A Roadmap Towards a Sustainable Zambian Soil Information System

Application of version 3 of the Framework for Sustainable National Soil Information Systems

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Executive Summary

In April 2024, the “Zambia Soil Information System: Roadmap Development Workshop” was held in Lusaka, Zambia. This workshop validated and refined the SIS framework and gathered information for a suggested roadmap for implementing ZamSIS.

The workshop investigated the status of five components: 1) the envisioning of the SIS definition and mission, 2) the enabling environment for the SIS, 3) the needs for the SIS, 4) the idealised SIS design and 5) the key stakeholder engagement and partnership development. For each component, an overview on available information, potential gaps and recommendations coming from the workshop or from CABI and ISRIC is provided in this roadmap. The recommendations are intended as optional and the ZamSIS project team decides which ones to execute.

The key recommendations for a sustainable and successful ZamSIS are as follows:

1. Refine the ZamSIS definition, problem, and mission statement (chapter 2.1);
2. Promote data sharing by developing a data sharing policy (chapter 2.2);
3. Specify and document the needs of users, producers, and beneficiaries on how they will interact with the system and data (chapter 2.3);
4. Design the architecture of the SIS together with SMART Zambia (chapter 2.4);
5. Develop a sustainable business plan with project partners (chapter 2.5).

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Version 3 of the SIS framework was applied and tested in the Zambia workshop, so please note references to different framework components and activities in this report may not reflect the current live version of the framework. The updated version of the framework is now live and can be accessed here: https://resources.isric.org/sis-framework/.

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Acronyms and abbreviations

AU	African Union
CABI	Centre for Agriculture and Biosciences International
FAO	Food and Agriculture Organization of the United Nations
ISRIC	International Soil Reference and Information Centre
LSC-IS	Land, Soil, Crop Information System
MU	Masaryk University
ODK	Open Data Kit
SADC	Southern African Development Community
SIS	Soil Information System
SLIM project	Sustainable Landscape through Integrated Management project
SMART Zambia	Electronic Government (e-Gov) also known as the Smart Zambia Institute
UNCCD	United Nations Convention to Combat Desertification
UNZA	University of Zambia
USSD	Unstructured Supplementary Service Data
ZARI	Zambia Agricultural Research Institute
ZamSIS	Zambia Soil Information System
ZamStats	Zambia Statistics Agency

Introduction

A soil information system (SIS) is, besides a technological output, also a process by which people and institutions must collaborate, explore, iteratively refine, and implement plans for data development, all while balancing multiple evolving sets of needs, setbacks, resources, and priorities. Understanding how these people and institutions should work together, and aligning on who is responsible for what, is a critical step to ensuring the progress of the SIS. There are three levels to consider: individual (suitable skills, knowledge, competencies, and attitudes), organizational (efficient structures, processes, and procedures), and governmental level (establishment of adequate institutions, laws, and regulations).

The project *A Process Toward Strengthening National Soil Information Services*, led by CAB-International and ISRIC – World Soil Information, supported by the Bill & Melinda Gates Foundation, created a framework for SIS design (re-named the framework for sustainable national soil information systems), to help those in the soil community interested in developing or funding a SIS, or anyone who would like to improve their existing SIS. It provides guidance for SIS owners, system developers, funders, implementing partners and research institutions involved to ensure their investment leads to sustainable outcomes. Within each phase of the framework there are "components", which contain suggested activities, accompanied by guiding questions, recommended tools and supporting resources to make the process as practical and as easily useable as possible.

In April 2024, the framework was validated and further refined during the "Zambia Soil Information System: Roadmap Development Workshop". This document gathers the information collected and validated during the workshop and proposes a suggested roadmap for implementing ZamSIS.

A roadmap is a strategic plan that details the steps required to achieve a specific goal. In this instance, the goal is a sustainable national SIS in Zambia that will last beyond project funding, be built on best practice, and will continue to meet the needs of users. This roadmap uses information collected from the workshop and previous research activities, comparing this to each component in the Initiation Phase of the SIS framework. Application of the framework supports identification of gaps and leads to recommendations of next steps that might be followed to better ensure the sustainability and success of ZamSIS.

The intention is that the SIS owner (ZARI), developer (FAO) and other key stakeholders (UNZA and SMART Zambia) will be able to refer to the roadmap throughout the development of the SIS to ensure continued alignment with the stated purpose for the SIS.

