Development of the Agricultural Management Database System (AMDS)

AMDS Prototyping Final Report
28 August 2025

1.0 Background and motivation

The Southern African Development Community (SADC) region faces significant challenges in the agricultural sector, primarily due to lack of reliable, accurate, and real-time farm data. This data gap hampers effective decision-making at the farm, country, and regional levels. Stellenbosch University (SU), in collaboration with the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA), has therefore initiated the development of an Agricultural Management Database System (AMDS). The AMDS, a user-driven mobile-based application, aims to address this challenge by leveraging mobile technology to facilitate real-time data collection directly from farmers. The innovation results from research conducted in the Faculty of AgriSciences at SU between 2016 and 2022. The design of the AMDS allows data to be collected through farmer registrations, in-app farmer record-keeping, in-app farmer knowledge exchanges, and in-app periodic surveys. Collected data will be integrated into the existing SADC Agricultural Information Management System (AIMS). In addition to data collection, the AMDS also helps link farmers with better markets and value-chain service providers. It also revolutionises the coordination and delivery of public extension services to smallholder farmers. The AMDS initiative is, therefore, a direct response to the need for better data management to support SADC's developmental plans, policies, and protocols, ultimately contributing to national and regional agricultural development and food security. Also, the AMDS aligns well with the objectives of the recently launched Comprehensive Africa Agriculture Development Programme (CAADP) Strategy and Action Plan (2026–2035), which emphasizes transformative programming for smallholder farmers, knowledge creation and sharing, data-driven planning, and the adoption of digital technologies as cornerstones for agricultural progress.

The AMDS prototype has been successfully developed and comprehensively validated through an all-stakeholder workshop. The purpose of this report is to document the prototyping activities and outcomes, and to outline the proposed next phase, which entails further system development and the initiation of Phase 1 deployment in an operational environment. This phase will facilitate continued research and refinement to ensure that the system effectively supports real-time farm data collection across the SADC region.

2.0 The objectives

2.1 The specific objectives of the project were to:

1) Capacitate regional stakeholders on available digital, ICT-based including mobile phone user-based solutions for data collection and decision making.
2) Develop an innovative mobile-user based solution that can be harnessed to address timely collection of agricultural data from various stakeholders in the

region to support the SADC Agricultural Information Management System (AIMS) or similar systems.

3) Validate the AMDS prototype through participatory usability testing with farmers, researchers and agribusiness value-chain actors from seven SADC countries, thereby assessing its functional relevance, adaptability, and applicability across farm, national, and regional contexts.
4) Refine the AMDS's key features and functionalities through co-design and stakeholder-driven insights, generating actionable recommendations that establish a clear pathway towards Phase I integrated system deployment in one pilot country.

2.2 These objectives were achieved through the following activities:

1) Conducting a Needs Analysis workshop to familiarise regional stakeholders with existing regional Agri-technology imperatives and critique them to develop value propositions for new technology.
2) Producing a scoping and user requirements report based on the initial SU/CCARDESA workshop and relevant literature
3) Developing a prototype of the AMDS mobile application that facilitates real-time data collection from farmers across the SADC region complete with a functional minimum viable product (MVP).
4) Conducting a validation workshop to:
    a. Conduct a participatory usability testing of the AMDS prototype with farmers, researchers, and agribusiness value-chain actors from seven SADC countries to assess its functional relevance, adaptability, and applicability.
    b. Facilitate co-designing sessions with stakeholders to refine AMDS features and functionalities and consolidate insights into actionable recommendations for Phase I integrated system deployment in one pilot country.

3.0 AMDS prototype software development

The development of the AMDS mobile application which commenced on 1 October 2023 and was completed on 30 April 2025. This followed the approval of the inception report and the conceptualisation of the scoping and statement of user requirements, which arose from the interrogation of the outcomes of the SU/CCARDESA innovation and needs analysis workshop held in Johannesburg from the 9th – 11th July 2024.

3.1 Solutions architect.

The solutions architecture phase commenced with a kick-off workshop of the AMDS development team on 1 October 2024, forming part of pre-development consultations with key stakeholders. This phase consolidated user needs, technical specifications, and workflow requirements, and culminated in the creation of a detailed product roadmap.

