, and reliability undermines informed decision-making across farm, national, and regional levels, weakening planning, service delivery, and resource allocation. In response to this challenge, Stellenbosch University (SU) and CCARDESA collaborated on developing the AMDS innovation. This user-driven, mobile-based application aims to bridge the agricultural data gap by enabling real-time data collection directly from smallholder farmers across the region. The AMDS platform facilitates data collection through farmer registration, in-app record-keeping of farm activities, and farmer knowledge-sharing exchanges. Data gathered through these interactions will be integrated into the existing SADC Agricultural Information Management System (AIMS), ensuring alignment with regional data protocols and systems.

Beyond its data collection capabilities, AMDS provides farmers with access to markets and value-chain actors while supporting the coordination of public extension and advisory services. The system aims to transform how agricultural services are delivered by promoting digital engagement and enhancing the visibility and voices of smallholder farmers in national and regional systems. Therefore, the AMDS initiative responds to the urgent need for improved data governance, aligning with SADC development strategies and contributing to sustainable agricultural transformation and food security.

The AMDS also supports the objectives of the CAADP Strategy and Action Plan (2026–2035), which prioritizes digitalization, smallholder inclusivity, knowledge exchange, and data-driven planning. Through participatory design and regional integration, AMDS represents a

scalable digital solution tailored for smallholder needs. Its development and validation, guided by user feedback and stakeholder collaboration, marks a key milestone in building data-informed, resilient agricultural systems in the SADC region.

CCARDESA, working with Stellenbosch University, developed a prototype Agricultural Management Database System (AMDS) to guide the national and regional developmental agenda. A scoping workshop was conducted on 9-11 July 2024 to discuss the progress made in the development of the AMDS. The team developing the AMDS now has an improved version of the prototype. Therefore, CCARDESA, in collaboration with Stellenbosch University, organized a workshop to validate the prototype AMDS. Key stakeholders, including farmers, extension agents, researchers, and agro-industry players, were invited to this important meeting. The main objective of the workshop was to test, validate, and refine the Agricultural Management Database System (AMDS) for sustainable farming and agricultural data ecosystems in the SADC region.

1.1. **Welcome Remarks – CCARDESA (Prof. Cliff Dlamini)**

Prof. Cliff Dlamini, the Executive Director of CAARDESA, welcomed the participants. He emphasized that agriculture remains the backbone of the SADC region, providing livelihoods for the majority of the population and serving as a driver of economic transformation. He was particularly happy that farmers, the drivers of African agriculture, were well-represented at the workshop. However, the agricultural sector continues to face multiple challenges, including climate variability, pests and diseases, limited access to timely data, as well as weak integration of technology in decision-making processes. The advent of digital innovations and data-driven tools, such as the AMDS, represents a game-changer. The AMDS is envisioned as a SADC regional public good that will enhance the collection, management and sharing of agricultural data and will be applied across Member States. Prof. Dlamini remarked that the participants were invited to the workshop to co-design, test, validate, and refine the AMDS. He further described the activities envisaged during the workshop:

- **Design and Optimization** - unites diverse stakeholders such as farmers, researchers, policymakers, and private sector partners to ensure the AMDS is technically sound, user-friendly, inclusive, and responsive to on-ground realities.
- **Testing and Validation** - this process ensures the system meets real-world needs and functions effectively in our region's diverse agricultural contexts, delivering tangible value to Member States
- **Refinement for sustainability-**– the goal is to co-create a sustainable solution that is adaptable, scalable, and evolves with advancements in agricultural technologies and the needs of farming communities

The AMDS enables policy-and other decision-makers, farmers, researchers, extension agents, among others, to have reliable, accurate, and up-to-date data. This will also guide planning processes as well as budgeting. He acknowledged that the AMDS tool may look complicated but this will be elucidated and simplified during the workshop. Prof. Dlamini passionately emphasized the need for scaling of this AMDS tool: ***scaling-up*** – to impact on laws, regulations, policies, institutions; ***scaling-out*** to impact on greater numbers of stakeholders and ***scaling-deep*** to impact on traditional norms. He noted that innovations were failing due to lack of scaling. He encouraged participants to be open, share their ideas and contribute practical insights that will make the AMDS a robust and reliable tool for the entire region. Prof. Dlamini thanked CCARDESA's cooperating partners, particularly the European Union (EU), and the AICCRA Project funded by the World Bank (WB), for their continuous support in advancing digital solutions for agriculture. Their collaboration and investment in building digital infrastructure for agricultural research and innovation are invaluable. He urged the SADC region to co-create a future where data-driven solutions

empower farmers, strengthen food systems, and drive inclusive agricultural transformation across Southern Africa. He officially declared the workshop open.

1.2. **Objectives of the Meeting (Prof Kennedy Dzama)**

Prof. Kennedy Dzama of Stellenbosch University gave a brief background to the initiative. In Seychelles, under AU-IBAR's **Genetics Project**, the challenge of obtaining accurate and reliable data, alongside the poor adoption of innovation, was identified as a significant constraint in SADC. This was followed up during the **Live2Africa Project** with the idea of African Technology and Innovation Incubation Hubs (A-TiChub) being muted. Consequently, CCARDESA and Stellenbosch University signed a Memorandum of Understanding (MoU) in 2021, giving birth to the current initiative to develop the AMDS. He reported that this project started with the Northwest farmers in South Africa, where a lack of data was identified as a significant constraint. Prof Dzama asked the participants to express their expectations from the workshop.

The following were some of the expectations:

- To learn how the AMDS App works and what it can do
- Excited to see technology being incorporated into agriculture; the older generation avoided it
- Expect to see how the data generated can be used
- Curious to see what type of data will be captured; broad data ecosystems
- Curious to see what the data will do and how it will benefit farmers; analyses of farmer needs

- How to resolve the question of willingness of farmers to share their data
- How sharing of data with academics will help farmers
- Curious to see if the App will help farmers in their peer-to-peer engagement as well as impact on policy-makers
- Need to check accuracy of data inputs into the App
- Many Apps have been developed but they have limitations, will the AMDS App be holistic; include CAADP indicators; have a One-Stop data centre; need feedback mechanism

The objectives of the workshop were to:

1. Demonstrate the functional capabilities and features of the AMDS prototype and facilitate hands-on usability testing with key agricultural value chain actors, including farmers from SADC countries.
2. Validate the AMDS through participatory feedback to assess its relevance, functionality, and adaptability across farm, national, and regional contexts.
3. Foster the co-design and collaborative refinement of the AMDS through structured design thinking sessions.
4. Consolidate stakeholder insights and generate actionable recommendations for technical enhancement, institutional alignment, and broader innovation deployment

2. WORKSHOP PROCEEDINGS

2.1. **Risks to Agriculture in the Region and the need for reliable information (Dr Gaolathe Thobokwe)**

Dr Gaolathe Thobokwe highlighted the three pillars of the SADC Vision 2050: (1) Industrial Development and Market Integration; (2) Infrastructure Development in Support of Industrialization and Regional Integration; and (3) Social and Human Capital Development in Support of Industrialization and Regional Integration. He noted that Agriculture falls under Pillar 1. There are many challenges facing the SADC region including: poor cereal production; low livestock numbers; inadequate fisheries resources, among others.

There are some risks which are negatively impacting on the SADC region and these are:

(i) **Climate change effects**

- irregular rainfall patterns, droughts, floods, cyclones, bushfires

(ii) **Effects of COVID-19**

- has become an excuse for under-investment in agriculture, financing challenges.
- Data show that most countries never met CAADP investment targets even before the pandemic

(iii) **Other factors affecting the region**

- Russia-Ukraine war, rural-urban migration, population growth, change in food preferences

The impacts of these risk factors include:

- Increased in macro-level food insecurity
- Increased sectoral-level pests and diseases, particularly Transboundary Animal Diseases (TAD) such as Foot and Mouth (FMD) and Highly Pathogenic Avian Influenza (HPAI)

Dr. Thobokwe expressed concern that the current SADC initiatives will not be successful without information and accurate, up-to-date and reliable data. He gave examples of some of the information systems in SADC including the Agricultural Information Management System (AIMS) and the Livestock Information Management System (LIMS). Both systems are efforts by SADC to address availability of information and data for decision-making. LIMS was reported to have some issues with software updates but was effective in predicting and understanding outbreaks of FMD. Furthermore, under LIMS, only the Animal Health module is currently working and this system needs to be evolving with the times. SADC Member States are no longer reporting on time, which renders the systems ineffective. Robustness of the data cannot be guaranteed under the current systems.

2.2. **Do mobile cellular phones spur agricultural productivity? (Prof. Amon Taruvinga)**

Prof. Taruvinga gave a presentation based on a collaborative study conducted by the University of Fort Hare (UFH) and Stellenbosch University (SU) which investigated the relationship between mobile cellular phones (MCP) and agricultural productivity (AP). Popular narrative suggests that use of mobile cellular phones promotes agricultural productivity. The study explored if this narrative was true for SADC Member States. Some SADC countries have indicated that the integration of MCP in the agricultural industry promotes productivity.

However, the following questions are important to enhance precision strategic targeting:

1. Is this narrative true for all SADC countries?
2. Is this narrative true for all agricultural subsectors?
3. Is the causal linkage unidirectional or bidirectional?

The causal linkages can be: (a) bidirectional – where MCP and AP both influence each other (preferred option), or (b) unidirectional – where MCP influences AP or (c) unidirectional – where AP influences MCP or (d) no causal links between MCP and AP.

The study used different data sources including: FAO, World Telecommunication, ICT Indicators Database, International Telecommunication Union (ITU), and World Bank Open Data (https://data.worldbank.org/).

The findings of the study indicate that:

1. There is long-term correlation between livestock/crop productivity and MCP adoption in all countries

2. In most countries, the relationship is unidirectional (MCP drives AP)
3. In all SADC countries MCP propels AP, except in Botswana, Lesotho, Malawi and Mauritius
4. In a few countries, the relationship is bidirectional (Mozambique: MCP and livestock productivity, South Africa: MCP and crop productivity, DRC: MCP and livestock productivity)
5. The relationship between MCP and AP is not automatic, differs by country and subsectors
6. Policies should be different based on type of relationship between MCP and AP
7. There is generally an upward trend (positive) between MCP and AP

In the plenary discussion, the following were some of the questions and responses:

Question 1: How accurate were the data and were the tests sufficient? Researchers did robustness tests. Data were at national level; it can be difficult to add other datasets

Question 2: Were there no other variables that drive the relationship? Yes, and these were accounted for by the modelling

Question 3: Did you also look at issues of adoption rates between commercial and rural farmers? Study was done at national level and data were not disaggregated; however, this is a relevant point.