1. Preparation Activities for the Roadmap

1.1. Key Informant Interviews

The invitees to the roadmap workshop, selected by ZARI, FAO and CABI, were invited to participate in a 1-hour online interview, scheduled during a two-week period prior to the workshop in Zambia. The purpose of the interviews was to identify and collect available information needed for the roadmap for ZamSIS. Collecting this information prior to the event contributed to maximising the productivity and focus of the breakout discussions during the event. 25% of the invitees was interviewed, representing both data producers and data users. The interview process followed Chatham House rules, and all responses were anonymized when communicated to other attendees during the event. The interview question template can be found in Annex II. The most common challenges identified during the interviews are:

- constrained access to soil data;
- limited data sharing from previous initiatives and between organisations;
    - these organizations do not always see the benefits of the sharing and digitization of their data;
- poor data management practices;
- IT developers may not fully understand requirements of soil experts/users;
- misalignment between existing/similar initiatives, resulting in duplication of efforts.

1.2. Online Surveys

The workshop invitees who did not participate in an interview were asked to fill in an online survey for further collection of information on Zambia's enabling environment, needs and the role each stakeholder might play in the development of ZamSIS. 25% of the invitees completed it, with representatives of data producers, data users, system owners, government, and donors. All the data has been anonymised and the detailed results can be found in Annex III.

1.3. The Roadmap Co-creation Workshop

CABI and ISRIC held a workshop on the 17-18 of April 2024 at the Intercontinental Hotel in Lusaka, Zambia. The workshop brought together key organisations that have a role to play in the development of ZamSIS. CABI and ISRIC partnered with ZARI, UNZA, FAO's SoilFER project and the MU's SLIM project, to test the SIS framework and to support the development of a roadmap for the design and implementation of ZamSIS. The goals of the workshop were to:

- Present and validate a framework, seeking feedback to improve it further.
- Facilitate stakeholder discussions to support ZARI, UNZA and FAO in the development of a roadmap for the design of ZamSIS.

The full programme and slide decks presented at the workshop can be found in Annex IV.

The main purpose of this roadmap workshop was to collect available information, identify the implementation plans of the SoilFER project in Zambia, identify evidence gaps and provide recommendations for next steps and for future phases of the framework. This approach also helped identify the applicability and usefulness of the SIS development framework. Feedback received during the workshop highlighted its effectiveness for assessing the enabling environment, and to set up partnerships in support of ongoing efforts, which is reflected in Component 5 of the Initiation Phase of the framework.

2. The Roadmap Towards a Sustainable ZamSIS

1.4. Component 1: Envisioning

Envisioning involves a series of activities that seek to articulate the problem the SIS will aim to solve, define the SIS, assess demand, articulate the value proposition or business case, and plan for funding. This becomes a key part of the project's documentation as more work is done, giving a SIS project team clear direction as they complete further steps. This also serves as a reliable point of reference as the SIS development process evolves in the future.

The various perspectives and information gathered from the SIS stakeholders during the workshop on Envisioning have been consolidated and are presented in the sub-sections below. The original bullet pointed information from the workshop can be found in Annex IV.

The recommended action points are **not** intended to be prescriptive, but rather they are presented as optional next steps based on what is within the framework for strengthening SIS design, and incorporating the ideas shared in the workshop.

1.1. Information and perspectives gathered from the SIS stakeholders

Draft Definition of ZamSIS: ZamSIS is envisioned as a comprehensive system designed to collate and disseminate soil information for wider usage. This platform facilitates interactions between soil data providers and users, aiding in the planning and sustainable use of resources in Zambia.

Draft Mission of ZamSIS. The proposed mission of ZamSIS from the workshop is multi-faceted:

- **Improve Access to Soil Data**: Provide a centralized hub for a diverse range of users.
- **Support Decision-Making**: Equip stakeholders with accurate soil information to inform their decisions.
- **Forge Alignment and Enable Data Sharing**: Coordinate among existing and future soil data projects and efforts.
- **Promote Sustainable Use of Soils**: Enhance long-term sustainable soil management practices in Zambia.