The AMDS high-level strategy was introduced to developers, providing the foundation for a scalable prototype system architecture and establishing a structured workflow to guide subsequent development.
The architecture supported agile and iterative development, with deliverables organised into two-week sprints to ensure flexibility and responsiveness to emerging requirements. Periodic reviews were conducted to monitor adherence to the established framework, while accommodating refinements where necessary.
To maintain alignment and momentum, the development team participated in weekly stand-up meetings, planning sessions, demos, and retrospectives. In-lab prototype testing, jointly undertaken by the SU team and Warp Development, enabled early identification and resolution of bugs and functionality issues. This approach ensured a robust foundation for the AMDS application, balancing technical soundness with adaptability. It positioned the system for successful usability testing and subsequent refinement, thereby reinforcing its readiness for validation and phased deployment across the SADC region.

3.2 Software development activities

The software development began with the Planning and Architecture phase. The core software development to support the major functionalities of the application is now completed. Although the developed prototype so far may not have all expected features due to budgetary constraints, a pilot MVP was successfully developed which will then be tested and used as a functional proof of concept.
The software design is basic, and its foundation is designed to allow future expansion to include more functionalities should more funding be made available in future. The prototype so far in place has core features such as:

1) Secure login functionality,
2) Farm data capturing,
3) Farm gross margin and performance overviews,
4) Forum discussions,
5) Marketplace, and
6) User contact list.

3.3 UI/UX System design

The UI/UX system design process for the AMDS project follows three key steps as follows:
Step 1 involved the designing of low-fidelity wireframes representing structural elements of the application. The initial designs were shared in Figma for the whole team to review and provide feedback. Feedback was provided on issues related to interface features and functionality and these were integrated in the new version.
Step 2 involved the development of high-fidelity designs focusing on content integration and interactive prototype development that offer enhanced content representation and user flows. This step aims to enhance usability and ensure a coherent user experience.

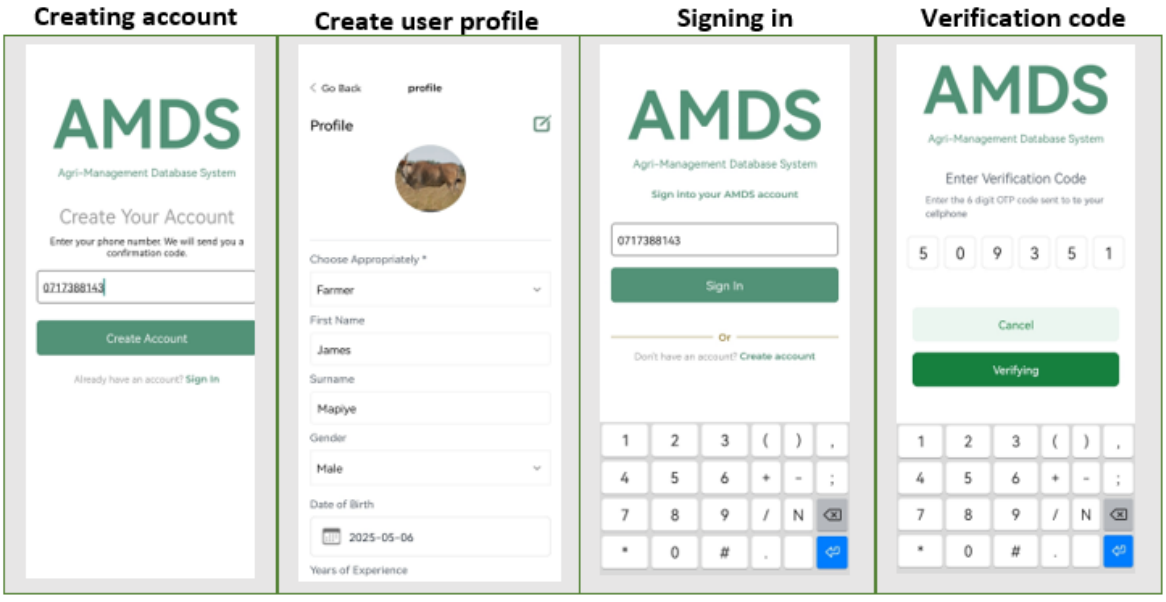
After several iterations this was finalised upon completion of the final MVP.
Step 3 also works hand in hand with the completed MVP. This involved finalising branding elements, visual tone, including colour schemes and iconography. This also ensures responsiveness for mobile devices as well as tablet devices. This iterative UI/UX development maintains user-centric design principles, aiming to enhance app usability and engagement effectively.

