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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CABI

ISRIC World Soil Information

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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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The CABI and ISRIC team would like to thank all workshop participants for their contributions that have led to the development of this roadmap. Specifically, we would like to thank FAO, ZARI and UNZA for their support in organizing the workshop, as well as the Masaryk University SLIM project for their willingness to share their findings for the benefit of ZamSIS. With special thanks also to the Bill & Melinda Gates Foundation for their support of the SIS Review project and funding the workshop.

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/.

Contents

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 **CABI** 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

2.1. 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.

2.2. 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.

2.3. 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.

2.3.1 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.

Recommendation:

- 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:

- 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.

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.

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.

2.4. 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.

2.4.1 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.

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.

Supporting Resources:

- Review the **Landscape of key stakeholders for the development of SISs**.
- 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.

2.5. 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.

2.5.1 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.

2.6. 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.

2.6.1 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 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.
- 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 unwillingness 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.

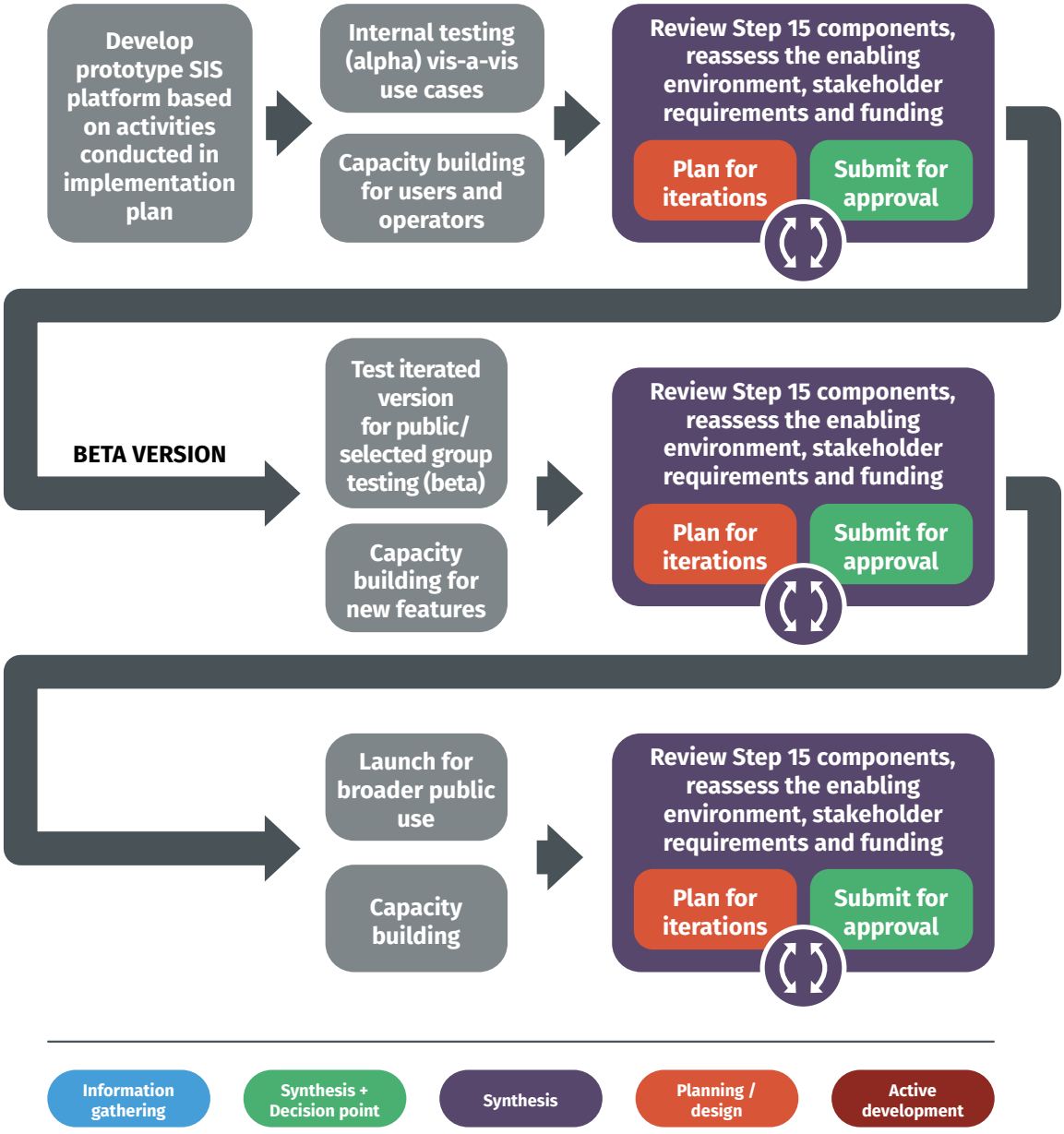
Annexes

Annex I: The framework for strengthening SIS design

2 Planning & Design

Information gathering | Synthesis + Decision point | Synthesis | Planning / design | Active development

3 Implementation



Annex 2: Semi-structured interview questions

Interviewer	
Date	
Attendees	
Duration	

Stakeholder Profile – to be prefilled before the interview:	
Organisation	
Address	
Website	
Contact person	
Position	
Email	
Mobile	

TOPIC		QUESTION
General questions	1	Can you describe the potential role(s) you or your institution envision playing in the development of a soil information system in Kenya, should one be established?
	2	How frequently do you / your organization currently utilize soil data in your work or research?
	3	Can you describe the significance of soil data to your current or future work/research efforts? Specifically, how does soil data contribute to the objectives and outcomes of your projects or initiatives?
	4	Can you share with me the specific data sources your organization currently utilizes to access soil data for its work or research? This may include databases, websites, publications, or other sources you frequently refer to.