Recommendation:

- Refine the first draft of ZamSIS definition, problem, and intention (mission) statement, using the information from the workshop.
- Guiding questions:

▪ What is the current problem that the SIS seeks to solve? ▪ What is your desired outcome for the SIS? ▪ Who is the SIS for? For whom is the SIS not? ▪ What are the primary or most important uses for soil data in the country?
Supporting Resource: • Defining the problem and intention (mission) statement in Annex V. • Example SIS mission statement from convening of key SIS stakeholders in Nairobi, March 2024: *"A multi-stakeholder demand-demand driven public good platform that collects, stores and serves soil data and enables decision and policy support to address food and nutrition security, land conservation and rehabilitation, climate change resilience."* • Example SIS definition from CABI: "*In many contexts, a SIS is defined as integrated information system that consolidates data from soil surveys (recent and/or historic), sample soil testing and analysis to final output generation for soil mapping and recommendation. It may contain multiple data sets, models, and tools for visualization in support of improved decision making by both soil data scientists (experts), and non-technical experts depending on the system in question. This definition primarily refers to the technological aspects. CABI also believes that any functioning system relies on a combination of technology, processes, and personnel.*"

Added Value to the Community: ZamSIS will offer several key benefits to the community:

- **Fertilizer Blending and Recommendations**: Enhance precision of fertilizer applications, resulting in cost savings for both the government and farmers.
- **Economic Valuation**: Provide economic insights on the benefits of precise soil information, highlighting cost savings.
- **Environmental Protection**: Help prevent environmental disasters by offering critical data to anticipate and mitigate risks such as flooding, which is influenced by soil types.

Ownership and Funding of ZamSIS. The ownership and operational responsibilities for ZamSIS will rest with ZARI, in cooperation with SMART Zambia. The high-level funding plan includes:

- **Primary Ownership**: ZARI, supported by SMART Zambia, will maintain, and operate the system.

- **SIS Champion**: ZARI will act as the SIS Champion[1], which is an institution responsible for liaising with multiple stakeholders to ensure continuous collaboration and progress. This effort will be supported by the University of Zambia (UNZA) and the UN Food and Agriculture Organization (FAO).

Recommendation:

- Decide when government funding comes in during the SIS development, and plan to sustain the system beyond project end date (see Component 5 for further recommendations on financial sustainability).

[1] A SIS Champion is an institution that liaises among the multiple levels of stakeholders and works to motivate continuous collaboration and forward progress. Ideally this institution has a vested interest in seeing the SIS succeed, regardless of their direct involvement in its funding or resourcing. This role is especially important during lean periods in funding or capacity shortages. A SIS champion may emerge at any point in the framework, but ideally this institution can be identified early and supported to fill this role for the long term.

1.5. Component 2: Enabling Environment Assessment

The enabling environment is the underlying social, political, institutional, and financial context that influences, enables, or inhibits the development and sustainability of a SIS. This includes, for example, assessment of existing soil information efforts, data and resources, and mapping of stakeholders. Information collated from the enabling environment becomes a key input to decision-making at later stages, as well as ensuring reduction of duplicated efforts and identifies areas of alignment between multiple actors operating in the space. It is likely that you will need to review the enabling environment at regular intervals throughout the development and maintenance of the SIS.

From a policy perspective, the development and maintenance of ZamSIS are aligned with government priorities and are likely to remain so. The involvement of key government entities like ZARI, SMART Zambia, and the Ministry of Agriculture underscores the significance of this initiative. Formalizing policies, creating strategic partnerships, and ensuring continuous updates and stakeholder engagement will be crucial for the long-term success and sustainability of ZamSIS.

The various perspectives and information gathered from the SIS stakeholders during the workshop on Envisioning have been consolidated and are presented in the sub-sections below. The original bullet pointed information from the workshop can be found in Annex IV and a synthesis report of the enabling environment of Zambia can be found in Annex VIII.

The recommended action points are not intended to be prescriptive, but rather they are presented as optional next steps based on what is within the framework for strengthening SIS design, and incorporating the ideas shared in the workshop.

2.2.1. Information and perspectives gathered from SIS stakeholders

Assessment of the current data governance, policies, and licensing landscape.
Data Sharing Policy: No formal policy exists yet.

- **Soil Data Collection Policy**: There is no established policy guiding the collection and reporting of soil samples. Plans are in place to create one.
- **Soil Strategy**: A comprehensive soil strategy is yet to be formulated, indicating an area of future development.
- **Data Privacy Policy:** There is no policy, but ZamSIS will use SMART Zambia's data privacy act as a foundation.
    - **User Agreement**: An option for user acceptance agreements regarding privacy can be implemented.
- **Data Governance**: Permissions for data usage must be clearly defined, with standards for data analysis.
- **Quality Assurance**: FAO and USDA standards, alongside GLOSOLAN guidelines, will ensure data quality.
- **Soil Standards**: FAO standards, ISO28258 for digital data exchange, and GLOSOLAN standards for soil labs will be utilized.
- **Ethical Concerns**: Ethical data use mandates verifying the data collector's identity.