4.0 Features and functionalities of the developed low-resolution prototype

The developed software architecture was based on delivering a successful, workable low-code prototype with some of the required functional features set specified at the kick-off workshop with Warp. Figures below each section show the interface features of the developed AMDS prototype.

4.1 Login page

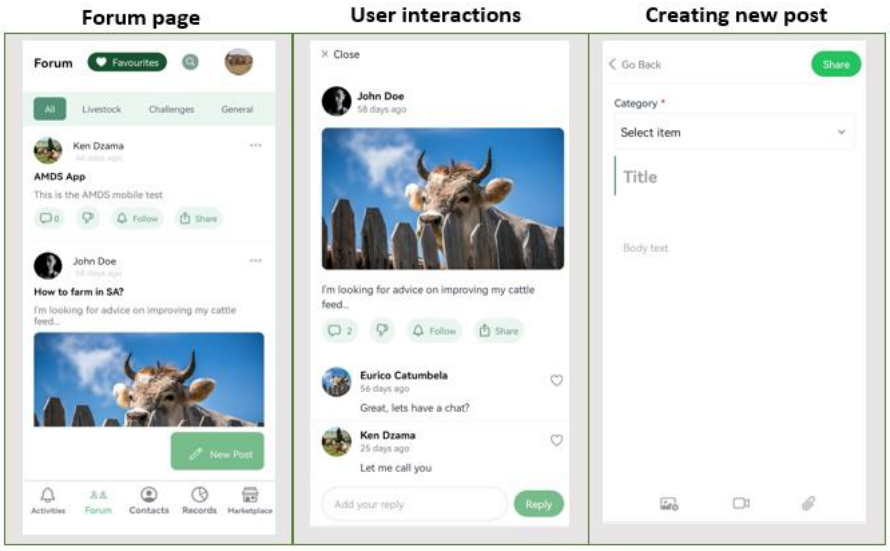
Users will receive a link via email to download the application and will be required to create an account by registering in the system (see Figure below). During registration, they will provide details on farm characteristics, enterprises, location, and other relevant information. The registration process enables the systematic collection of individual farmer data, which is automatically integrated into the central farmer database. To log in, users will enter their mobile phone number and receive a one-time six-digit verification code to access the system.



4.2 Forum page

This is an interactive discussion space that enables farmers to ask questions and seek assistance from fellow farmers and experts (Figure below). To post, users select a discussion category, provide a brief title, and enter their message or query. They may

also share photos, short videos, and PDFs. Other users can then respond or provide feedback. As conversations accumulate, relevant data and information are captured through AI and stored in a database, thereby documenting indigenous technical knowledge.