Questions for soil data users and practitioners (extension officers, farmer orgs, private sector, NGOs)	1	Can you describe the primary purpose or application for which you primarily utilize soil data in your work or research?
	2	What specific aspects of soils do you typically need to know about or utilize data for in your work or research? Could you provide examples of these aspects?
	3	When it comes to derived information products based on soil data, which ones do you find essential for your work or research? Can you provide examples or specify any additional products you may require?
	4	What specific challenges do you encounter with accessing and using soil data for your work or research? Could you elaborate on any challenges that you find particularly significant?
	5	Looking ahead, what specific benefits do you anticipate experiencing in your work or research through the establishment of a Kenya Soil Information System? Can you highlight the top two benefits that are most important to you, or mention any others that you consider significant?
	6	How would you describe your capability with accessing and utilizing soil data across key aspects such as data retrieval and access, interpretation and analysis, integration with other datasets, and application in decision-making? Could you provide examples or describe your experiences in these areas?

Questions for government, ministry officials	1	"Can you discuss whether you or your department have utilized soil data in your policymaking or other activities? If yes, could you specify the purposes or applications for which soil data has been used? If not, could you please elaborate on why soil data has not been utilized?"
	2	Which types of soil data do you typically utilize in your work?
	3	In what ways have you utilized soil data in your work? Could you provide a specific example or instance where soil data has informed decision-making, policy formulation, or implementation processes within your department or ministry?
	4	What are the potential applications of soil data in your work?
	5	From your perspective, what do you consider to be the greatest obstacles to using soil data in your work currently?
	6	Which other government stakeholders do you believe should be engaged in conversations about developing a new Soil Information System (SIS) for Kenya? Can you list the names of any institutions or individuals whom you consider to be key stakeholders from the government perspective?

Questions for data producers	1	"What is the specific soil data-related role of your institution? If multiple options apply, kindly select the option that best describes your *primary* or most important role. A) Producing soil data through field surveys or laboratory analysis B) Conducting analyses and mapping of soil properties, characteristics, or classifications C) Providing data infrastructure or technical support for soil data management and dissemination D) Serving soil data and derived information to end-users through online platforms or other channels"
	2	Can you discuss some of the key challenges that your institution encounters in this role?
	3	Which specific technical aspects of fulfilling this role within your institution may require further capacity building? Which aspects do you believe are already sufficiently developed?
	4	What specific opportunities do you identify for improving process or practices around soil data in your institution? Could you highlight one opportunity that you believe is particularly important, or mention any other opportunities you see?
	5	When it comes to prioritizing capacity-building efforts in your institution regarding soil data, what would be your top two priorities for capacity-building?
Questions for data governance and enabling environment	1	"Can you discuss whether you or your department have utilized soil data in your policymaking or other activities? If yes, could you specify the purposes or applications for which soil data has been used? If not, could you please elaborate on why soil data has not been utilized?"
	2	Which types of soil data do you typically utilize in your work?
	3	In what ways have you utilized soil data in your work? Could you provide a specific example or instance where soil data has informed decision-making, policy formulation, or implementation processes within your department or ministry?
	4	What are the potential applications of soil data in your work?
	5	From your perspective, what do you consider to be the greatest obstacles to using soil data in your work currently?
	6	What are key policy considerations in Zambia around soil data, data sharing, and data governance?
	7	Which other government stakeholders do you believe should be engaged in conversations about developing a new Soil Information System (SIS) for Kenya? Can you list the names of any institutions or individuals whom you consider to be key stakeholders from the government perspective?

Questions for SIS funding partners	1	What factors would influence your decision to invest in the establishment of a national soil information system in Kenya? Can you elaborate on any specific considerations that you find particularly important?
	2	Looking ahead, what potential challenges or concerns do you anticipate in supporting the establishment of a national soil information system in Kenya? Could you provide insight into any specific challenges that you perceive as most significant?
	3	If you were to invest in a national soil information system in Kenya, what specific outcomes or impacts would you expect to see? How do you envision this investment contributing to broader goals or initiatives?
	4	From your perspective, how important is it to foster collaboration and partnership among multiple organizations, national governments, and other stakeholders in the development and implementation of the national soil information system?
	5	Additionally, how important is it for you to see collaboration among multiple funders or donors in supporting the establishment of the soil information system? Can you elaborate on the significance of collaborative efforts in achieving shared goals?
	6	Are there any specific criteria or conditions that would guide your decision to provide funding or support for the establishment of a national soil information system in Kenya? If so, could you describe these criteria in more detail?
Questions for potential SIS Owner	1	Can you discuss the factors that your institution considers most important when considering assuming the role of hosting or owning a national soil information system in Kenya?
	2	What potential challenges or concerns do you anticipate your institution facing in this role?
	3	How do you envision the integration of a national soil information system with your institution's current programs, initiatives, and strategic priorities?
	4	What are the key benefits or opportunities that your institution foresees from taking on the responsibility for the soil information system?
	5	What is the importance of support and collaboration from external partners and stakeholders for your institution in the development and operation of the soil information system?
Recommendations	1	Which organisations would you recommend us to interview?
	2	Suggestions for CABI for delivering a roadmap to co-develop a National Soil Information System
Level of Engagement	1	Potential interest in engaging in next steps

Annex III: Online survey results

Zambia SIS workshop survey: data producers

Q1. What role(s) would you or your institution play in the development of a soil information system in Zambia, if one were to be established?		
Answer Choices		Responses
Leading the initiative for developing and implementing the soil information system.	0.00%	0
Offering expertise, contributing data, and/or building technical capacity for the establishment or maintenance of the soil information system.	0.00%	0
Providing financial support or resources to facilitate the development of the soil information system.	0.00%	0
Planning to utilize the soil information system for research, agricultural advisory, or applied decision-making purposes.	100.00%	1
Planning to utilize the soil information system for policy design and other governance processes	0.00%	0
Other (please specify)	0.00%	0
	Answered	1
	Skipped	0

Q2. How frequently do you / your organization currently utilize soil data in your work or research?		
Answer Choices		Responses
Rarely or never	0.00%	0
Occasionally	100.00%	1
Monthly	0.00%	0
Daily	0.00%	0
	Answered	1
	Skipped	0

Q3. How important is soil data to your current or future work or research?