Recommendations:

- Discuss further potential for a data sharing policy to ensure FAIR data sharing for the ZamSIS.
- Consider developing a high-level FAIR data[2] Aligning Principles to guide the development of a data strategy during the Planning & Design Phase.
- Discuss possibility of a soil data collection policy on how to collect and report soil samples.
- Discuss possibility of a mandate that new soil data should be uploaded to the SIS with a defined standard (to avoid any new projects that collect soil data cannot be uploaded in the SIS).

Optional Tools:

- See FAIR Data Aligning Principles in Annex VII.
- Developing a data sharing policy Annex VI.
- Explore the Data Sharing Toolkit to gain insights into the potential for data sharing: Data Sharing Toolkit.
- Adhere to responsible and ethical data practices by referring to the guidelines: Minimising harmful impacts from data sharing.

Supporting resources:

[2] The FAIR Principles are an acronym for Findable, Accessible, Interoperable, and Reusable. These concepts are crucial to managing the vast amounts of data generated in today's data-driven world. They provide a framework to guide data producers towards effective data management and the high-quality publishing, use, reuse, and accessibility of research data. The principles address challenges arising from the growing volume, complexity, and speed of data generation and aim to support data-driven research and innovation. Additionally, they encourage transparency and reproducibility and have become a guide for many large organizations in conceptualizing the best data practices in their projects.

- Case study of developing a soil and agronomy data sharing policy in Ethiopia: https://doi.org/10.21955/gatesopenres.1117085.1
- Ethiopia's Coalition of the Willing guideline on data collection https://ethioagridata.com/Resources/Guideline_for_Agronomy_and_Soil_Fertility_Data_Collection_National.pdf
- Example of the law in the Netherlands: obligation to upload any new soil information to the soil information system – *the National Key Registry of the Subsurface Act*: https://basisregistratieondergrond.nl/english/legislation/

Assessment of existing efforts. Several parallel and related initiatives are developing soil information products and services in Zambia. These include – but are not limited to:

- **iSDA's "Farmer Know Your Soil"** initiative, focusing on soil awareness among farmers.
- **Total Land Care**, which addresses soil erosion and fertility issues.
- **One Acre Fund**, which supports smallholder farmers.
- **IFDC and Space2Place**, organizations involved in soil data and management.

Recommendation:
- Continue to collaborate with pre-existing efforts and encourage a culture of responsible data sharing.

Optional Tool:
- Draw upon ZamSIS Data Ecosystem Map, to identify opportunities for data sharing and collaboration.

Assessment of data & resources availability and accessibility. Several parallel and related initiatives could hold relevant data and information for the SIS.

Recommendation:
- Continue building the inventory of existing and legacy data.
- Assess whether and how the existing data and information might be already leveraged to address needs of data users and other stakeholders.

Optional Tool:
How to create a data inventory

Supporting Resources:
- Review the checklist of domains with soil information as part of the Guide for an assessment of the SIS enabling environment.
- Examples of available legacy data:
  - Soils of Zambia
  - Soil reference profiles of Zambia

Assessment of digital and computing infrastructure. Several existing tools and systems could support ZamSIS:

- SMART Zambia's tools and CGIAR's Global Soil Data Manager app are examples.
- The Land Information System could be leveraged.
- The website and emails of ZARI are hosted by SMART Zambia.

Mapping the Data Ecosystem. The data ecosystem for ZamSIS is detailed in an interactive map available at ZamSIS Data Ecosystem Map, with supporting information available on slides 99-101 in Annex IV.

Recommendation:
Review data ecosystem map to understand connections between stakeholders and the system, specifically:

- Identify any gaps in data sharing, underutilized digital tools, or missing connections between stakeholders.
- Highlight opportunities for enhancing digital collaboration, data interoperability, and the adoption of digital solutions.
- Formulate strategies to address identified gaps, leverage opportunities, and improve the overall digital ecosystem.
- Outline steps, responsible parties, and timelines for executing the strategies.