2.3. **Demonstrating the AMDS Application (Dr Obvious Mapiye)**

Dr Mapiye reported that the development of the AMDS started in 2017 and was a result of the problem analyses which highlighted: (1) lack of farm-level data (2) weak national and regional databases (3) ineffective decision-making due to lack of data. The AMDS app takes advantage of advances in Artificial Intelligence (AI) and the Internet of Things (IoT). The AMDS app was developed in collaboration with "Warp Development", a software development company in South Africa. Dr Mapiye demonstrated how the AMDS app worked. Participants were requested to download the app on their smartphones.

Following the demonstration, participants shared some observations:

Feedback during app demonstration

Registration

- Need an option to add multiple farms. Currently, the app does not allow different farms under the same contract number.
- Size of farm (ha/acres).
- GPS, type of soils – do farmers know? This information could be obtained from the extension

Forum

- How can one know if information recommended by peers is accurate?
- How long will AI and machine learning take before they recommend accurate data?
- Can this machine learning be trusted?

Selling

- The GPS coordinates – this information may fall into the hands of criminals; therefore, it is not safe to display it. This could be made optional.
- Issue of uploading photos – include an option where one can open the camera, take photos, and share while using the app

- There must be a dropdown where one can select suppliers, buyers – generally all people/businesses that one normally does business with. Once one enters that business in the app, the system should be able to include the business in the suggested list next time
- When selling, the system must pick up all details of the animal (e.g. age, weight, etc.) once the animal ID records are entered

Pop-ups

- There must be an option to allow/disallow pop-ups or notifications.

Records

- For animals, need more breeds in the dropdown.
- Animal ID – make a provision for a name instead of tag number as is common in communal areas
- If the animal ID is unknown, allow the sire/dam ID to be a certain value (e.g. 999)
- Common issues in communal areas.
- Must be conditional logic when inputting data – for example: If one enters a record for a newborn calf, the liveweight cannot be above a certain weight e.g. 100kg; if one selects "sex" as female, "bull" or "steer" should not be under that sex classification
- Option to add and update information for each animal (e.g. periodic change/update of liveweight).
- Option to state the interval of when one wants to update records and information

Data records, safety and security:

Farmers were skeptical of who will have access to their information and records

- beyond the farmer, backend developers can be added to see
- Researchers (farmers need to give their consent)
- Government bodies
- CCARDESA and other regional bodies
- Data are needed for decision-making by extension officers, government, etc. to help farmers and also farmers themselves can use it.

Discussion on why farmers should change mindset/perception.

- Data can help with financing - financial service providers need financial data and AMDS can provide
- Adoption of the app will be dependent on people on the ground, with farmers leading the process.
- Emphasis on security and safety of records.

- Farmers were assured that their data were safe - information shared with relevant third parties cannot identify exact farm (identifiers removed).
- Main challenge: cyberattacks - if hacked, everything is open. There is need for legal advice on what to do in such cases.

Researchers' Concerns

- • Accuracy of data.
- Training can help (farmer training).
- Capacity building.
- Extension staff can assist.
- Conduct surveys to establish if farmers are providing accurate information
- People should not overthink accuracy as data are consolidated at regional /provincial/national levels and information may be distorted to fit certain narratives.
- Maybe there must be some level of filtering on the data by the level at which it can be shared

Farmer suggestion: AMDS app needs to include customized reports, especially on finances to help the farmer

2.4. **Deep dive into AMDS practical usability, testing and validation (Dr Obvious Mapiye)**

2.4.1. **Group work**

Five groups were formed, each with farmer, extension, research representatives, respectively. The groups were tasked to report on the following:

1. Challenges with the App
2. What was most useful in the App
3. What improvements were proposed

Groups Feedback sessions

Group 1

Challenges with the app:

- Connectivity - App needs internet and farmers do not always have data bundles which are too expensive
- Not user-friendly, complex for older or communal farmers.

Useful app features:

- Record keeping of herd health
- Marketplace

Suggested Improvements:

- Can there be a way of recording management, animal husbandry practices and input costs
- Incorporate weather information (can be linked to meteorological services).

Group 3

Challenges with the app:

- Too many features and modules, probably best to start with simple features first then add others with time

Useful app features:

- Good for record keeping

Suggested Improvements:

- Have upper-lower limits/cut-off points for certain data e.g. calf birthweight cannot be above 100kg
- Link the app to existing databases – some data and information need not be entered every time

- Offline access so the app can work without internet

Group 2

Challenges with the app:

- Some errors were detected
- The app is not versatile – delayed responses
- There were some security concerns
- Weak moderation
- Some variables need dropdown features
- App does not allow multiple enterprises

Useful app features:

- • Good for record keeping

Suggested Improvements:

- Development and inclusion of more features for comparisons
- Develop a way to generate prompt reports
- Marketplace can be improved
- Need for adequate training of farmers
- Validation of inputs e.g. animal liveweights during sale
- Need for offline data capturing
- Question: How relevant will the app be by the time it is fully developed?

Group 5

Challenges with the app:

- Errors during registration and updating of e.g. animal records

Useful app features:

- Marketplace

Suggested Improvements:

- Address errors
- System should allow for autofill logins
- Make it easier - start with product, then fill the form later

- Let farmers have time to farm, not be taken over by data capturing
- Use extension workers for data capturing
- Have young people validate the app; outcome might be different.

Group 4

Challenges with the app:

- Lots of steps
- Modules are too many

Useful app features:

- None specified

Suggested Improvements:

- Let extension agents do the data capturing for most of the inputs

General discussion

It was generally agreed that young farmers/people should be involved in the validation of the app. An example was provided of schoolchildren being taught of "digital gardens". The same could apply for livestock production by the youth. It was also suggested that the data and information collected through the app should not drift too much away from what the Ministries of Agriculture already collect. An extension dashboard could be included in the app where there is information to guide the farmer in decision-making, improvements in profitability, knowledge of markets, among others.

The challenges, the most useful and areas of improvement of the app are summarized in Table 1 below.

Table 1: Challenges, liked features and suggested improvements to the AMDS app

Category	Challenges with the App	Features Stakeholders Liked	Suggested Improvements
Registration	• Cannot add multiple farms under one contract number. • Errors during registration and updating records. • Missing dropdown features. • Not versatile. • Cannot allow multiple enterprises.		• Allow multiple farms/enterprises under one profile. Include farm size (ha/acres). • Add autofill login option. • Make registration simpler (start with product, fill form later).
Forum	- Accuracy of peer-recommended info questionable. - Trust issues with AI/ML recommendations.		• Provide validation/verification of peer/AI data. • Build trust through transparency and training.
Selling/Marketplace	- Safety concerns with sharing GPS (risk of targeting by criminals). - Errors during selling process.	- Marketplace feature appreciated.	• Make GPS optional. • Enable camera access directly from app. • Add dropdown for suppliers/buyers (auto-suggest on repeat entry). • Improve marketplace usability. • Add customised financial reports.
Pop-ups & Notifications	- No control over pop-ups/notifications.		- Add option to allow/disallow notifications.
Records & Data Entry	- Limited breed types in dropdown. - No provision for animal names (common in communal areas). - Data entry errors possible (e.g., calf > 100kg).	- Record-keeping (herd health, general records) highly valued.	- Add more breed types. - Allow naming of animals. - Conditional logic in data entry (weight, sex, class restrictions). - Auto-fill animal details when ID entered.

	- Cannot update/change animal data easily. - System errors when updating records.		- Allow updating of records (e.g., weight). - Set intervals/reminders for data updates. - Validation of inputs. - Offline data capturing option.
Connectivity & Usability	- Requires internet; farmers lack data/airtime. - Too complex for older/communal farmers. - Too many modules at once.		- Enable offline access. - Simplify app interface (start with core features only). - Use extension workers/young people for data capturing. - Farmer training & capacity building.
Data Security & Trust	-Fear of who can see data (developers, researchers, govt). - Cyberattack risk → potential exposure of farmer info. - Researchers concerned about data accuracy.		- Ensure anonymisation of farmer data (remove identifiers). - Legal framework for data protection & cyberattacks. - Farmer consent for research use. - Filtering/data-sharing at appropriate levels. - Training farmers to ensure data accuracy. - Extension officers to assist in verification.
General Functionality	- App errors & bugs. - Concerns on long-term relevance by full rollout.	- Record keeping. - Marketplace.	- Add extension dashboard (decision support, market info, gross margin). - Link to existing databases (avoid re-entry). - Add weather integration (link to meteorological services). - Ability to generate prompt/customised reports (esp. financial).

Re-Cap 1 and key suggestions:

Importance of farmer inclusion and collaborative validation of AMDS highlighted

Sustainable innovation leading to strategies for scaling-up, scaling-out, and scaling-deep

scaling deep - including farmers of all ages even those without connectivity

scaling out - include everybody who needs the information (increasing numbers)

scaling up - CCARDESA taking the system to Member States

Think of incentives for farmers sharing their data - farmers, like everybody else, do not give anything for free

Eswatini finds the AMDS useful; now thinking of how to implement; may start with lead farmers

App helpful at farm-level but also for trade e.g. BRICS

How do we reach out to traditional/remote areas with these innovations?

Use of USSD for capturing data using dump phone

Develop trust with the people first

Accept what they do first, integrate to new way of doing things

Let us create a culture of working collaboratively with communities, emphasizing on comprehensive use of data and information

2.5. Presentations of Artificial Intelligence and Technology Thrust

2.5.1. Artificial Intelligence (AI) in Animal Production (Prof Tinyiko Halimani

Prof Halimani highlighted that AI calls for culture change, change of mindsets. Artificial Intelligence is a tool with a purpose just like every tool is designed for a purpose. However, a tool may be re-purposed (for some legitimate use, misuse or abuse). Therefore, AI is a toolbox that mimics human intelligence as well as stupidity. The following are some of the uses of Artificial Intelligence:

- AI allows for optimization of production
- AI enhances decision-making processes
- AI automates critical actions
- AI reduces wastage

Use of AI at farm-level:

1. Animal breeding:
   - Record-keeping
   - Improving functionality of adaptive traits, e.g. disease, heat tolerance, fertility, behavioural traits; meat quality traits
2. Sustainability
   - optimizing inputs (e.g. water usage), wastes, methane production
3. Animal welfare
   - monitor the animal health, movements etc. to predict health issues

4. Reproduction
    - for example, detecting heat in females
5. Other
    - Optimizes pasture management
    - Also useful for smart, precision farming; marketing, traceability, logistics

Prof Halimani stressed that the successful use of AI will depend on data collection. However, like any technology, there are constraints in the use of AI. These include:

1. Huge data gaps, AI needs data yet the data are a scarce and contested resource
2. Ethical and privacy concerns
3. Equitable access, global disparities; much safe in the global South
4. AI requires a shift in competences, skills sets
5. Gaps in key technology infrastructure
6. Control, governance, ownership; issue of patents - USA and China are the world leaders in AI
7. Trust and fear of the unknown – the spectrum is huge

AI can be used beneficially but can also be misused or abused. However, Africa should harness the power of AI and not be left behind.