	Not important at all		Somewhat important		Moderately important		Very important		Extremely important		Total	Weighted Average
1	0%	0	0%	0	0%	0	100%	1	0%	0	1	4
											Answered	1
											Skipped	0

Q4. Which data sources do you currently use to access soil data for your work or research? Please list names or titles of databases, websites, publications, or other sources.			
Answered	1		
Skipped	0		
Respondent ID	Response Date	Responses	Tags
118575368538	Apr 06 2024 10:03 AM	"FAO SOIL PORTAL (https://www.fao.org/soils-portal/data-hub/soil-maps-and-databases/faounesco-soil-map-of-the-world/en/) European soil data centre (https://esdac.jrc.ec.europa.eu/content/soils-map-republic-zambia-republic-zambia-atlas-sheet-no-12) Rural agricultural livelihood soil sample data collected by IAPRI and ZARI in 2021 "	

Q5. What is the specific soil data-related role of your institution? If multiple options apply, kindly select the option that best describes your *primary* or most important role.		
Answer Choices		Responses
Producing soil data through field surveys or laboratory analysis	0.00%	0
Conducting analyses and mapping of soil properties, characteristics, or classifications	0.00%	0
Providing data infrastructure or technical support for soil data management and dissemination	0.00%	0
Serving soil data and derived information to end-users through online platforms or other channels	100.00%	1
	Answered	1
	Skipped	0

Q6. What are the key challenges your institution faces in soil data collection and laboratory analysis? Please select the top two most important or significant challenges.		
Answer Choices		Responses
Limited funding or resources for equipment and staff training	0.00%	0
Capacity and knowledge constraints in conducting soil sampling and laboratory testing	0.00%	0
Challenges in maintaining data quality and consistency	0.00%	0
Difficulty in accessing representative soil samples from diverse geographical areas	0.00%	0
Integration of emerging technologies into soil analysis processes	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q7. How important do you consider capacity-building initiatives in enhancing the technical aspects of soil data collection and laboratory analysis in your institution?		
Answer Choices		Responses
Extremely important	0.00%	0
Very important	0.00%	0
Somewhat important	0.00%	0
Not so important	0.00%	0
Not at all important	0.00%	0
	Answered	0
	Skipped	1

Q8. What specific opportunities do you see for improving soil data collection and laboratory analysis practices in your institution? Kindly select the two opportunities that are most important to you, or specify another.		
Answer Choices		Responses
Enhancing collaboration with research institutions and government agencies	0.00%	0
Accessing funding opportunities for equipment upgrades and staff training	0.00%	0
Implementing quality assurance and quality control measures in soil analysis procedures	0.00%	0
Adopting innovative technologies for soil sample collection, analysis, and data management	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q9. How would you prioritize capacity-building efforts in your institution regarding soil data collection and laboratory analysis? Please indicate your top two priorities for capacity-building.		
Answer Choices		Responses
Training staff on standard soil sampling techniques and laboratory protocols	0.00%	0
Providing advanced training on specialized soil analysis methods and equipment operation	0.00%	0
Establishing quality assurance and quality control procedures for ensuring data accuracy and reliability	0.00%	0
Strengthening collaboration with external partners for knowledge exchange and skill development	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q10. What are the primary challenges your institution faces in soil data organization, modeling, and/or mapping? Please select the top two most important or significant challenges.		
Answer Choices		Responses
Limited funding or resources for software and infrastructure development	0.00%	0
Capacity constraints in soil data management, modeling, and spatial analysis	0.00%	0
Challenges in integrating diverse soil datasets and ensuring data interoperability	0.00%	0
Difficulty in accessing high-resolution spatial data for accurate mapping	0.00%	0
Implementing quality control measures to ensure accuracy and reliability of soil maps and models	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q11. How important do you consider capacity-building initiatives in enhancing the technical aspects of soil data organization, modeling, and/or mapping in your institution?		
Answer Choices		Responses
Extremely important	0.00%	0
Very important	0.00%	0
Somewhat important	0.00%	0
Not so important	0.00%	0
Not at all important	0.00%	0
	Answered	0
	Skipped	1

Q12. What specific opportunities do you see for improving soil data organization, modeling, and/or mapping practices in your institution? Kindly select the two opportunities that are most important to you, or specify another.		
Answer Choices		Responses
Enhancing collaboration with research institutions and government agencies for data sharing and model validation	0.00%	0
Accessing funding opportunities for software development, spatial analysis tools, and staff training	0.00%	0
Implementing standardized protocols and guidelines for soil data organization and modeling	0.00%	0
Incorporating machine learning and remote sensing techniques for improving model accuracy and efficiency	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q13. How would you prioritize capacity-building efforts in your institution regarding soil data organization, modeling, and mapping? Please indicate your top two priority areas for capacity-building.		
Answer Choices		Responses
Training staff on advanced GIS and spatial analysis techniques	0.00%	0
Providing workshops or seminars on soil data management best practices and standards	0.00%	0
Investing in software and tools for soil modeling and mapping	0.00%	0
Establishing partnerships with academic institutions or research centers for collaborative research and skill development	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q14. What are the primary challenges your institution faces in soil data infrastructure, IT, and technical support services? Please select the top two most important or significant challenges.		
Answer Choices		Responses
Limited funding or resources for maintaining and upgrading data infrastructure and IT systems	0.00%	0
Capacity constraints in providing technical support and training for soil data users	0.00%	0
Challenges in ensuring data security, privacy, and integrity	0.00%	0
Difficulty in integrating diverse soil data sources and formats	0.00%	0
Keeping pace with emerging technologies and innovations in soil data management and analysis	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q15. How important do you consider capacity-building initiatives in enhancing the technical aspects of soil data infrastructure, IT, and technical support services in your institution?		
Answer Choices		Responses
Extremely important	0.00%	0
Very important	0.00%	0
Somewhat important	0.00%	0
Not so important	0.00%	0
Not at all important	0.00%	0
	Answered	0
	Skipped	1