1.6. Component 3: Conduct Needs Assessment

A comprehensive assessment of the needs of all stakeholder groups is critical to knowing how to approach the design and implementation of the SIS. This allows the SIS to be fit-for-purpose by giving SIS developers a clear understanding of what stakeholders—including users, data producers, and beneficiaries—need from the SIS to be able to support their activities and objectives. The workshop did not conduct a detailed user needs assessment[3], but provides a brief overview of the needs of users, producers, and beneficiaries.

2.3.1. Information and perspectives gathered from SIS stakeholders

Main User Groups and Beneficiaries of the SIS. The Soil Information System (SIS) is designed to serve a diverse range of user groups and beneficiaries. According to stakeholders, the primary users include:

- **Government Entities**: Various ministries will utilize the SIS for policy-making and environmental management.
- **Policymakers**: They will leverage the data for informed decision-making.
- **Environmental Managers**: For monitoring and managing soil health and environmental impacts.
- **Private Sector**: Companies involved in agriculture, fertilizers, and related industries.
- **Learning Institutions and Researchers**: Universities and research bodies will use the SIS for academic purposes and advancing soil science.

The main beneficiaries of the SIS are:

- **Farmers and Farmer Groups**: Who will directly use the soil information to improve their agricultural practices.
- **Farmer Associations**: Which will disseminate information and best practices to their members.

Recommendation:
• Identify and specify stakeholders involved.
Supporting Resources:
• Review the Landscape of key stakeholders for the development of SISs.

[3] A user needs assessment is a process through which user needs are identified for a SIS. It can help to understand the current situation and to identify gaps. It is a tool for making decisions about how to serve the potential users of an information system (Watkins et al., 2012). It is also important to take into consideration the needs of both beneficiaries and producers of soil information when building the SIS. We suggest adapting the user needs assessment guide to assessing the needs of beneficiaries and producers too, for an in-depth understanding of all those who will interact with the system and its outputs.

- Review the data ecosystem map and build on the stakeholders identified there.

Main Use Cases. The SIS will support a variety of use cases essential for soil and agricultural management, including:

- **Soil Fertility Management**: Providing insights into soil health to optimize crop yields.
- **Fertilizer Application Recommendations**: Tailoring fertilizer use to specific soil needs.
- **Fertilizer Blending**: Creating custom fertilizer blends based on soil data.
- **Farmer Decision-Making**: Offering data-driven guidance to farmers for better crop management.
- **Crop Suitability Mapping**: Identifying the best crops for different soil types.
- **Training and Research**: Enhancing educational programs in universities and colleges.
- **Spatial Land Use Planning**: Help in planning and allocation of land resources.
- **Informing Policy**: Providing data to support agricultural and environmental policies.
- **Monitoring Environmental Pollution**: Tracking and mitigating soil and environmental contaminants.

Stakeholder Needs:

Data users and beneficiaries of the SIS have specific needs to ensure the system is effective and useful:

- **Accessibility**: The system must be accessible to various user categories with diverse levels of expertise.
- **Data Formats**: Providing data in formats suitable for different users, from policymakers to farmers.
- **Up-to-Date Data and Technologies**: Ensuring the latest soil data and technological tools are available.
- **Open Contributions**: The system should allow for contributions from new data sources and stakeholders.
- **Data Compilation**: Bringing together currently scattered data into a centralized, organized system.
- **Capacity Building**: Training in the following areas is necessary:
    - **Analysis and Interpretation**: Converting soil data into actionable advice and recommendations.
    - **Service Provider Standards**: Ensuring soil testing and other services meet high standards.
    - **Digital Literacy**: Improving the digital skills of smallholder farmers.

- **Institutionalizing Data Sharing**: Creating frameworks for consistent and standardized data sharing.

Data producers and contributors also have specific needs and face challenges that need to be addressed:

- **Capacity Building**: Training is required in areas such as:
  - **Soil Erosion Mapping**: Enhancing skills to accurately map and manage soil erosion.
  - **Data Integration**: Combining soil data with data from other domains for comprehensive analysis.

Challenges:

- **Scattered Data**: Much of the existing data is dispersed and stored on personal computers, making it difficult to compile and standardize.
- **Georeferencing**: Legacy data often lacks georeferencing, which is crucial for spatial analysis.
- **Data Sharing Policy**: A need for a formal policy to facilitate and regulate data sharing among stakeholders.