In the ensuing discussions, concerns were raised on the issue of AI being in the wrong hands and is abused or misused to create "monsters". If there can be some "controls" on the use of AI. There were also suggestions that there is always skepticism when a new technology is introduced, for example, the advent of scientific calculators. Concerns were also raised on the issue of job losses due to AI. However, AI can also create certain jobs with particular skill sets.

2.5.2. **CCARDESA Technology Thrust (Ms. Futhi Magagula)**

Ms. Magagula explained the objectives of CCARDESA, a subsidiary of SADC which was established in 2010. The CCARDESA objectives are to:

- **Coordinate** and promote collaboration among regional and National Agricultural Research Systems (NARS)
- **Facilitate** the exchange of information and technology among Member States;
- **Promote partnerships** in the SADC region between public, private, civil society, and international organizations in R&D;
- **Improve** agricultural technology generation, dissemination, and adoption in the region through collective efforts, training, and capacity building; and
- **Strengthen** research and development in States Parties by mobilizing human, financial, and technological resources to implement and sustain demand-driven activities.

Some statistics on the SADC region were provided, including the overall GDP of USD720 billion; the human population of 415 million people; and that 65% of the population depends on agriculture for food and livelihoods. The current workshop is aligned with **Result Area 6**: *Use of improved agricultural digital solutions and agricultural information, communication, and knowledge management systems by diverse CAARDESA stakeholders enhanced*.

One of CCARDESA's contributions to the CAADP is through the project CAADP-XP4, funded by the European Union (EU) and managed by the International Fund for Agricultural Development (IFAD), where CCARDESA collaborates with other Sub-Regional Organizations: AFAAS, ASARECA, CORAF, and FARA. Another project for CCARDESA is the AICCRA project, funded by the World Bank and managed by Alliance of Biodiversity International and CIAT.

Some key achievements of CCARDESA were reported, including 4.6 million beneficiaries reached, 97,000 farmers trained, and 41,300 farmers supported. CCARDESA, in its technology thrust, developed a mobile learning app to assist extension and farmers to learn about climate-smart agriculture (CSA). CCARDESA, in collaboration with Purdue University, is working on the production of animated digital tools (video) in different local languages for use by extension workers when working with farmers in the region. As part of building regional capacity on technology, CCARDESA promoted the use of the Agricultural Innovation System-Policy Practice Index (AIS-PPI) tool developed by FARA to support national and regional policy formulation and implementation.

Despite these achievements, there have been challenges in using digital tools, including limited infrastructure and connectivity, and low digital literacy among the SADC population. Concerns were raised about the sustainability of apps. Questions were also raised about the collaboration between CCARDESA and Purdue University, and it was reported that they have vast experience in creating videos. Africa's dependency on foreign donors was questioned. And it was suggested that Africa should fund its own development, especially given the resources at its disposal.

2.5.3. **Design Thinking (DT) approach: From Problem to Prototype (Dr. O. Mapiye)**

Dr. Mapiye described "Design Thinking" as a human-centred methodology to solving problems. He highlighted the five steps in Design Thinking.

1. **Empathize** - listen, understand, communicate, and learn about the audience for whom you are designing, e.g., farmer, ask what, how, and why questions, do not be judgmental
2. **Define** – bring clarity to the problem, characterize/identify the target user, their needs, get insights about meeting their needs, and develop "Point of View"
3. **Ideate** - brainstorm potential, generate many ideas - emphasize on quantity of ideas, not quality, do mind-mapping, encourage innovation, generate the "how might we" solutions
4. **Prototype** – build a representation of one or more ideas from the ideation, draft version of the product that solves the problem/need
5. **Test** – return to target user with the prototype and test the ideas, see if the problem has been framed correctly; get user feedback

This Design Thinking approach is an iterative process involving the developer, target users and others and requires patience and dedication.

Discussion on Design Thinking

- **Provide practical examples of the application of this approach for the AMDS?**
    - project started with empathizing by use of surveys, focused group discussions (FGD) and key informant (KII) interviews with farmers
    - this process led to defining of problems, after which ideation was followed through research
    - prototype was developed after and is now at the testing stage
- When will the app be ready for use?

- depends on the issues raised during this workshop
- targeting to have revised prototype by December 2025

It was also noted that systems thinking can cause confusion on the user and also the notion that sometimes "users do not always know what they want" to help solve their problems/needs. Therefore, these have to be taken into consideration during the Design Thinking process.

2.5.4. **Empathizing with Farmers: real-life needs and challenges**

The farmer participants were asked to highlight their main needs and challenges at their farming operations.

1. Mr. Alfred van Wyk (Ventersdorp NW, South Africa)

He is a primarily livestock farmer, with a breeding herd of Bonsmara (80%) and Nguni (20%). Sells off weaners for cashflow. Established some links with feedlot owners and abattoirs and well as some auctioneers. Mr. van Wyk also has a flock of sheep on 80% and 20%, intensive and extensive system, respectively. He sells lambs.

Challenges:

- Poor access to export markets because they require up-to-date data on e.g. parentage, birth dates, weaning weights, animal health (vaccinations, medication the animals have received) etc., on the animals
- Access to auctions - need improvements
- Feed costs are high
- Record keeping: currently records manually on paper and loses these records
- Poor access to information e.g. animal health (veterinarians do not share online), disease outbreaks
- Poor access to market information e.g. price

Suggested solutions:

- Innovations such as the introduction of the AMDS app
- Need ground personnel for checks and follow-ups on the farm o help otherwise end up dropping its use if we do not understand it well
- Needs information on agricultural and other events in the area/province

2. Ms. Boitumelo Mokgalagadi (Potchefstroom, NW, South Africa)

She runs a sheep farm with Meat Master breed. Also has chickens, crops including hemp. She practices organic farming, no chemicals, believes in farm-to-fork traceability. She produces hemp products such as soap, serum, lip balm cosmetics etc. Her vision is to be involved across the entire value chain. She relies heavily on indigenous knowledge with occasional use of modern technologies, where necessary.

Challenges:

- Inadequate record-keeping and financial book-keeping, sometimes records information on smartphone, difficulties maintaining records such as receipts which become illegible after some time
- Most of the educated youths are not interested in farming, therefore most of the workers are illiterate
- The South African Space Agency should provide timely weather information services – this should be included in the ADMS app
- Poor market access and prohibitive regulations, for example, farmers need expensive permits to produce certain products like castor bean

Suggested solutions:

- For the AMDS app, include space where one can just scan (photos) e.g. their receipts and records are kept;
- Could financial recording and management be done through AI
- Include space for adverts; skills development, short training courses e.g. have some videos where one can learn on the app
- Include an option to filter challenges being faced by other farmers and include feedback if suggested solutions worked or not

3. Mr. Ncamiso Mamba (Eswatini)

Mr. Mamba is an apiculture farmer with over 450 hives in Eswatini and is aiming for 15,000 hives. He mentors other bee farmers and also clears bees when necessary. He is using the modern beehive, Langstroth and can harvest 30kg/hive. However, most Eswatini beekeepers are using traditional hives, and yields are lower.

Challenges:

- 80% of honey available in Eswatini is imported, and the quality if questionable, while 20% is local, pure honey from mainly informal beekeepers
- Bees are kept naturally; however, they need fruit trees and forests for honey production
- Climate change, including unpredictable rainfall patterns, cyclones, contributes to the washing away of the nectar which the bees need for honey production
- Honey harvesting seasons have shifted from April to June to July to September
- There are stringent standards for exports but very little for imported honey, there is need for certain standards e.g. processors
- Planning to build a honey-processing plant but funding is a challenge
- Other challenges for bees include lack of water, pests and diseases and bee management is not easy
- A climate mismatch has been observed where bees come out when there are no flowers
- He does not keep any records or data for his bee operation

In the ensuing discussion, it was suggested to have "suitability maps" for bees to guide those who want to go into beekeeping. The government of Eswatini is helping the beekeepers with training and some funding. Also, Government macadamia and orange farms are providing nectar for honey production.

4. Ms. Lesley Molapo (Potchefstroom NW, South Africa)

She operates a mixed farm with Merino sheep, pigs, chickens, quails and soya and castor beans. Ms. Molapo is also into agro-processing.
Challenges:

- Market and the wool industry are disappearing
- Load-shedding of power is a major problem
- African Swine Fever (ASF) is also a problem
- Government regulations, especially permits and fees are causing farmers serious expenses

It was suggested that the AMDS app should have a section on regulations affecting farmers.

5.Ms. Marjorie Mavuso (Eswatini)

She farms on a 2.25 ha plot and operates a piggery as well as producing oyster mushrooms. Uses banana trees to absorb waste water from the plot and is constructing a biogas digester. She used to record her livestock in terms of ages, sales, deaths. She also manages cashflow records, projections, data on feeds, income records.
Challenges:

- The data do not tally with projections and data on debtors were often missing.
- When the number of pigs increased, it was difficult for her to maintain records. Now her pigs are not ear-tagged.
- Lack of superior breeds

However, she was introduced to a web-based data recording system (Pigbase) and is very keen to use the AMDS app when operational. It was reported that government and NGOs are providing support to farmers, especially women and youths. The government of Eswatini has established an Artificial Insemination Centre for pigs and providing guilts and training farmers in piggery.

2.5.5. **Empathizing with Extension Officers: real life needs and challenges**

1. Mncedisi Dlamini (Eswatini)

Mr. Dlamini highlighted the role of extension officers in Eswatini, including: conducting training on livestock production; practical demonstrations on best livestock production practices; and organizing exposure visits for farmers. However, the extension officer: farmer ratio is reportedly very high, with each extension officer covering over 10,000 farmers in one sub-region of Eswatini. Other roles of extension officers include: linking farmers to input suppliers, markets, and finance, and facilitating the formation of commodity groups. Extension officers also conduct Monitoring and Evaluation visits.

Challenges:

- Insufficient personnel: Eswatini has four regions, about 3000 m^2 each, and one extension officer has to cover each region
- There are data gaps (lack of on-farm data, real-time data, and data capturing tools) that negatively affect decision-making and donor funding
- The government has good bull loan schemes to improve breeding, but the challenge is that there are no data records
- Shortage of resources (transport, extension)
- Lack of feeder stock for feedlots; cover long distances in search of slaughter animals.

The AMDS app marketplace would be very useful for Eswatini and feedlot farmers can be champion farmers for the app before it is rolled out to everyone else. Eswatini government is working to improve service delivery. The country is banning 2G and 3G phones, hence everyone will be using smartphones in the near future. This will be useful in data recording.