Q16. What specific opportunities do you see for improving soil data infrastructure, IT, and technical support services in your institution? Kindly select the two opportunities that are most important to you, or specify another.		
Answer Choices		Responses
Strengthening partnerships with soil data producers, researchers, and government agencies for collaboration and knowledge exchange	0.00%	0
Accessing funding opportunities for data infrastructure upgrades, software licenses, and staff training	0.00%	0
Developing customized IT solutions and tools for soil data management, analysis, and visualization	0.00%	0
Providing user-friendly interfaces and training materials for soil data users	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

Q17. How would you prioritize capacity-building efforts in your institution regarding soil data infrastructure, IT, and technical support services? Please indicate your top two priority areas for capacity-building.		
Answer Choices		Responses
Providing training sessions or workshops on data management best practices, IT security, and software usage	0.00%	0
Investing in staff development programs for enhancing technical skills and expertise	0.00%	0
Upgrading data infrastructure and IT systems to ensure scalability, reliability, and performance	0.00%	0
Establishing a dedicated helpdesk or support team for assisting soil data users with technical queries and issues	0.00%	0
Other (please specify)		0
	Answered	0
	Skipped	1

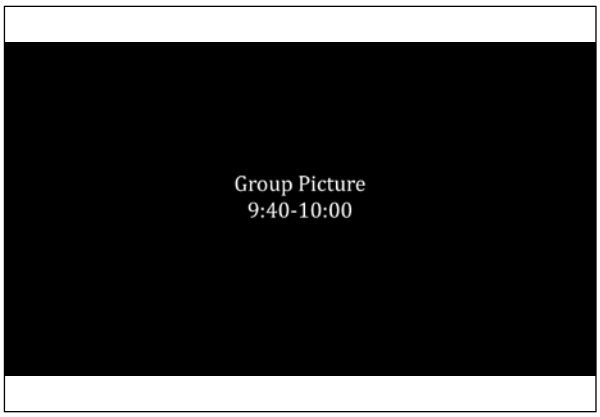
Q18. What are the primary challenges your institution faces in serving soil data and deriving soil information products? Please select the top two most important or significant challenges.		
Answer Choices		Responses
Limited funding or resources for data dissemination and product development	100.00%	1
Capacity constraints in conducting soil data analysis and deriving information products	0.00%	0
Challenges in ensuring the accuracy and reliability of derived soil information products	0.00%	0
Difficulty in meeting diverse user needs and requirements for soil data and products	0.00%	0
Integration of soil data with other environmental or agricultural datasets	100.00%	1
Other (please specify)	0.00%	0
	Answered	1
	Skipped	0

Q19. How important do you consider capacity-building initiatives in enhancing the technical aspects of serving soil data and deriving soil information products in your institution?		
Answer Choices		Responses
Extremely important	100.00%	1
Very important	0.00%	0
Somewhat important	0.00%	0
Not so important	0.00%	0
Not at all important	0.00%	0
	Answered	1
	Skipped	0

Q20. What specific opportunities do you see for improving the services and products provided by your institution in relation to soil data? Kindly select the two opportunities that are most important to you, or specify another.		
Answer Choices		Responses
Enhancing collaboration with soil data producers, researchers, and government agencies for data sharing and product development	100.00%	1
Accessing funding opportunities for software tools, technical expertise, and staff training	0.00%	0
Developing innovative approaches for soil data analysis, visualization, and interpretation	0.00%	0
Providing tailored information products and services to meet the needs of different user groups (e.g., policymakers, researchers, farmers)	100.00%	1
Other (please specify)	0.00%	0
	Answered	1
	Skipped	0

Q21. How would you prioritize capacity-building efforts in your institution regarding serving soil data and deriving soil information products? Please indicate your top two priority areas for capacity-building.		
Answer Choices		Responses
Providing training sessions or workshops on soil data analysis techniques, data visualization tools, and product development methodologies	100.00%	1
Investing in staff development programs for enhancing technical skills and expertise in soil data analysis and product generation	0.00%	0
Upgrading software infrastructure and tools to improve efficiency, accuracy, and usability of soil information products	0.00%	0
Establishing partnerships with external organizations or experts for collaborative research, knowledge exchange, and skill development	100.00%	1
Other (please specify)	0.00%	0
	Answered	1
	Skipped	0

Annex IV: Workshop materials



A Process Toward Strengthening National Soil Information Services (SIS)

SIS Review: A foundation-funded initiative to develop tools and processes for evidence-based SIS design

Why this project

The full value of a SIS is often not achieved.

Why? Technology-focused SIS interventions often are not responsive to:
- Local **users**, their **needs**, and their **use cases** for soil information
- In-country **capacities** and **resources** for sustaining the SIS

There is a need to improve on SIS intervention design. We are:
- **Learning** from past successes, **identifying** barriers, and understanding the enabling environment for SIS
- **Communicating** these lessons effectively with key actors involved in SIS development

Our Goals

Main output

A framework (implementation guidelines) for setting up any new or updating existing SIS in sustainable way

Takes a broader view
Includes financial, policy, technical, user needs

Why CABI and ISRIC?

CABI has worked on several SIS investments in Africa
→ supporting grantees to overcome specific data sharing challenges.

ISRIC has expert knowledge on soil assessment, soil analysis and soil data handling.
→ Supporting building Soil Information Systems in Africa

Joint effort to research all enabling environment factors for setting up a SIS.

Development options for a Soil information workflow and System

Goal

Inventory and assessment of the current soil technology solutions for a soil information workflow and system

The report ***Development options for a Soil Information Workflow and System*** offers support and information for designing a SIS for on:
- **methods**
- **standards**
- **tools available**

–in every step of the soil information workflow

Soil Information Workflow

Examples

New evidence for a SIS Development Framework

Mariah Coley: CABI Associate

National Soil Information History

Beginnings 1930:
- Started using aerial photos for mapping.
- Used aerial photos to spot areas with similar features.
- Kolmogorov (1941) and Krige (1951) pioneered geostatistics and 'kriging' for predicting geologic formations.