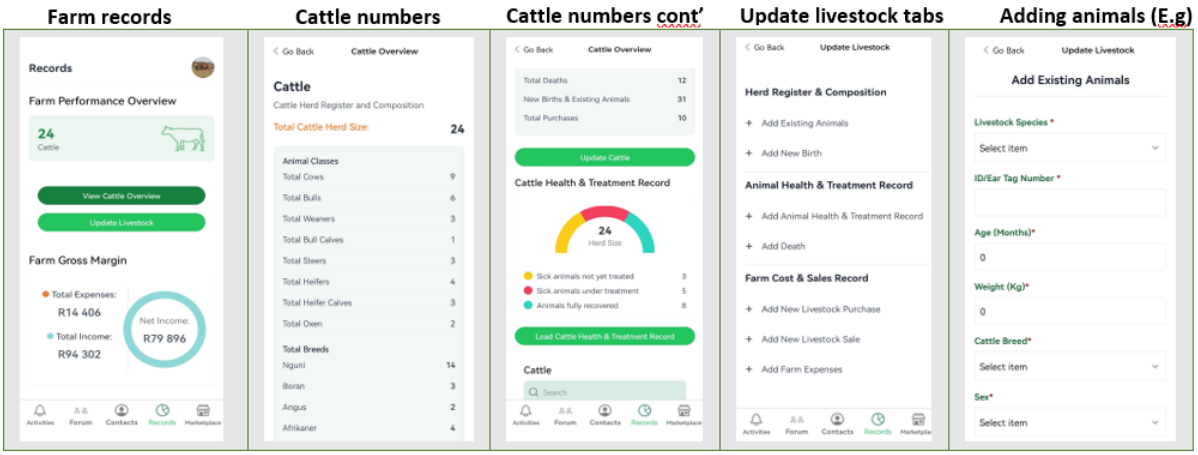


4.3 Records keeping page

The tool provides user-friendly record-keeping templates that enable users to accurately and efficiently document daily farming activities, thereby enhancing their capacity for informed farm management (Figure below). The current templates support the following functions:

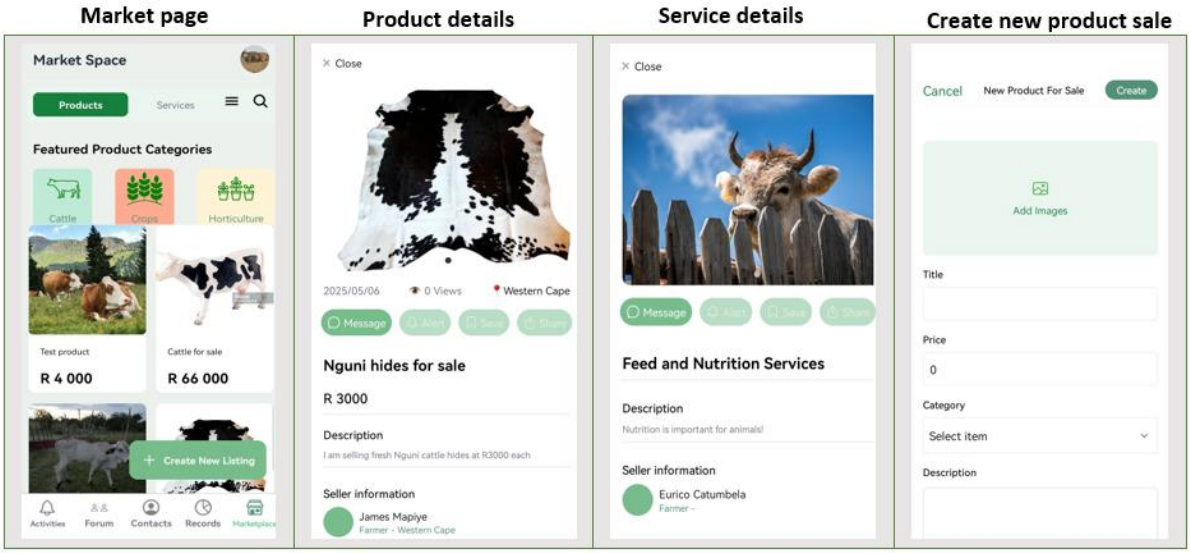
- *Herd register and composition:* Adding existing animals and recording new births.
- *Animal health and treatment:* Tracking treatments, illnesses, and mortalities.
- *Farm costs and sales:* Logging livestock purchases, sales, and other farm expenditures.

All record-keeping templates are designed to capture data directly from farmers in real time, with the information stored in the backend database. While raw data is not accessible at this prototype stage, the system generates summaries of key farm performance indicators such as total herd size, classifications, breeds, deaths, sales, and births. It further supports gross margin analysis by calculating total expenses, income, and net farm income.



4.4 Market place

The marketplace allows farmers and agro-dealers to upload bids and offers to buy or sell agricultural products and services through the application (Figure below). Users can create listings with a title, attached image, quantity, price per unit, optional location, and a short description. They receive personalised messages from interested buyers or sellers via WhatsApp for further engagement. Marketplace activities enable the collection of important real-time data, which is integrated into the backend database. This functionality provides users and key stakeholders with timely access to marketing data and information.



5.0 AMDS prototype validation

A multi-stakeholder workshop on *"Testing, Validating, and Refining the AMDS for Sustainable Farming and Building Agricultural Data Ecosystems in the SADC Region"* was convened from 19–22 August 2025 in Johannesburg. The event brought together farmers, researchers, agro-dealers, representatives from SU, CCARDESA, and the SADC Secretariat, covering seven SADC countries.