2. Mr. Sibusiso Mlimo (NW, South Africa)

Apart from extension advisory services, staff also provide professional support to projects and programmes. One such is a Nguni Project with a "pass-on the progeny" approach where farmers get 24 females and 1 bull for 5 years and are expected to pass on eight (8) progeny to others. Farmers are using WhatsApp groups for sharing information and data.

Challenges:

- Shortage of extension personnel; current ratio of extension worker to farmer is 1:850-1000 but the standard is 1:250
- Lack of vehicles for extension staff
- No proper record keeping among farmers
- Disease outbreaks, exacerbated by climate change
- Some farmers are laggards in innovation adoption

3. Mr. Kabelo Mkwanazi (NW, South Africa)

Mr. Mkwananzi reported that he works with approximately 450 farmers, mostly in informal settlements. Used to have a digital pen to capture data and has access to laptop, smartphone and data bundles.

Challenges:

- Due to defunding of public extension services, there is a shift towards privatization of extension services, including technology. An example was given where in North West (NW), a tech company supplied data capturing system but it did not send information to the server
- There is poor sharing of information among stakeholders
- Roles of extension staff are too restricted which limits their activities and there are some stringent requirements when assisting farmers

- Regulation (specialization) of extension officers, officers are only expected to provide service in one function e.g. animal health and cannot assist with e.g. crops
- Farmers have many challenges such as lack of water which is a basic right and this lack can adversely affect other goals that researchers/policy makers are targeting e.g. efforts to increase productivity.
- There is political interference that affects the extension staff in conducting their mandated duties
- Although farmer registers are available, they are hardly used
- The market tends to discriminate against the Nguni breed

2.5.6. **Empathizing with Agro-dealers: real life needs and challenges**

4. Ms. Didintle Mohosh (OBARO - Brits NW, South Africa)

Ms. Mohosh assists farmers with animal production, including traceability as well as irrigation schemes. Assists farmers with carcass competition and evaluation for farmers. In the process, farmers give the agro-dealers access to their data and information.

No specific challenges were presented.

2.5.7. **Empathizing with Researchers: real life needs and challenges**

5. Prof Amon Taruvinga (University of Fort Hare)

Prof Taruvinga explained that researchers collect data for many uses including publications, qualifications, commercialization and development of prototypes.

Challenges:

1. Data quality
    - poor and compromised, this might be due to wrong instruments being used or farmers or households reluctant to participate
2. Data quantity
    - sometimes the type of research or research tool used requires huge numbers of observations/respondents to make meaningful analysis
3. Unit of measurements
    - a challenge especially when collecting data at household level in rural areas
    - researchers use international standard units (e.g. kg) which are not consistent with what the farmer/household is familiar with (e.g. kg vs no. of bags)
4. Data ownership
    - Researchers are aware that the respondents have rights to take part/refuse to take part in providing data
    - However, data ownership after collection is the issue, researchers keep the data and respondents do not have a say. Meanwhile, researchers surrender the rights to publishers when they publish
5. Multiple objectives
    - researchers collect data at a particular point to answer specific objectives
6. Duplication of information (data silos)
    - different researchers visit the same communities asking the same or related questions, leading to farmer interview fatigue
7. Data collection tools
    - some tools have limited capacity to capture required data
    - technology like drones could be needed to capture data in areas that are not easily accessible

Suggested solutions:

- There is a need for comparisons of existing databases for researchers to improve quality of information that is available and avoid duplication
- Incentives to farmers to entice them to provide information?
- Often, incentives lead to bias in response, so incentives will not work and they are short-lived.
- Collaboration can help researchers, extension, farmers, and associations

2.5.8. **Reflections of Farmer, Researcher and Extension experiences (Prof K. Dzama)**

Prof Dzama noted that there is apparent working in silos, yet the farmer, researcher, and extension should be an inclusive and collaborative system. He called for collaboration to foster harmonious relationships between farmers, researchers, and extension services.

Table 2: Summary: Empathizing

Stakeholder	Challenges	Suggested Solutions
Farmers – Van Vyk (NW)	• Limited access to auctions • High feeding costs • Poor record-keeping (lost papers; required by abattoirs for exports) • Lack of accessible information (animal health, markets, prices, disease outbreaks)	• Adoption of innovations like AMDS • Ground personnel to assist farmers with app use • Access to local/provincial information updates
Farmers – Itumelo (NW)	• Poor record-keeping & bookkeeping (receipts fade) • Illiterate workforce, youth disinterest in farming • Inadequate weather information services • Limited market access & restrictive regulations (e.g., permits)	• AMDS app with scanning/AI bookkeeping feature • Training videos embedded in the app • Challenge filtering & solution feedback option in app
Farmers – Mamba (Eswatini)	• 80% honey imported (low market for local pure honey) • Bee feed scarcity (climate change, rainfall shifts) • Standards required for exports • Funding challenges for processing plant	• No specific app-based solution noted, but AMDS could support through market visibility & standards documentation
Extension Officers – Eswatini	• Insufficient personnel (1 officer per region of 3000 sq. km) • Data gaps affecting decision-making & funding • Shortage of transport/resources • Feedlots struggle to find feeder stock	• Government banning 2G/3G → shift to smartphones for data entry • AMDS marketplace feature to link feedlots with farmers • Use champion farmers to drive AMDS adoption
Extension Officers – NW (1)	• Personnel shortages (1:850–1000 vs. standard 1:250) • Lack of vehicles	• Farmers already using WhatsApp groups for sharing info (can link to AMDS)

	• Poor farmer record-keeping • Disease outbreaks worsened by climate change • Farmers slow to adopt innovations	
Extension Officers – NW (2, Kabelo)	• Underfunded → privatization of extension • Dysfunctional private tech systems (failed data capture) • Rigid specialization of officers (animal health vs. crops) • Farmer challenges (e.g., lack of water affecting productivity goals) • Political interference	• Address multiple farmer challenges simultaneously rather than in isolation
Agro-dealers – OBARO	• Not explicitly stated as challenges, but currently facilitating farmer engagement through carcass evaluation competitions	• Continue using tools like carcass evaluation & classification to support farmers
Researchers	• Poor/compromised data quality • Insufficient data quantity • Unit measurement inconsistencies (kgs vs. bags) • Data ownership disputes • Narrow research objectives • Duplication of efforts (data silos) • Limited data collection tools (need drones, etc.)	• Compare/align existing databases to avoid duplication • Explore but reconsider incentives (bias risk) • Foster collaboration among researchers, extension, farmers, associations

Re-Cap 2 and doing things the African-way

Key points from Day 2 were presented. This resulted in a brainstorming session on whether Africa should advance her own knowledge and cultural systems when conducting research, just like the other regions such as Asia, Europe are doing? It was agreed that mistakes have been made using the European ways which Africa adopted over the years. There is need for a systems' shift allowing choice and integration. Africa needs to finance her own programmes rather than continue relying on external donors who sometimes dictate research focus and direction. If Africa adopts foreign technology, she should adapt it to suit her culture and narrative. An example of China was given, when America subjugated them to Google, they adapted and developed their own system, Baidu, in their own language. Japan has done similar in adapting western technologies to its own situation. Africa can also do that e.g. developing 'Ask Gogo' with an AI-powered speech recognition and use indigenous languages and local accents. There is need to start documenting indigenous traditional knowledge, given that average age of farmers in 60 years. This is important for scaling deep. However, this African wish to succeed, hinges on financial and political will.

2.6. **Country perspectives on the subject matter**

Participants were asked to present their country's perspectives on the issue of agriculture and agricultural data.

1. *Eswatini (Mr. Bongani Magagula)*

Eswatini is promoting the use of appropriate technology in agricultural production and requires data to fulfill food self-sufficiency, employment creation, economic development, etc. Current technologies include ear-tags and traceability systems like Eswatini Livestock Identification and Traceability System (SLITS), Agriculture Integrated Information System (AIIS), and Pigbase – a web-based pig management app that serves the pig industry in Eswatini, e-Horticulture Information System, among others. However, there have been glitches of the software with bugs. Pigbase is working well, but farmers are slow in record-keeping. On policy and regulations, the country has the Livestock Identification Act, Data Protection Act, Livestock Breeding Policy, and Livestock Development Policy. The country is adopting ICT and digital transformation, and it has an e-government platform where people can easily access government programs. Opportunities of information systems include: 90% of the population have cell phones, a supportive government, and good internet infrastructure.

Challenges:

- farmers are generally slow to adopt technology - AMDS would be very helpful
- poor record-keeping

2. *Namibia (Dr Deidre Januarie)*

Namibia is divided into two distinct zones by a fence due to animal health concerns, particularly FMD. The fence is audited annually by the EU and the USA. The country has produced a Catalogue of

Livestock Breeds and has the Registrar of breeds - the Namibia Stud Breeders Association. As for policy and regulations, the Livestock Improvement Act and the Animal Health Act are the most prominent. The country also has the Namibia Livestock Identification and Traceability System (NLITS), which is used for animal movement. Breedplan is the country's preferred recording and genetic evaluation system. Extension agents collect data from the commercial and communal areas. Market data is also collected. The Namibia Statistics Agency (NSA) is the custodian of all data. A Bush Biomass Quantification Tool (BQT) was developed.

Challenges:

- Data capturing is mainly done by stud breeders but not communal farmers. In the communal areas, the government tags the animals and then collects data based on the animal numbers.

3. *Zimbabwe (Prof Tinyiko Halimani)*

It is unclear why farmers do not keep records, but records can lead to funding, making them a good incentive. Stud breeders keep records because that is how they make money. Commercial farmers collect and keep records to calculate gross margins. Apps are there, e.g. LIMS, but somehow farmers do not use them to collect data and keep records. There are some records collected at the public dip-tanks. Challenges in Zimbabwe are very similar to those of other SADC countries. It was suggested that sociologists and social scientists are needed to determine why farmers do not keep records, despite the benefits of doing so. There is a need for a cultural shift among farmers and a change of mindsets.

4. *Botswana (Dr Phetogo Monau)*

Botswana attempted to collect data using the rumen bolus. However, for various reasons, including boluses being lost, this system did not work as intended. There is the Botswana Animal Identification and Traceability System managed through the mobile app BAITS, latest version is BAITS 3.0.
Challenges include; generally poor internet coverage; although use of tags is mandatory, ear-tags are expensive and farmers only tag the animals they want to sell; there is no performance recording. Extension officers capture data. The government also captures data during national vaccination exercises. Botswana will be best country to pilot AMDS.