Remote Sensing (1970s to present)
- Production of digital elevation models (DEM) began.
- Digital remote sensing products became available
- ***Present***: new technologies like LiDAR are increasingly improving data quality for soil mapping.

Soil mapping techniques introduced (late 1970s - 1990s).
- Introduction of Digital Soil Mapping (DSM) and spatial statistics.
- DSM initially focused on local scale, later expanded.
- Geostatistics emphasized in soil mapping by pioneers like Richard Webster in the USA.
- Soil information systems introduced (1970)

New technologies and datasets (1980s onwards)
- Testing relationships between remotely sensed variables and soil properties
- Integration of DTA and existing maps for enhanced soil property prediction
- Establishment of Geospatial Databases (1984 onward).

1990s to present
- Pedo-transfer and spline functions utilized for soil property interpolation.
- Expert knowledge approach enhances Soil Survey maps via DSM models, yielding improved results.
- Digital mapping models offer finer detail and higher accuracy thanks to enhanced resolution and spatial features of digital base maps.

Interviewed countries

Synthesis insights

1. Understand the **value model for soil data** and how it contributes to stakeholders' decision processes
2. **Benchmark new SIS initiatives on any ongoing related efforts** and on existing and legacy soil data
3. Build **long-term buy-in among national partners** and support a **SIS champion to coordinate** across stakeholders
4. Match the **technological design of the SIS with stakeholder needs** and **capacity building** plans

Archetypes of the enabling environment for SIS development

Q & A

Mariah Coley: CABI Associate

Coffee Break 10:45-11:00

Dr. Lydiah Gatere – CABI

Climate Change and Soil Expert - CABI

Lydiah is a soil scientist with over 15 years experience in management of development programs in Soil Health (food security and poverty alleviation), Climate Resilient Agriculture and Biodiversity Conservation through creating sustainable impact on small-scale agriculture.

A framework for strengthening soil information system design

Mariah Coley- CABI Associate

Framework for SIS planning and design

3 Phases

1 Initiation

2 Planning & Design

3 Implementation

Initiation Phase

Objectives

Prerequisites

Outputs

Checklist

Tools

SIS Development Framework: Initiation Phase

Mariah Coley- CABI Associate

1 Stakeholder mapping & engagement

2 Existing & ongoing efforts assessment

3 Needs & demands assessment

4 Existing & legacy data resources inventory

5 Initial enabling environment assessment

6 Vision & approval

SIS Development Framework: Planning & Design Phase

Lydiah Gatere- CABI

2 Planning & Design

7

8

9

10

11

12

13

14

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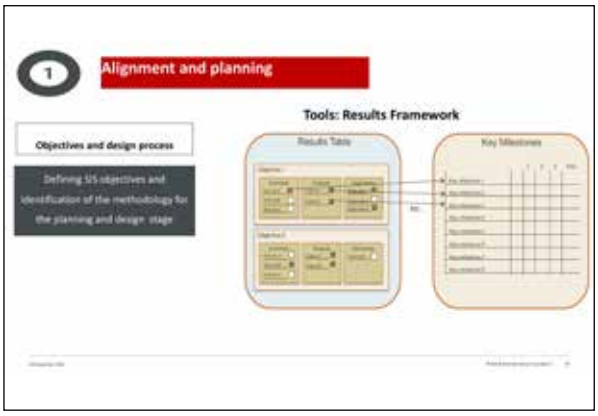
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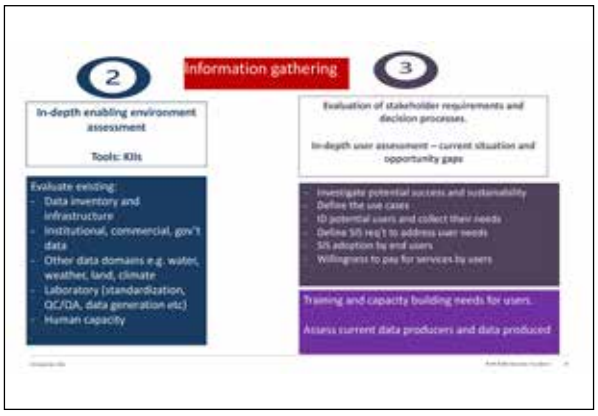
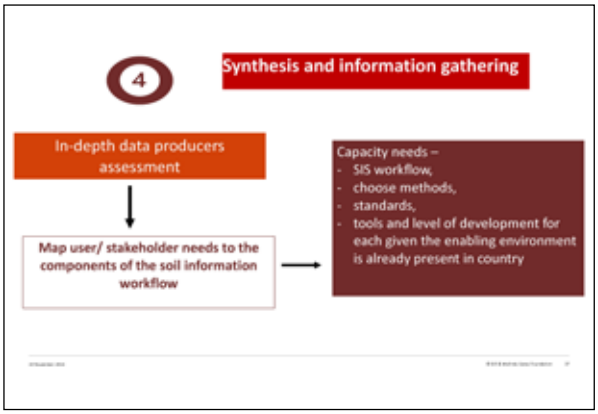
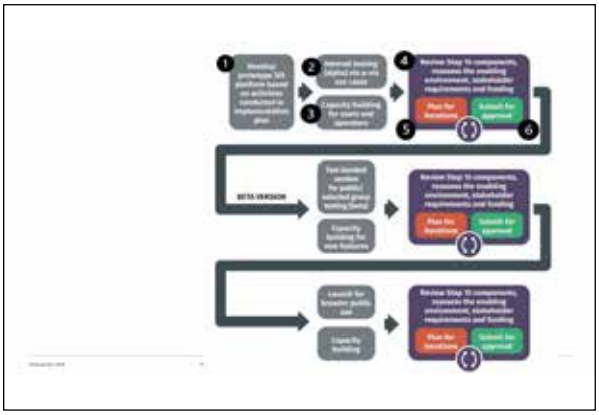
Alignment and planning
Tools: Results Framework
Objectives and design process
Defining SIS objectives and identification of the methodology for the planning and design stage
Results Table
Key Milestones