Recommendations: • Conduct further assessment of the needs of producers and beneficiaries, through interviews, meetings, and/or workshops on how they will interact with the system and data. • **Assess technical expertise and capacities** of each stakeholder group to identify gaps and training needs.
Supporting Resources: • Review the checklist of domains with soil information as part of the Guide for an assessment of the SIS enabling environment. • Refer to chapter 2 of *Development options for a Soil Information Workflow and System* for guidance on conducting needs assessment. • Refer to Annex I in *Development options for a Soil Information Workflow and System* for guidance on assessing technical capacities.

1.7. Component 4: Idealised System Design

This activity describes the idealised system, as if there were no constraints, either financial or other. The information in component four can be used to develop the architectural design of the system in the Planning & Design phase. The architectural design should be technologically feasible and realistic within the current regulatory and institutional environment, be capable of being improved over time and linked to the users, data producers, and their needs.

2.4.1. Information and perspectives gathered from SIS stakeholders

Content of ZamSIS. Stakeholders emphasize that ZamSIS should contain:

- comprehensive soil data, including both raw and processed forms;
- feature spatial data at a higher resolution than what is currently available;
- integrate soil data from other domains such as land and crop information;
- spatial data should be bounded at agricultural extension camps;
- provide attributed data and maps for agroecological zones;
- lab analysis results;
- interpreted information beneficial for farmers and other stakeholders.

Recommendations: • Develop a document outlining the ideal outcomes for each aspect of the SIS. The components of the ISRIC Soil Information Workflow can be used as a guideline. • Create interactive maps to visualise spatial information effectively.
Supporting Resources: • ISRIC's Soil Information Workflow • The Land, Soil, Crop information hub Kenya uses Terria.JS to visualise spatial information: https://kenya.lsc-hubs.org/#maps

SIS functionalities. ZamSIS should offer several key functionalities to enhance user experience and utility:

- **Community Model**: A forum that brings together users and data providers, fostering collaboration and knowledge sharing.
- **Decision Support Tools**: Tools to aid decision-making for various stakeholders, from policymakers to farmers.
- **USSD Interactivity**: Integration with SMART Zambia to allow farmers to access information via Unstructured Supplementary Service Data (USSD) codes, making it accessible even without internet.
- **Traffic Monitoring Dashboard**: A dashboard to monitor who is accessing the SIS, providing insights into user engagement and usage patterns.

Log-In Functionality. Introducing a log-in function for ZamSIS is seen as beneficial for several reasons:

- **User Tracking**: Tracking the types of users and their interactions with the system.
- **Usage Metrics**: A hybrid system can help generate usage metrics that translate into value estimations.
- **Access Control**: General information could be freely viewable on the website, with additional, more detailed information accessible after login.
- **Revenue Generation**: This can also help self-sustain the SIS by generating income through subscription-based access to premium content.

Communication Tools. Effective communication tools are crucial for ZamSIS, including:

- **Translation Services**: Translating information into local languages to ensure accessibility for all users.
- **Forums**: A platform for data users and providers to communicate and collaborate.
- **User Feedback Mechanism**: A system for users to provide feedback on the accuracy and usefulness of the recommendations.
- **Audio Information Delivery**: Providing information in audio format for those who may not be able to read the data.
- **Mobile Apps**: Presenting data through mobile apps to demonstrate how soil data can be practically used.
- **Documentation**: Comprehensive documentation about the system and usage guidelines.

Supporting Resource:

- An example of documentation for different users can be found at the LSC information hub of Kenya: https://kenya.lsc-hubs.org/docs/

Data Management. For capturing, managing, and organizing data, ZamSIS should consider:

- **Data Cataloguing and Harmonisation**: Compile scattered data into a unified catalogue.
- **Quality Control and Validation**: Implement quality control, data processing, and validation capabilities to ensure data integrity.
- **Metadata Descriptions**: There is no defined standard or format for metadata, which complicates data integration and usage.
    - Provide a template for descriptions of metadata to facilitate understanding and use.
- **Filtering and Sorting**: Enable data filtering and sorting by jurisdictions (districts, camps, blocks, etc.).

- **Citation Guidance**: Offer guidance on how users should cite data sourced from ZamSIS.

Recommendations:
• Follow guidelines for soil data standardisation and harmonisation. • Develop a metadata template to standardize the information collection for ZamSIS.
Supporting Resources:
• Soil Assimilation guidance for soil data standardisation and harmonisation • Metadata explanation Example metadata template from the LSC hub project, which is available in an online ODK form.