5. *Malawi (Prof Timothy Gondwe)*

Over 90% of the farmers are in communal areas and data collection and record-keeping are poor. Animals known by their names, not tag numbers. For Malawi, key data sources include the Agricultural Productivity Estimate Survey (APES) with data compiled annually, but collected three times a year at grassroots. However, data collection is still done manually (paper) and is prone to errors and subject to manipulation by government. The Chiweto App disseminates livestock market information, insurance and data. A manual is used to guide the collection of data and these data include: number of households, livestock species, numbers converted to Tropical Livestock Units (TLU) for ease of comparison with other countries, breeds, ages and classes. These data are also used to monitor trends, and generate estimated value of livestock. Malawi is developing the National

Agriculture Management Information System (NAMIS). The AMDS can integrate in this national information system, NAMIS

6. Mozambique (Dr. Anica Massas)

Mozambique has two information systems, the Agricultural Market Information System (AMIS) which provides information about agricultural products, prices, and market trends, helping farmers connect with buyers and improve their incomes. The other is the Labour Market Information System (SIMT) which collects and analyzes labor market data to inform policy decisions related to employment, skills development, and social security. Data are collected manually and accuracy is compromised. There are little resources for collection of data by extension staff, including lack of transport forcing staff to walk more than 20 km to collect data. Because of these challenges, staff end-up filling the forms on their own without respondent farmers. There are many policies and regulations affecting the agricultural sector but these are hardly implemented.

7. South Africa (Sibusiso Mlimo)

South Africa has some programmes to support women and youth in agriculture. The Livestock Identification and Traceability System (LITS) is used but there are issues of how the system should be implemented, financed or managed. Other systems include INTERGIS, a collection of databases and programs that addresses the animal recording needs, which is used at the ARC. However, INTERGIS is also facing challenges, as farmers are not collecting data.

8. South Africa (Mr Kennedy Ramatsea)

Mr. Ramatsea described how corporate funds can be used to uplift communities and aggregate their common needs. ***We-Earth*** "empowers communities to voice needs, from unemployment to healthcare by digitalizing them to record their SDG actions for us to connect them with resources". Communities are at the centre of the process. Farmers needs include markets for their produce and We-Earth is assisting these farmers to minimize wastage, transact through cryptocurrency. In the advent of BRICS and AfCFTA, the opportunities are immense. There are suggestions to create an African currency to increase inter and intra-African trade. We-Earth is offering farmers real-time e-commerce, agro-intelligence, geospatial integration using AI to give alerts.

2.7. Breakaway group sessions: Practical Design Thinking

The participants were split into four groups, each group with farmer, extension, researcher representation. The available agro-dealers joined two of the groups. The groups were tasked to go through the process of Design Thinking, from Empathize to Prototype. The four groups conducted the Design Thinking process and presented their proposals in plenary.

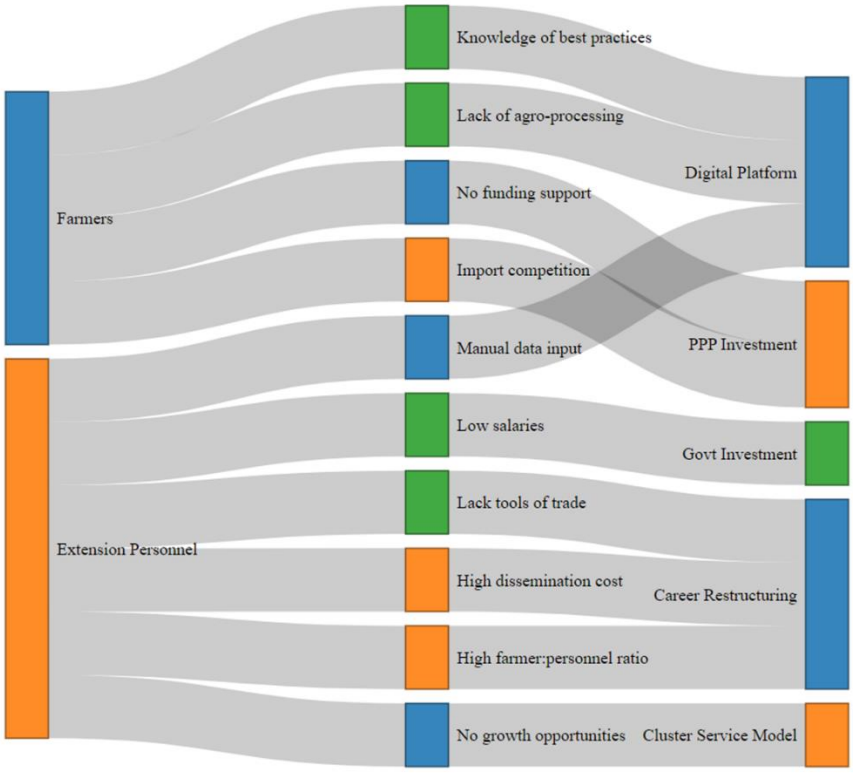
2.7.1. DESIGN THINKING – Group presentations

Group 3: Sustainable Farming App

Challenges for farmers highlighted by the group included: climate variability; pests and diseases; market access; lack of capital; lack of capacity for export; poor technology adoption.

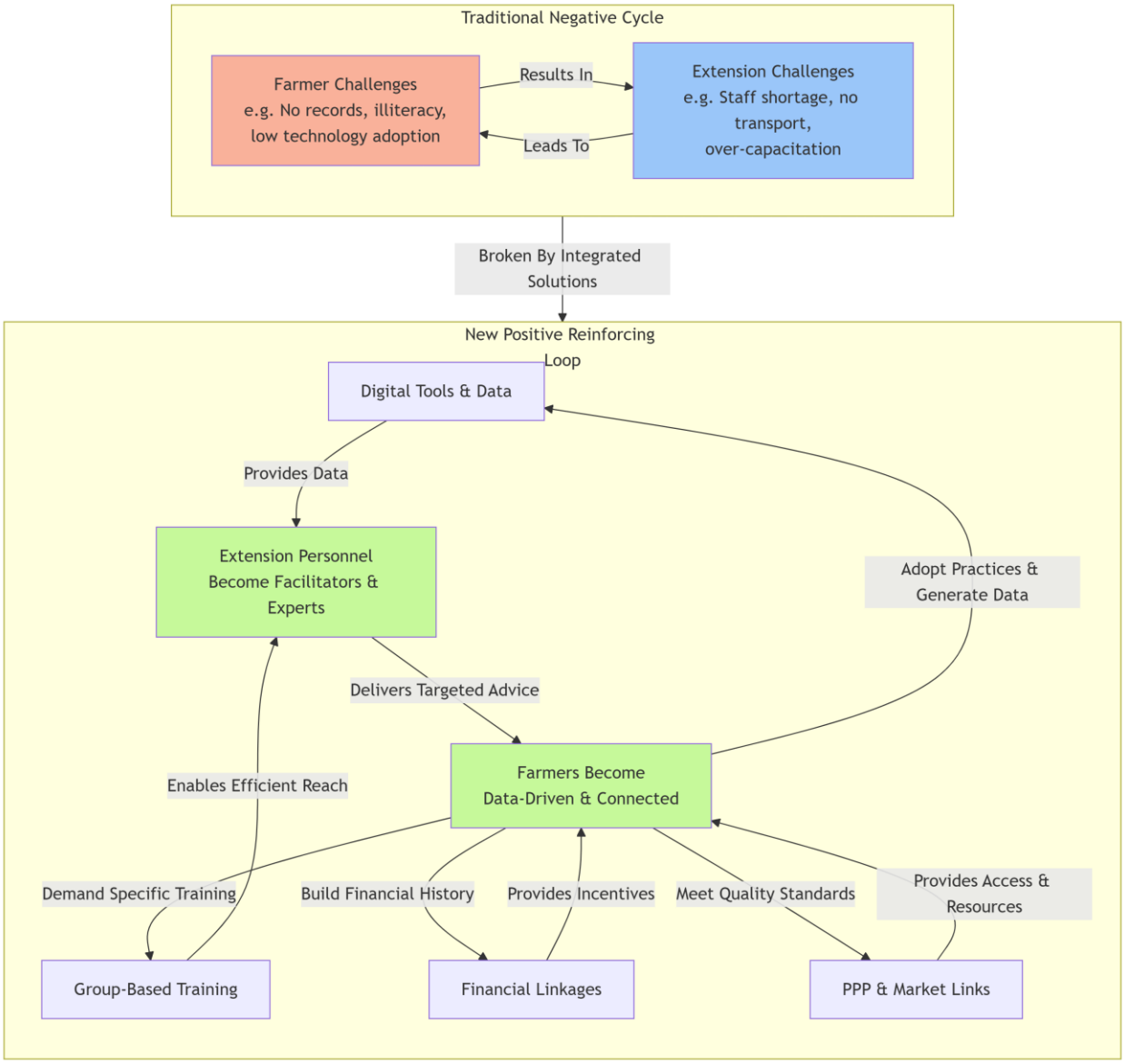
Challenges for extension included: transport; record-keeping; literacy rate; "Jack of all trades" where extension staff are expected to assist farmers in all aspects of farming.

The group used two programming languages, ***R*** and ***Python***, to generate some outputs, using the farmer and extension challenges. The group proposed that incentives for farmers such as financial visibility will result in more funding opportunities.



User	Need	Insight
Farmer	Market Access	Increase Profit. The fundamental goal is not just to sell, but to sell profitably. Without reliable buyers, produce goes to waste, and income is lost.
Farmer	Farm Input (Quality & Affordable)	Increase Production & Quality Product. Access to certified seeds, fertilizers, and tools directly translates to higher yields and better quality produce, which commands better prices.
Farmer	Pest Management Program	Integrated Sustainable Farming & Improved Production. Pests and diseases represent a direct threat to their livelihood. They need proactive, effective, and often sustainable solutions to protect their investment and ensure a harvest.
Farmer	Price Regulation/Stability	Increase Profit & Competitive Advantage. Volatile prices make financial planning impossible. Stable, predictable prices provide a sense of security and allow them to compete more effectively by knowing their margins.
Farmer	Training on Climate Variability	Improved Production & Integrated Sustainable Farming. They see the climate changing and need practical knowledge to adapt. This isn't just theoretical; it's about survival and maintaining yields in the face of drought, floods, or erratic seasons.
Farmer	Lack of Capital (Funding/Credit)	Increase Production & Increase Profit. Capital is the engine for growth. Without it, they cannot purchase better inputs, scale their operations, or invest in technologies that would ultimately make them more profitable and resilient.