2
Information gathering
3
In-depth enabling environment assessment
Tools: KIIs
Evaluation of stakeholder requirements and decision processes.
In-depth user assessment – current situation and opportunity gaps
Evaluate existing:
- Data inventory and infrastructure
- Institutional, commercial, gov't data
- Other data domains e.g. water, weather, land, climate
- Laboratory (standardization, QC/QA, data generation etc)
- Human capacity
- Investigate potential success and sustainability
- Define the use cases
- ID potential users and collect their needs
- Define SIS req't to address user needs
- SIS adoption by end users
- Willingness to pay for services by users
Training and capacity building needs for users.
Assess current data producers and data produced

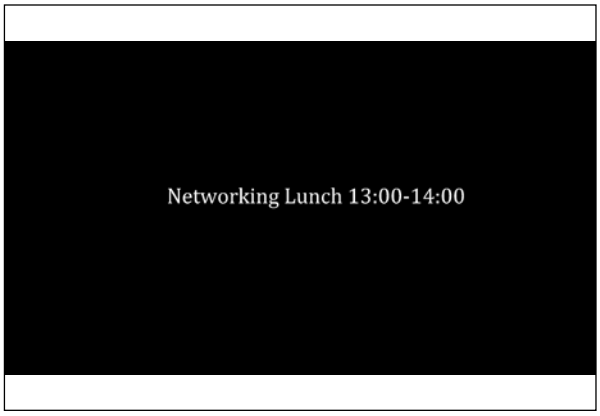

4
Synthesis and information gathering
In-depth data producers assessment
Map user/ stakeholder needs to the components of the soil information workflow
Capacity needs –
- SIS workflow,
- choose methods,
- standards,
- tools and level of development for each given the enabling environment is already present in country


SIS Development Framework:
Implementation Phase
Thaisa van der Woude – ISRIC World Soil Information




Framework availability
Your participation will improve the framework


Feedback and Q&A on the Framework


Networking Lunch 13:00-14:00

Rodgers Kabiti – ZARI

Chief Agricultural Research Officer – Zambia Agriculture Research Institute

He is responsible for coordinating of soil Research in ZARI. He is also the Focal Point for SoilFER in the Ministry of Agriculture. Rodgers holds an MSc in Analytical Chemistry

Stalin Sichinga – ZARI

Principal Agriculture Research Officer - Zambia Agriculture Research Institute in the Ministry of Agriculture

19 years' soil resource management experience in Soil Survey Team. Involved in soils research work covering environmental issues of soil and water pollution, soil survey, land use evaluation and evaluating lands for crops suitability

Dr Sinda Mabvuso – University of Zambia

Lecturer (Department of Soil Science) – University of Zambia

Mr. Sinda has nine years' experience working as a water resources expert. He has worked with the Government of Zambia, under the Ministry of Agriculture and Cooperatives. He worked as Irrigation Engineer (Chongwe District) and Senior Irrigation Engineer Lusaka Province the position he last held before joining the University of Zambia as Lecturer in the Department of soil Science.

Immediate Needs to Future Goals:

The SoilFER proposes a holistic approach that addresses the need for short, medium, and long-term solutions

Short Term

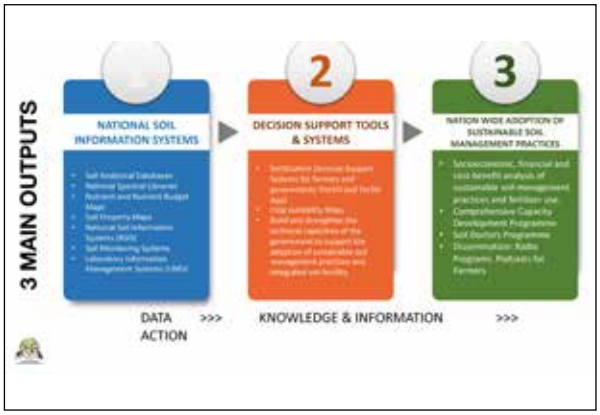
The SoilFER aims to equip farmers and the government with tools and resources for data-driven decision making at national and farm level.

Medium Term

The SoilFER focuses on promoting sustainable management practices to help farmers **maintain and improve soil health and fertility** through Sustainable Soil Management (SSM).

Long Term

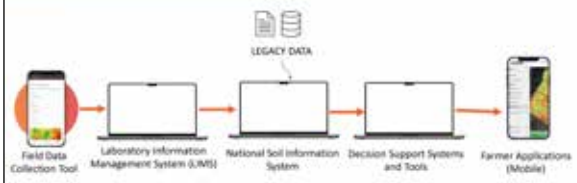
(Beyond the project lifetime) - SoilFER is dedicated to fostering a culture of **ownership and self-reliance** within Zambia, aiming to establish **sustainable soil-crop system to empower the government to support its farmers.**



SoilFER Workflow

Soil Analysis

Seamless Data flow



Government

National High Resolution Digital Soil Maps

- Soil Nutrient, Nutrient Budget Maps (Time Series)
- Soil Property Maps
- Soil Threats
- Crop Suitability Maps

Integrated National Soil Information Systems (NSIS)

- Connected with LIMS
- Monitoring System
- Spectral Services (Libraries and Calibration Services)
- National Level Decision Support Systems (NDSS)

Capacity Development Programme – Government Staff

- Soil Surveys, Sampling
- Soil Data Management
- Digital Soil Mapping
- Soil Organic Carbon Sequestration Modeling
- Trainings on using NSIS & FarMIS Applications

Soil Laboratories

(LIMS) Laboratory Information Management System

- Central Sample and Analysis Management
- Built-in QA/QC, Data Validation Tools
- Connected to the NSIS & Internet
- Stock Management (Chemicals & Supplies)

Modernization of the National Laboratories & Capacity Development

- Trainings (Wet & Dry Chemistry, Safety, Procurement, QA/QC)
- Fully equipped for all soil and fertiliser analysis
- Increased technical & technological capacities
- Spectral Libraries and Calibration services

Farmers

One Tool for all Farming Needs

For instance:

- Fertiliser Recommendations
- Fertiliser Recommendation Maps (Variable Fertiliser Application)
- Realtime Vegetation Index
- Access to Field Data
- Crop Suitability
- Extreme Weather Alerts

Soil Doctors Programme

- Peer-to-Peer Training
- Improve the capacity of farmers on sustainable soil management while supporting national governments and stakeholders in addressing the needs of their rural communities.