Participants engaged in live demonstrations and hands-on usability testing of the AMDS prototype. Farmers, researchers, and agribusiness actors provided structured feedback, validating the system's functionality, adaptability, and regional relevance. Recommendations focused on strengthening user-friendliness, improving data integration, and enhancing alignment with institutional frameworks.

The AMDS was successfully validated by all stakeholder groups, confirming its potential to address critical gaps in agricultural data collection and utilisation. Importantly, consensus was reached on the next step: refining the system's key features and advancing towards Phase I integrated deployment in one or two pilot countries.

6.0 The proposed next steps

Building on its successful prototype development and subsequent validation workshop with key stakeholders, the AMDS innovation has attained Technology Readiness Level (TRL) 6, denoting a prototype system tested and validated under relevant conditions.

The forthcoming phase entails iterative refinement of the system's software through systematic integration of stakeholder feedback. This process will position the tool to immediately advance to TRL 7, at which stage an integrated pilot system will be deployed and evaluated under operational field conditions with targeted end-users.

A usability study involving farmers, extension officers, and veterinary personnel is currently underway in four districts across the North West and Mpumalanga provinces. The study also assesses South African researchers' perceptions of the AMDS's effectiveness in improving primary farm data collection and availability. These activities aim to further define user requirements and generate recommendations to enhance the system's usability and scalability, thereby reinforcing the proof of concept

7.0 Conclusion and recommendations

The development and successful validation of the AMDS prototype mark a significant milestone in strengthening agricultural data ecosystems and enhancing the performance of farming systems across the SADC region. Despite resource and time constraints, the SU-CCARDESA collaborative initiative has delivered a functional, user-driven system that integrates farmer registration, record-keeping, advisory support, and market access into a single digital platform. The multi-stakeholder validation workshop conducted in August in Johannesburg confirmed the system's usability and adaptability through hands-on testing and constructive feedback from various stakeholders across the region. Importantly, all stakeholder groups endorsed the AMDS as a relevant and scalable solution to the region's persistent agricultural data gaps. The agreed next key steps involve further development of the system and advancing to Phase I rollout/deployment in one or two pilot countries providing a clear pathway for operationalisation. With sustained collaborative efforts and financial support, the AMDS is well positioned to further accelerate digital transformation in regional agriculture and underpin evidence-based decision-making at the farm, national and regional levels.

Milestones		Achieved Activities	Deliverables	Budget	Completion Date
M1	Solutions Architect	1. Pre-development consultation & needs analysis 2. Project workshop & planning 3. Requirements specification & documentation 4. Technical architecture design 5. Workflow & rollout planning	1. Pre-development consultations 2. A project workshop detailing user and system requirements. 3. A proposed technical architecture, phased workflow and rollout strategy for the software solution.	R	31/10/2024
M2	UI/UX designer	1. Step 1: Low-fidelity wireframes (page structure) 2. Step 2: High-fidelity mock-ups & interactive prototype 3. Step 3: Visual design phase (brand guide, color palette, icons, imagery) 4. Design optimization for mobile & tablet responsiveness	1.. Low-fidelity wireframe set with basic screen layouts illustrating page structure & navigation flow. 2. High-fidelity mockups & interactive prototype with detailed UI/UX screens with finalized content and a clickable prototype for SU team review. 3. A comprehensive brand guide including color schemes, typography, iconography, and imagery style. 4. Optimized UI/UX designs for mobile & tablet devices, ensuring consistent user experience across screen sizes.	R	30/11/2024
M3	QA and DevOps	1.. Functional testing & validation 2. Compliance with quality standards 3. Automated testing implementation 4. Performance/stress testing 5. CI/CD pipeline setup 6. Infrastructure as Code (IaC) 7. Configuration automation 8. Security checks & regulatory compliance	1. Functional, automated & performance/stress testing outcomes, including the identified issues & resolutions 2. CI/CD Pipeline & DevOps setup developed 3. App improved based on feedback provided by the SU team.	R	30/04/2025

APPENDIX 1: Scope of work defined by AMDS software development milestones, activities, deliverables, budget and timelines



forward together
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