User	Need	Insight
Extension Personnel	Lack of Personnel (High Farmer: Officer Ratio)	Efficiency in rendering extension (Increase in extension to farmer contact). They are overwhelmed. The need for more staff is really a need for a more efficient system that allows them to reach and impact more farmers without being physically present for every single query.
Extension Personnel	Lack of Transport	Improved extension service delivery. Without mobility, they are office-bound and ineffective. This need is fundamental to performing their core duty: being in the field with farmers. It directly impacts the quality and reach of their service.
Extension Personnel	Record Keeping (Farmers do not keep records)	Proper records & Efficiency. The lack of farmer records makes their job difficult. Accurate records are not just paperwork; they are essential for tracking farmer progress, proving impact, providing tailored advice, and efficiently allocating their limited time and resources.
Extension Personnel	Commodity Specialist Extension (Not Specialized/Over-Capacitated)	Relevant information to a specific farmer (e.g., a beekeeper). Being a generalist forced to know about everything from corn to cows to bees leads to superficial advice. They need to either specialize or have direct access to specialist knowledge to provide accurate, valuable information that truly helps specific types of farmers.



In the plenary discussion, it was suggested that group training would lessen the burden on the extension workers. The lack of career growth for extension workers was cited as a major challenge.

Group 4: Improve farm management skills
Key challenges for farmers included: climate variability, poor record-keeping, regulations, poor farm management skills, and inability to meet market standards.

For extension staff, challenges included a lack of financial and human resources.
The "point of view" for the group was that "*small-scale farmers require farm management skills to operate viable farming businesses*". Farmers can make informed decisions and have greater access to formal markets.

On ideation, the group agreed on "training and skills development for smallholder farmers". With skills development at the centre, the extension worker needs the tools, equipment, and human resource capacity, and this is where the AMDS app comes in. The farmers will be trained in record-keeping and business management, including how to monitor running costs, gross margin analysis.
For the prototype, the group proposed a problem-solving skills app with: digital training modules; digital record-keeping with analytics, report-generating capacity; protocols on scaling-up and expected standards; digital online extension services; online data collection; two-way interaction (feedback mechanism); digital alerts. The group suggested that Stellenbosch University could include short, accredited courses in the app, working with extension officers to ensure relevance, and that these courses should not be overly academic. This will also benefit the departments of agriculture in their capacity-building efforts, and they could co-finance that part of the app. However, the challenge of poor internet connectivity of farmers remains. If the short courses could be conducted offline with video clips in vernacular languages, that would be preferred.

Group 1: Equipping small-scale farmers with tailor-made solutions
The challenges for farmers and ideation were presented:

Challenge	Main aspects of challenge	Ideate
Lack of mechanization	• outdated machines • expensive to mechanize • unavailability of equipment in the country • skills to operate machinery	• Group funding for machinery • Aggregation hubs to facilitate farm needs and resourcing • Cooperative banking to solve high interest rates
Lack of access to finance	• lack of collateral (title deed; property) • lack of record keeping • lack of financial literacy • regulations of financial institutions	• Cooperatives for group machine sharing • Farmer-centered finance (tailor-made financing) • TVET partners for operating machines
Lack of access to markets	• market monopoly • legislation too expensive to comply with • market demand	• Market based research - through cooperatives; aggregation hubs; Government informed.

	• farming not according to demand • lack of product aggregation • poor marketing skills	• Address monopoly through - aggregation hubs and legislation • Government should stop outsourcing the legislative and regulatory structures.

For the prototype, the group proposed use of existing databases by adding layers to existing systems; and use Artificial Intelligence for other information. We need to collaborate with farmers to resolve their challenges. This involves working with municipalities/local governments to address these challenges. The app should reduce the workload on farmers for record-keeping and utilize interns to collect other relevant information. Technology should not create "zombie farmers".

Group 2: User-friendly record-keeping app

The challenges for farmers and extension staff were identified as: record-keeping (farmers); accessing, collecting and using data (extension staff).

The "point of view" statement for the group was "*How might we help farmers to keep records for them to be able to access the Market?*". And the solution is a user-friendly record-keeping app.

The prototype must include features like:

Pasture/nutrition remote sensor-based data; algorithms; have training materials; electronic photo sensor that can estimate body condition scoring, nose ID; estimate liveweight; sales data (market prices; yield; calculate turnover); animal inventory (animal ID, gender, age; birth weight; weaning weights; breed); animal health records (disease prevention – vaccinations; parasite control; treatment); Linkages to markets; local farmer peers; agri institutions; animal health; extension agents.

In the plenary discussions, issues were raised on the need for simplicity of the app; reduction of tediousness/cumbersomeness; inclusion of pop-ups such as weather, stolen animals alerts. For the photo sensor there is need for collection of lots of data on animals first for the app to learn. Could the photo sensor also identify other in-body aspects of the animals?

Re-Cap 3

"African solutions to African problems" was a discussion point for the plenary. There was general consensus that Africa needs take cue from other regions and adopt its own solutions, rather than rely on external/foreign interventions. It was agreed that social scientists should be involved in the development and adoption of innovations and technologies by farmers. However, success depends on belief in Africa, political will and financial support for Africa's programmes. It was clear from the presentations, that many of the countries' perspectives were similar; poor record-keeping by farmers; poorly-resourced extension services; policies and regulations are there but poorly or not implemented. What incentives/behavior change are required to induce improvements in record-keeping? On the prototypes, these apps should make farmers' life easier; easy record keeping, provide information (e.g. market prices, weather information, conduct analyses, generate reports, calculate gross-margins)

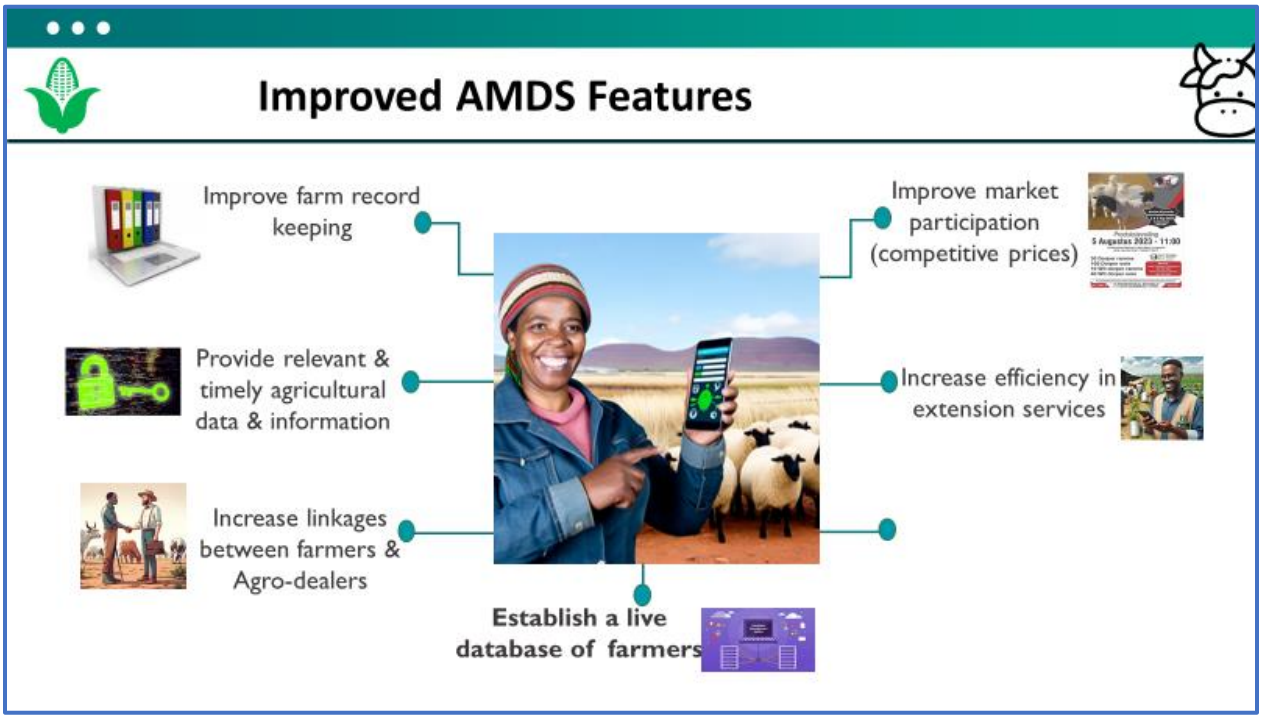
2.7.2. The refined AMDS: Key Features and Core Functions

Based on the suggestions by the participants on how to improve the AMDS, the refined version was presented.

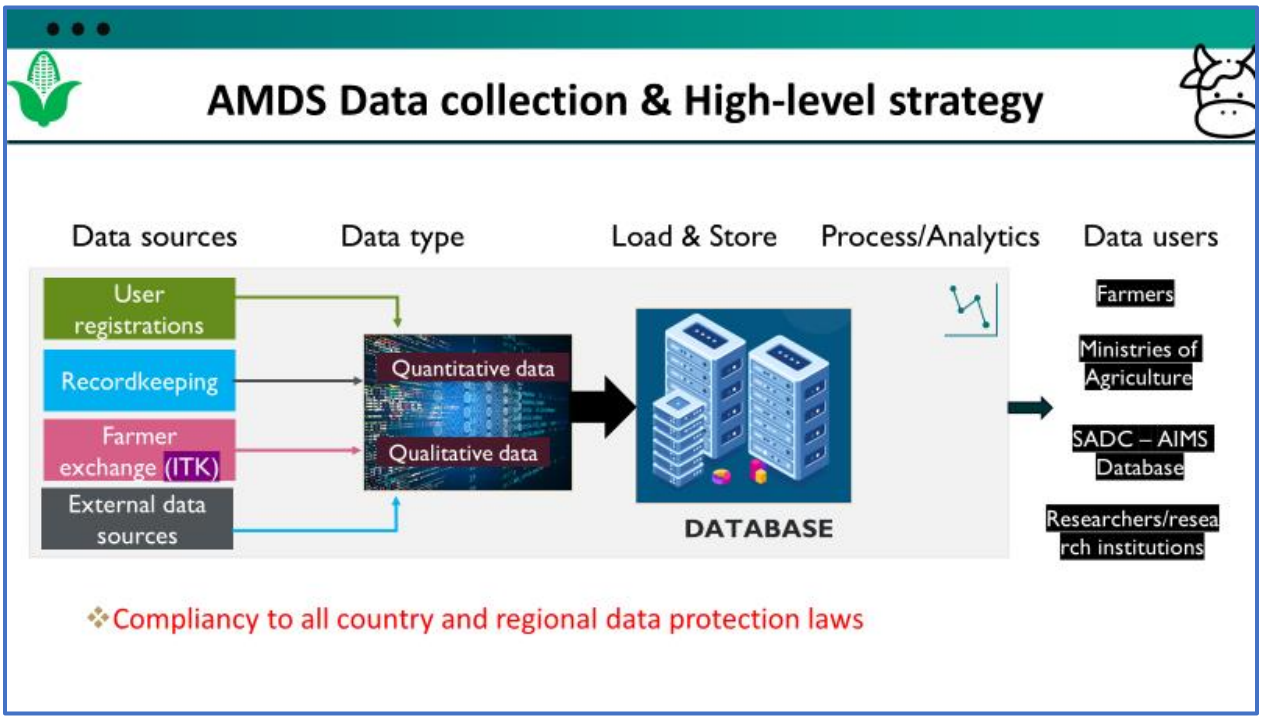
Stakeholder	Key Challenges
Farmers	• Poor record/bookkeeping • Market access and regulatory barriers • Data privacy/sharing personal information and cyberattacks. • Limited appropriate information (health, weather) • Climate change impacts • Illiteracy and youth disinterest
Extension Officers	• Very low extension to farmer ratio 1: 850 (ideal is 1:250) • Recordkeeping and data gaps • Lack of funding (Resources and transport shortages) • Slow adoption of innovation among farmers • Political interference in extension service delivery
Agro-dealers	• Farmers' record keeping
Researchers	• Surveys - Poor/low data quality and quantity • Data ownership disputes • Data duplication/silos • Limited data collection tools • Inconsistent units (kgs vs. bags)