Communication and Awareness raising

- Podcasts for Farmers in Local Languages
- Radio Programmes
- Webinars and Seminars
- Trainings (Agro-Dealers)

Advice Services

- Amendment
- Sustainable Soil Management Practices
- Mitigation of Soil Threats

Status of the Implementation

Q3 and Q4 of 2023

- Conducted a Country-Needs assessment and developed a national workplan - Q3 of 2023
- Project was officially endorsed by the Zambian Government in Q3 of 2023
- The SoilFER and Space-to-Place project workplans for Zambia were harmonized in Q4 of 2023
- SoilFER National Workplan validated by Zambian Government - Q4 of 2023
- FAO and IFDC soil projects jointly launched - Q4 of 2023

Status of the Implementation

Q1 of 2024

- ✓ Procurement Plans for Lab Equipment were validated - January of 2024
- ✓ 10 Provincial Permanent Secretaries (PSs) and 10 Provincial Agricultural Coordinators PACOs) were sensitized on the project's objectives, scope, deliverables and expected outcomes - February of 2024
- ✓ Baseline assessment was conducted, in February of 2024
- ✓ A national soil laboratory network was established and officially launched, in February of 2024
- ✓ 8 public soil labs and 1 private soil lab have been officially registered with the newly established national soil labs network, in February of 2024
- ✓ A comprehensive review of existing soil legacy data was done, in February of 2024
- ✓ A comprehensive assessment of the current capacities of the main soil lab at the Ministry of Agriculture (ZARI) and the University of Zambia [Soil Science Lab] was done in February of 2024.

SoilFER

Thank You

Q&A

Breakout Session 1
15:10 - 16:40

Users and Beneficiaries
Room: Chembeshi

Data Producers & Contributors
Room: Nalikwanda

Welcome to breakout session 1

Data producers and contributors' requirements

Action planning sessions – Validation of the requirements for ZamSIS (Part 1)
15:10 - 16:40

Framework steps 9 - 10

Objectives

Working along the Soil Information Workflow components, develop and prioritize a list of key considerations for data producers and providers, to include:

- Data producers' needs from a SIS
- Their key constraints
- Opportunities for the SIS to align with existing resources and efforts

Before we start ...

Tell us:

- Who are you?
- From which organisation?
- What soil data do you produce?

Background info from interviews

Soil Information Workflow

User Consideration

Example responses from our interviews

"For experts in soil management, it is good if you are capable to access the system directly. Sometimes IT people are blind to soil, so they know the IT aspects but do not consider key aspects of the soil."

"Even in collaborative partnerships, attribution is important. If two projects with similar focus and objectives are happening, it's important to sit together and figure out who is doing what."

Data Collection | Laboratory Analysis

Example responses from our interviews

"Chemical analyses are the most challenging because of the requirements to work in the lab." [...] "But if we can capacitate the labs, then this process of soil analysis can be ongoing and continue to add to the database even after the project."

"Combination of old data with new data (if done intelligently) [is an opportunity]; investment in compiling legacy data is small compared with a new data collection effort."

Data Organisation | Modeling & Mapping

Example responses from our interviews

"... have a lot of fragmented data not in central repository, because there's not the capacity for data management, and don't know how to make it easy for it to be accessible by others...has been archived on individual desktop."

"Related to the SIS platform, IT challenges – softwares to use, etc. Software may need training and capacity building."

Applying Soil Information | Data and Info Serving

Example responses from our interviews

"Collecting the data is not always easy, and it is important to ensure that the organisations they collect the data from see the benefit of sharing the data and even processing it further (e.g. digitising existing data)"

"Information archived in hard copy, but this is the first time we are digitizing. What are the key parameters to put on the platform."

Needs, constraints, and opportunities for data producers and contributors

Introduction

We will ask questions to verify your requirements

Per group:

- Assign one presenter
- Assign one note taker
- Please write down your answers **per question** to present

Per group to answer

Nr	Question
1	What soil information products do you miss in your daily work life?
2	Would a Soil Information System be beneficial for you? If yes, how? If no, why not?
3	How would an ideal SIS look like for you if no financial or other constrains?
4	Under which condition would you share your data in the SIS for users?
5	Do you have data sharing policies in place ? If yes, which one? If not, what is missing?
6	Is the private sector involved in the SIS? If yes, how is the relation with data sharing? If not, how could they be involved?
7	How could a SIS best align with on-going efforts on soil data production?

Answers for questions on slide 77:

1.Soil physics & irrigation scheduling, just need to know the depth. And texture of the soil- this information is missing. So beneficial if end up in SIS in format of package for the farmer. When it comes to climate, there's information, but certain aspects of soil have been over shadowed. In Lusaka recurring problem which results in epidemic, due to failure to understand the drainage of this place- is it down to soil type? This type of information is lacking. Soil erosion index map for Zambia, but still needs validation- links to capacity building of how to build an erosion map. Most samples are not geo-referenced. Most legacy data in UNZA, not georeferenced, so difficult to use it. Have to be innovative on how we can support the users to georeference. Wants standardised form for soil collection & registration. This is about small scale farmer who may not even own a smart phone or understand d what coordinates is.

1. Don't need GIS knowledge- can use google earth, ask for landmarks and can zoom into the area. The georeferencing needs to be a part of the advocacy of SoilFER. A lot of people cannot access the soil labs. The use of extension officer can help here. Need for training of Eos also in this area. Staffing is still a challenge and transport for Eos to the areas of need is also a struggle. EO to be middle man from farmer collection needs and lab analysis and sharing data back with the farmer.

2. Purpose of generating data is for people to use it. There's a lot of info the public is not using, but through the SIS the public would be able to access this information.