Data Security. To ensure data security, workshop stakeholders propose that ZamSIS should examine:

- **Client Permissions**: Obtain permission from data owners before using and sharing their data.
- **Metadata Hosting**: Host metadata on ZamSIS and facilitate direct access requests to the original data owners.
- **User Tracking**: Implement log-in access to track which users are accessing what data.

Catalogue and Repository System. Currently, there is no preferred catalogue or repository system decided for ZamSIS.

Recommendations:
• For the architectural design, especially related to the catalogue and repository system, review the systems used and designed by SMART Zambia.
Supporting Resources:
• The report "*Development options for a Soil Information workflow and System"*

Feedback Incorporation. The workshop suggested how to incorporate feedback in the SIS through:

- **Testimonies and Case Studies**: Collect and include user testimonies and case studies in the SIS.
- **Feedback system in the SIS**: Establish a robust feedback mechanism to gather and incorporate user feedback.
- **Ministry of Agriculture Events**: Utilize events organized by the Ministry of Agriculture to gather stakeholder feedback and input.

Supporting Resources:
• The Land, Soil, Crop information hub Kenya uses GIT for user feedback collection: https://kenya.lsc-hubs.org/#hub-community

Updating the SIS: the information in the SIS should be kept to up to date ensure continuation of usage.

Recommendations:

- Incorporate a soil monitoring program to ensure that soil information remains current and accurate.

1.8. Component 5: Partnership Development and High-level Sustainable Business Plan

A SIS is, besides a technological output, also a process by which people and institutions must collaborate, explore, iteratively refine, and implement plans for data development, all while balancing multiple evolving sets of needs, setbacks, resources, and priorities. Understanding how these people and institutions should work together, and aligning on who is responsible for what, is a critical step to ensuring the progress of the SIS. Additionally, this component provides initial thinking on the financial sustainability of the SIS. During the workshop, initial information and perspectives from key stakeholders were gathered on this topic which are detailed below.

2.5.1. Information and perspectives gathered from SIS stakeholders

Partnership Clarification and Formalization: To streamline efforts and prevent duplication, identifying various roles within ZamSIS, clarifying responsibilities, and determining optimal partnership models for each role will enhance efficiency and effectiveness. For example, there is need to clarify the relationships and activities between Smart Zambia Institute and ZamSIS, as well as the process of engagement with ZamStats, to ensure seamless collaboration. Additionally, active engagement of the Ministry of Agriculture is critical, going beyond mere information dissemination to ensure their active involvement and engagement in ZamSIS activities.

Addressing Current Challenges for a Better Future: Collecting soil samples and empowering farmers with data can enhance productivity and income, leading to improved livelihoods. Key indicators of success include increased user accessibility, higher data uploads, and improved capacity among stakeholders. Ensuring that laboratories are equipped with both personnel and resources will facilitate data collection and analysis, strengthening ZamSIS's capacity to fulfil its mission effectively.

Recommendations:

- Develop a Memorandum of Understanding among partners to formalize relationships and activities, providing a clear framework for cooperation.
- Co-develop a Theory of Change[4] with partners, building on "*addressing current challenges for a better future*," to align on the short-, medium- and long-term visions.
- Clarify roles and responsibilities between SMART Zambia, ZARI and UNZA for hosting ZamSIS.

[4] A theory of change aims to provide a strategic plan that details what change the stakeholders want to see and how their specific intervention will make that change happen.

- Document a partnership strategy, which includes ensuring all partners have full log-in and edit rights when hosting with SMART Zambia.

Supporting resources:

- Theory of Change guidance
- Review the Landscape of key stakeholders for the development of SISs

Brainstorming a Sustainable Business Plan

Exploring financing options beyond the project's duration is crucial for the sustainability of ZamSIS. Understanding which stakeholders are willing and able to pay for data is essential to map out potential revenue streams and ensure the financial viability of the system in the long run. This assessment will guide the development of a business model that accommodates the different motivations and needs of various stakeholders, including private sector entities, public sector agencies, and NGOs. The workshop participants brainstormed the following potential paying users:

- University – could embed payment model into student fees;
- Regional bodies—AU, SADC, UNCCD;
- Some smallholder farmers;
- Private sector.

Seeking investment from United Nations Convention to Combat Desertification (UNCCD) and related organizations, as well as regular clients requiring consultancy services, could provide sustainable funding sources. A diversified financing approach will help mitigate financial risks and ensure the continued operation of ZamSIS beyond the initial project phase.