AMDS Features	Suggested Improvements
Registration	• Allow multiple farms/enterprises under one profile. • Include farm size (ha/acres). • Add autofill login option. • Make registration simpler
Forum	• Provide validation/verification of peer-to-peer knowledge sharing. • New messages alerts
Marketplace	•Make GPS optional. •Enable camera access directly from the app. •Add drop-down for suppliers/buyers (auto-suggest on repeat entry).
Records & Data entry	•Allow naming of animals. •Conditional logic in data entry (weight, sex, class restrictions). •Auto-fill animal details when ID entered. •Allow updating of records (e.g., weight). •Set intervals/reminders for data updates. •Validation of inputs. •Offline data capturing option.
Connectivity & Usability	•Offline access. •Keep interface simple (start with core features only). •Use extension workers/young people for data capturing. •Farmer training and capacity building.
Data Security & Trust	•Ensure anonymisation of farmer data (remove identifiers). •Legal framework for data protection •Farmer consent for research use. •Filtering/data-sharing at appropriate levels. •Training farmers to ensure data accuracy. •Extension officers to assist in verification.
General Functionality	•Add extension dashboard (decision support, market info, gross margin). •Link to existing databases (avoid re-entry). •Add weather integration (link to meteorological services). •Ability to generate prompt/customised reports (esp. financial). •Add option for pop-up notifications (to allow/disallow).

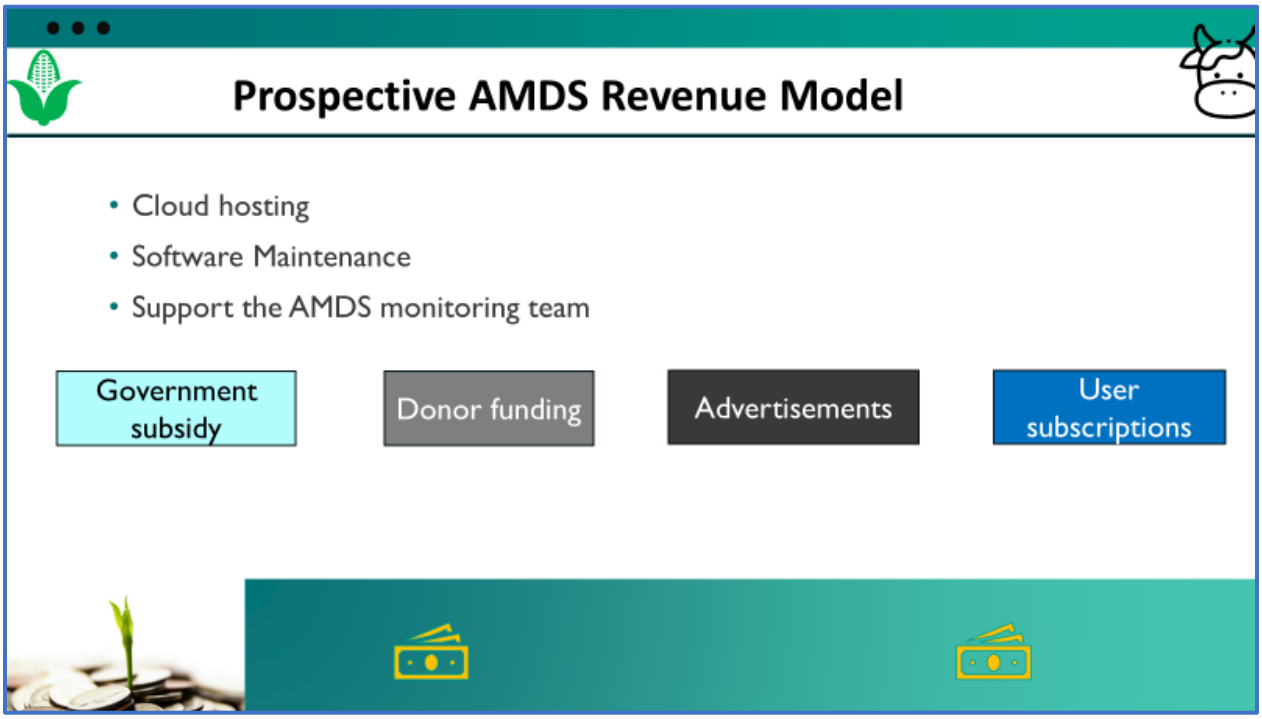
Improved Features:



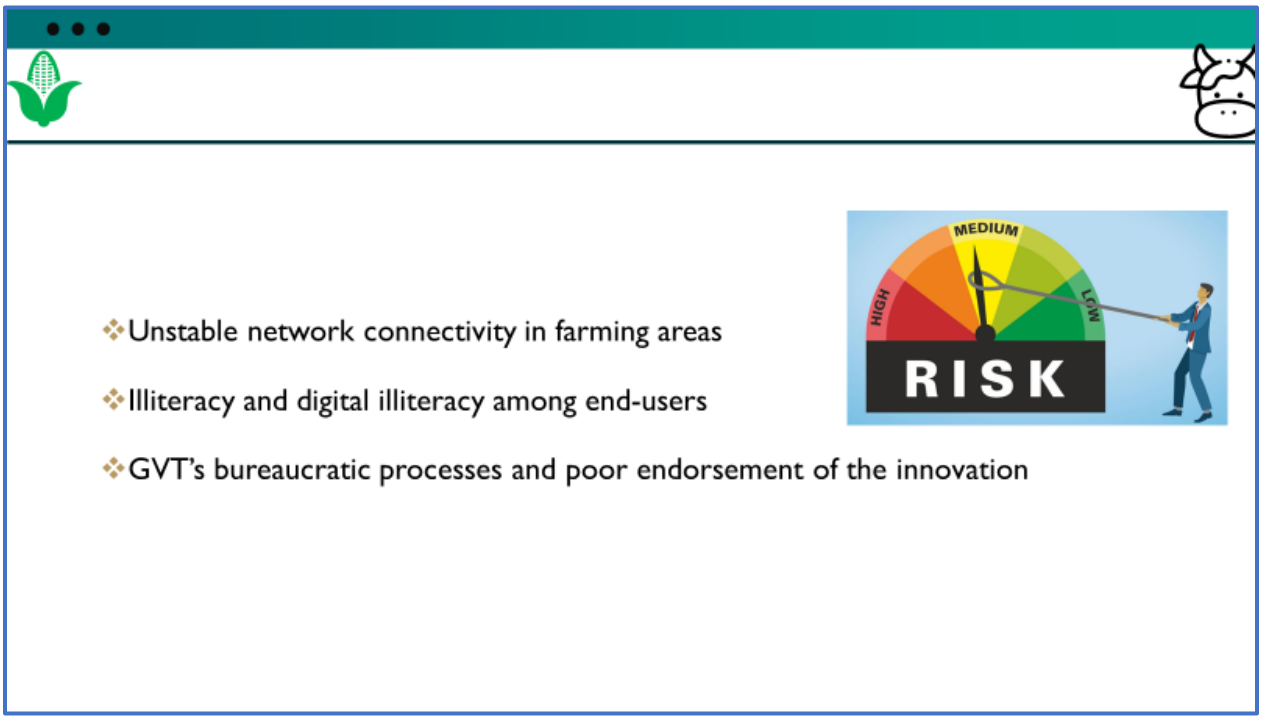
The Lay-out:



The Funding model:



The Potential Risks:



Plenary discussion on AMDS Refinement

The challenges facing the AMDS include digital-illiteracy of most farmers and farmer fatigue from endless interviews and surveys. It was suggested that the youth should be engaged and encouraged to use the app. Political interference will have to be addressed through policy interventions and CCARDESA were requested to assist. On climate variability, there is no one size fits all. The AMDS Monitoring team should be supported throughout the process.

There was debate about whether farmers are willing to pay subscriptions for the app? It was suggested that farmers could pay but probably not as subscriptions. Perhaps best is to charge them for downloads of information and data that they want and is relevant to them e.g. industry data. Farmers can also pay as their associations if they want to exploit information on a particular product. An example from Zimbabwe was provided, where dairy cooperatives send milk for testing and then pay based on the results. In South Africa, the Auctioneers Association collects levies from farmers for services rendered. Therefore, if there are direct benefits for farmers, they are likely to pay. Another suggestion was to place the farmers in tiers according to their capacity to pay. Farmers should not pay for inputting their own data and analysis that they can do with their own data; this should also be free. The issue of payment of subscriptions will depend on who owns the IP. If it is the government, then it will be free, but if it is private, e.g., Stellenbosch University, then there would be a charge. The onus is on extension services to influence government participation by demonstrating how useful the AMDS app is.

3.0. Validation of the AMDS app

The participants were asked whether they could consider the process of developing the proposed AMDS app validated. The following were the sentiments during plenary:

- The process was thorough, and the team consulted stakeholders during the development process
- The farmers were comfortable with approving the process and if their suggestions are incorporated, validate the AMDS app itself
- The farmers enquired if some of them could start using the AMDS app immediately
- The AMDS app is robust in data collection and the app has vast potential
- Agro-dealers were also happy with the process and want the app to be operational soon
- The development team of the AMDS app will incorporate the suggestions collected during this workshop and make necessary amendments and the improved version is expected to be showcased by the end of 2025
- Researchers present were satisfied with the proposed AMDS app and willing to start inputting data to provide valuable insights

3.1. Roadmap/Next Step

Prof Dzama thanked the participants who were carefully selected and contributed valuable inputs to the process of the development of the AMDS app. He expressed the need for continuity and encouraged participants to inform those who were not present at this workshop about the AMDS app. Participants should continue to ask questions and make suggestions during this developmental process. The AMDS app development team will work tirelessly to address and incorporate the suggestions from this workshop to provide ***African solutions to African problems***. Prof Dzama proposed that the roll-out/piloting of the final version of the AMDS app could be conducted in North West South Africa (however, there could be complications) or in Eswatini which should be easier and is willing to be the roll-out country. Eswatini has a diverse agricultural industry which may prompt more issues for the AMDS app. Thereafter, the app will be rolled out in the rest of SADC countries. There will be challenges but the process should forge ahead with determination until finalization.