It was also discussed that one strategy to address *un*willingness to pay is bundling ZamSIS services with other products or services. For example, collaborating with fertilizer or seed companies to include soil information in the price of their products could incentivize users to access ZamSIS without additional charges. Donor funding or regulatory mechanisms could be explored to cover the cost of bundled services more efficiently than individual payments. Additionally, offering access to finance as part of the bundled services can further incentivize users to pay for soil information, potentially offsetting costs through a slight increase in transaction fees.

Regular updates are critical to maintaining the relevance and accuracy of ZamSIS data. A sustainable financing mechanism, such as a payment model, could facilitate data updates, ensuring that dynamic soil parameters are regularly monitored and measured. ZARI, with its expertise in soil data management, should oversee the implementation of new data quality assurance procedures and ensure adherence to established standards.

Recommendations:

- Co-develop a clear and feasible high-level sustainable business plan that takes into consideration the cost structure of the SIS (e.g., personnel, data management and infrastructure costs)
- Discuss further the ideas raised in the workshop for revenue-generating initiatives, such as:
    - Subscription-based services: Offer exclusive reports, resources, tools, technical analysis, and access to new surveys. Engage government partners on policy and the development of legislation and regulation.
    - Private sector services: Provide innovative solutions, technical guidance on soils and links to policy and regulatory authorities to enhance their competitiveness and meet regulatory obligations.

Supporting Resources:

- Example public goods that generate revenue through governmental and private sector collaboration can be found in the seed certification sector, such as: TOSCI in Tanzania (https://www.tosci.go.tz) that is a more government-led approach; and SANSOR (https://www.sansor.org/) in South Africa that is more led by the private sector.
- Review the Guide to support SIS financial sustainability planning

Brainstorming Marketing Strategies: Implementing targeted marketing strategies, such as including a tagline on relevant websites and promoting ZamSIS at Ministry of Agriculture events, can attract new users and raise awareness about the platform. Leveraging existing networks and partnerships will enhance the reach and effectiveness of marketing efforts, driving user adoption and engagement.

Extensive outreach efforts are necessary to inform beneficiaries, including farmers, fertilizer companies, and teaching institutions, about ZamSIS and its benefits. Utilizing various communication channels such as radio programs, social media platforms, and physical engagements will help reach diverse audiences effectively. It is assumed that ZARI, as the lead organization,

Recommendations:

- Develop a communications and engagement strategy that clarifies who will be responsible for coordinating outreach activities and ensuring widespread awareness of ZamSIS.

Anticipating Changes and Challenges: Foreseeing potential changes in government, high personnel turnover, and evolving technology standards are essential for effectively managing ZamSIS. Continuous staff training, standardized recruitment processes, and keeping up with technological advancements will enable ZamSIS to adapt and thrive in a dynamic environment. Additionally, regular reviews of technological advancements and updates to industry standards will ensure that ZamSIS remains at the forefront of soil information management.

Conclusion

The goal of ZamSIS is to support establishment of a sustainable soil-crop system to empower the government to support its farmers. By offering a comprehensive platform that integrates high-resolution spatial data, decision support tools, and user-friendly interfaces, ZamSIS aims to meet the diverse needs of stakeholders across the agricultural sector. The roadmap for implementing ZamSIS has been carefully crafted based on the insights gathered throughout the workshop and preceding stakeholder consultations, using the framework to support a strengthening of SIS design.

A foundational step in design involves first refining the mission and problem statements to ensure clarity and shared understanding among all stakeholders. This serves as the cornerstone for subsequent activities as it supports understanding of how users, producers and beneficiaries will interact with the SIS, promotes data sharing throughout, and supports design of the architecture of the SIS with project partners.

A significant recommendation from this roadmap is to develop a sustainable business plan, the creation of which involves identifying stakeholders willing to pay for data and services and creating innovative payment models, such as bundling soil information services with products such as fertilizers or seeds, and exploring funding from international bodies and government.

The suggested recommendations provided here give some advice for next steps in the development for a sustainable ZamSIS, with the note that responsibility to decide which recommendations to follow lies firmly with the ZamSIS partnership. They will be best placed to understand which ones to prioritise to ensure that the SIS best matches stakeholders need in ways that the SIS can be sustained over the longer term.

Annexes