3.2. Closing Remarks – CCARDESA (Prof. Cliff Dlamini)

Prof Dlamini thanked the participants for their active engagement, valuable insights, and commitment during the workshop sessions. The participants were able to express themselves freely and gave valuable feedback and recommendations which will help in refining the AMDS app. The stakeholder representation was well appreciated with the participation of farmers, researchers, extension and agro-industry. This co-creation of the AMDS was helpful, part of a systems approach. Prof Dlamini was happy that there was gender-balance at the workshop. The workshop showcased the functionality of AMDS and its potential to revolutionize agricultural data in the SADC region. The AMDS is a strategic enabler of evidence-based decision-making in agriculture, supporting policy formulation, investment planning, technology dissemination, and regional integration. The success in the development and deployment of the AMDS hinges on collaboration. strengthening partnerships, aligning priorities, and mobilizing resources to ensure that the AMDS is fully adopted and institutionalized across the SADC region. Prof Dlamini thanked Stellenbosch University for contributing to the conceptualization and development of AMDS. He commended the farmers, extension staff, government officials, researchers, private sector, and other stakeholders for their contributions. AMDS is more than a digital platform; it reflects the shared vision for a data-driven and resilient agricultural sector in SADC. He implored that together, agriculture can be transformed in the region through knowledge, innovation, and partnerships. The challenge is to scale-out; scale-up and scale-deep this AMDS app to other stakeholders. He wished participants safe travels back home and looked forward to continued engagement. Prof Dlamini declared the workshop officially closed.

ANNEXES

LIST OF DELEGATES

AMDS DEMOSTRATION AND THE ROADMAP VALIDATION WORKSHOP
19 – 22nd August 2025, Johannesburg, South Africa

CCARDESA is required to collect basic data on attendees of its events, including meetings. (*) You may leave the phone field empty to avoid being contacted.

Date: 19 – 22 August 2025

No.	NAMES	ORGANISATION (ACRONYM)	GENDER [M/F]	Age Cat. 1=<25yr 2=25-35 3=35-45 4= +45	Type of person (e.g., Researcher, Policy maker, Administrator, Academia, etc)	EMAIL	TELEPHONE NUMBER
1.	Prof. Cliff Dlamini	CCARDESA	M	4	Executive Director	cdlamini@ccardesa.org	+267 74 260 982
2.	Ms. Futhi Magagula	CCARDESA	F	4	Programmer	fmagagula@ccardesa.org	+267 74 239 415
3.	Mr. Dagmore Tawonezvi	CCARDESA	M	4	Researcher	dtawonezvi@ccardesa.org	+267 75 579 027

No.	NAMES	ORGANISATION (ACRONYM)	GENDER [M/F]	Age Cat. 1=<25yr 2=25-35 3=35-45 4= +45	Type of person (e.g., Researcher, Policy maker, Administrator, Academia, etc)	EMAIL	TELEPHONE NUMBER
4.	Mrs. Ellen Machao	CCARDESA	F	3	Executive Assistant	emachao@ccardesa.org	+267 74 391 529
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6.	Dr. Goalathe Thobokwe	SADC	M	4	Policy Maker	gthobokwe@sadc.int	+267 71 322 530
7.	Mr. Bongani Magagula	Ministry of Agriculture	M	4	Policy Maker	bonganimag21@gmail.com	+268 76 528 829
8.	Mr. Mncedisi Dlamini	Ministry of Agriculture	M	3	Policy maker	mncedisimaxdlamini@gmail.com	+268 76 322 122
9.	Ms. Marjorie Mavuso	Farmer	F	4	Farmer Maker	marjorie.mavuso@gmail.com	+268 76 028 877
10.	Mr. Ncamiso Mamba	Farmer	M	3	Farmer	bongmisoinvestment@gmail.com	+268 76 055 409
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12.	Prof. Armindo Cambule	UEM	M	4	Academia	armindo.cambule@gmail.com	+258 84 328 5400
13.	Dr. Anica Massas	IIAM	F	3	Researcher	anicamassas@gmail.com	+258 87 777 9080
14.	Dr. Deidre Januarie	MAFWLR	F	4	Researcher	deidre.januarie@gmal.com	+264 81 349 4790
15.	Prof. Kennedy Dzama	University of Stellenbosch	M	4	Academia	kdzama@sun.ac.za	+27 072 901 2026
16.	Mr. Panashe Mazungunye	University of Stellenbosch	M	2	Researcher	17564700@sun.ac.za	+27 74 475 5505
17.	Dr. Obvious Mapiye	University of Stellenbosch	F	3	Researcher	omapiye@sun.ac.za	+27 71 738 8143
18.	Prof. Amon Taruvinga	University of Fort Hare	M	4	Academia	amontalus@gmail.com	+276 37 982 970

No.	NAMES	ORGANISATION (ACRONYM)	GENDER [M/F]	Age Cat. 1=<25yr 2=25-35 3=35-45 4= +45	Type of person (e.g., Researcher, Policy maker, Administrator, Academia, etc)	EMAIL	TELEPHONE NUMBER
19.	Dr. Refilwe Mofokeng	University of Stellenbosch	F	3	Researcher	pceemofokeng101@gmail.com	+279 44 345 85
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21.	Prof. Tinyiko Halimani	University of Zimbabwe	M	4	Researcher	tinyiko.halimani@gmail.com	+263 772 321 761
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26.	Mr. Hennock Tladinyane	Farmer - Brits NW	M	4	Farmer	kotla.gopolang@gmail.com	+27 827756905
27.	Mr. Kabelo Mkwanazi	Dept of Agriculture NW	M	4	Agric Advisor	kmkwanazi@nwpg.gov.za	+27 727922598
28.	Mr. Sibusiso Mlimo	Dept of Agriculture NW	M	4	Agric Advisor	smlimo@nwpg.gov.za	+27 727616986
29.	Ms. Didintle Mohosh	OBARO - Brits NW	F	2	Technical	didi.mohosh@obaro.co.za	+27 658155813

PROGRAMME OF THE MEETING



AMDS DEMOSTRATION AND THE ROADMAP TO FULL DEVELOPMENT AND DEPLOYMENT WORKSHOP 19 – 22nd August 2025

Date	TIME	ITEM	Responsible
Monday 18th August 2025	**Arrival**		
Tuesday 19th August 2025	**Plenary to Set the Scene**		
	08:30 – 09:00	Registration	CCARDESA
	09:00 – 09:15	Introduction and checking in	Dr Nengomasha – Facilitator
	09:15 – 09:45	Welcome Remarks	CCARDESA
	09:45 –10:00	Objectives of the workshop	Prof. Dzama- SU
	10:00 –10:15	Agri-Innovations and Technology: A Regional Outlook	Dr Thobokwe, SADC
	10:15 – 10:30	Group photo	CCARDESA
	10:30 - 11:00	**HEALTH BREAK**	**ALL**
	11:00 – 11:30	Do Mobile Phones Enhance Agricultural productivity: Evidence From SADC	Prof Taruvinga
	11:30 – 13:00	The AMDS innovation prototype – Purpose, Features & Development progress	Dr Mapiye *[All to bring laptops]*
	13:00 -14:00	**LUNCH BREAK**	**ALL**
	14:00 – 15:30	Deep dive into AMDS practical usability testing and validation with all participants	Dr Mapiye + All
	15:30 – 16:00	**HEALTH BREAK**	**ALL**
	15:45 – 17:00	AMDS User Validation: Insights from the groups	Facilitator + Groups
	17:00 – 17:10	**Housekeeping**	CCARDESA
	End of Day 1		

DAY 2	TIME	ITEM	Responsible
Wednesday 20 August	**Plenary**		

	09:00 – 09:15	Recap of day 1	Prof Dzama
	09:15 – 09:45	AI in Animal production	Prof Halimani
	09:45 – 10:30	CAADP-XP4 Technology thrust	Ms Magagula
	10:30 – 11:00	**HEALTH BREAK**	**ALL**
	11:00 – 11:30	Design Thinking approach: From Problem to Prototype	Dr Mapiye
	11:30 – 13:00	Empathizing with farmers: Real-life needs and challenges from the field	Farmers
	13:00 – 14:00	**LUNCH BREAK**	**ALL**
	14:00 – 14:45	Empathizing with public extension officers: Real-life needs and challenges from the field	Extension officers
	14:45 – 15:10	Empathizing with Market players: Real-life challenge stories from the field	Agribusiness actors
	15:10 – 15:30	Empathizing with Researchers (Data challenges in Agriculture: Farm to regional level)	Prof Taruvinga
	15:30 – 16:00	**HEALTH BREAK**	**ALL**
	16:00 – 17:00	Reflection on farmer, researcher, extension experiences	Prof Dzama
	17:00	**END OF DAY 2**	
DAY 3	**TIME**	**ITEM**	**Responsible**
Thursday 21 August 2025	**Plenary**		
	09:00 – 09:15	Recap of day 2	Prof K Dzama
	09:15 – 10:15	Country perspectives on the subject matter	Facilitator + Country Reps
	10:15 – 10:30	Breakaway sessions preparations and instructions – *Flip charts, Sticky notes and Laptops*	Facilitator & Dr Mapiye
	10:30 - 11:00	**HEALTH BREAK**	**ALL**
	11:00 – 11:40	Breakaway session – Empathizing and Defining targeted user problems: *Farmers, Extension, Researchers, Agro-Dealers and CCARDESA*	Groups
	12:20 – 13:00	Breakaway session (Ideation): Developing POV and HMW statements, Brainstorming solution ideas	Groups
	13:00 - 14:00	**LUNCH BREAK**	
	14:00 – 14:30	Breakaway Session (Prototyping) – Design to enhance the AMDS Prototype	Groups
	14:30 – 15:30	Group presentations on AMDS improved features & impact *(Mock-ups, Sketches/schematics, Storyboards)*	Group reps

	15:30 - 16:00	**HEALTH BREAK**	
	16:00 – 17:00	Discussions and synthesis	
		END OF DAY 3	
DAY 4	**TIME**	**ITEM**	**Responsible**
Friday 22 August 2025	**Plenary**		
	09:00 – 09:15	Recap of day 3	Prof Dzama
	09:15 – 10:15	The Refined AMDS: Key Features and Functionalities	Dr Mapiye
	10:15 – 11:15	The next steps: *The pathway to AMDS full development & deployment.*	Prof Dzama
	11:15 – 12:00	Closing Remarks	CCARDESA
		END OF DAY 4	
		DEPARTURE	