2.Once information is known, opens up aspect in terms of what decision solutions need to be made.

2. Raw data, but more process data as it can come up with packages to get specific groups or locations.

2. Animal species- grazing, inclined to areas with soils that have enough nutrients- so want to know the soil type and the vegetation. This will then inform interventions.

3. If each ministry had their own information system- then can integrate & link to other place- role of SMART Zambia. But challenge for this is the data is scattered, and even the overview of all the data within one ministry is not feasible.

3. Perspective in ministry can be old school- hard copies. But central government is saying moving in digitalisation path is essential.

3. Already a level of Digital as far see are using phones more, so even better if comes from ministry level.

4. Needs to be restriction for commercial use- at least a contribution, but free for students.

4. Farmers to do minimum fee (depending on which category of farmer they are, e.g. some small scale farmers can afford to pay for the information, whilst others may not)

Answers for questions on slide 77:

4. Expensive to get fertiliser, so trying to see if SIS intervention can make it cheaper

4. Level of details of data, e.g. Want to know ph level ask for small fee

4. If going to pay need to make known what is available before someone pays to access

4. Disclaimers for people who can access and use the data, e.g. to avoid liability and no compensation for e.g. crops not reacting favourably

5. Need subsidiary legislation,

5. Need to write a letter to director to access met data

6. Private lab set up that have dry chemistry (crop nut) but don't know how much data they'd be willing to share

6. Private sector data collection might not be in format that's useful for SIS

6. If put DSA in place with PS, might be willing to share (plus payment)

6. Soil data policy- guidelines for how to collect and report, so compatible with the system. Should be mandated that any soil data generated should be shared and out into the SIS.

6. MoA has to approve any new projects happening on soil that can manage data sharing better and unsure the system benefits from data generation

7.SHF and emerging farmers are the critical issue- more climate smart preservation of biomass, not so much precision ag (mostly done in commercial farms on high value crops)

7. Smart Zambia already has backup, regular daily backup)- storage capacity not an issue but did not provide in depth information?

7. ZAMREN institution using big data, has large capacity (if failure on smart Zambia, then can look at this inst as another option for back up)

Wrap up

Did we meet our objectives?

Objective	What issues or questions remain unresolved?
Working along the Soil Information Workflow components, develop and prioritise a list of key considerations for data producers and providers, to include: • Data producers' needs from a SIS • Their key constraints • Opportunities for the SIS to align with existing resources and efforts	

Welcome to breakout session 1

Users and beneficiaries' requirements

Action planning sessions – Validation of the requirements for ZamSIS (Part 1)
15:10 - 16:40

Framework step 9

Objective

Develop and prioritize a list of key considerations for users and beneficiaries, to include:

- Users' and beneficiaries' needs from a SIS
- Their key constraints
- Opportunities for the SIS to align with existing resources and efforts

Validating user needs, constraints, and requirements
Potential users

Who are the main user groups of soil data in Zambia?	
	Smallholder farmer association: "small holder farms have highest need of this information, but not aware of services available to them or limitations in knowledge about what they need to know about their soils for production purposes."
	Research community – to develop (e.g.) maps, tools (DST). "FDC working with ZARI. SZF working with ZARI &ZRIC for soil mapping with information SIS embedded. SZF aim is to develop DS system/tool."
	Private sector (to some extent). "Zambia has huge commercial farms so there are people generating the data. On the seed-and-provide sector has taken it to a different level, quality and regulations...but this hasn't happened in soil & fertilizer. Private sector have their own labs in Zambia. There's a huge demand."
	Students: "In the university, when it comes to soil science, they have 3-4 areas students can specialize eg soil chemistry/physics/mineralogy/land husbandry/evaluation/irrigation...but soil data stewardship is not a component of this."
	Fertilizer working group: "FDC have Africa fertilizer.org, where they provide info on fertilizer market + also have fertilizer working group with all stakeholders involved in Zambia (funded by BMGF)."
	Government ministries and partners: "colleagues from forestry department, NGOs involved in the lobby for good env management – worldwide fund for environment, other ministries – livestock and fisheries." "supporting smallholder farmer productivity: "For smallholder maize they are getting 2.2 tons/ha but for commercial it's 8-9 tons – so there is a question about what is going on in smallholder fields and how to improve their yields."

Validating user needs, constraints, and requirements
Use cases

For what purposes (use cases) are soil data needed?	
Where are the opportunities for the SIS to serve multiple uses?	
	Precision agriculture - targeting fertilizer recommendations to soil types
	Optimizing fertilizer blending
	Advisory for irrigation planning and scheduling
	Soil acidity management – e.g. lime application
	Soil degradation
	Understanding crop response to fertilizers
	Understanding soil needs combined with farmer socio-economic and management characterisation
	Tailoring advisory to small-scale farmers, emerging farmers, mid- and larger-scale farmers

Validating user needs, constraints, and requirements
User needs

What do users need from a SIS to be able to address the use cases?	
How should users be enabled to interact with the SIS?	
What are users' constraints?	
Scale of data	Currently the spatial scale of soil data poses a challenge to users; the scale is too coarse to be utilized for informing at the scale of farms
Data sharing	Data are generated by various actors, but not well centralised so that a broader user group can access; this is an area of need
Data formats	Data are available in formats that are best for each type of user

Validating user needs, constraints, and requirements
SIS requirements to address the needs

How does a SIS look that would address these needs?	
Data types	Soil pH, soil fertility & nutrients, soil types / classifications, soil erosion & degradation, organic matter, moisture
Ease of access	*Improving efficiency in accessing and utilizing soil data* is one of the top aspirations for the SIS named by respondents to the survey
Data integration	Use of soil data (from various sources) integrated with other environmental or agricultural data sets: clearer guidance and/or improved soil data that can be more easily handled alongside other data • What are opportunities to align with related efforts in soils and environment data ? (e.g. SLIM project)

Wrap Up- Day 1

Zambia Soil Information System Roadmap Development Workshop

17 and 18 of April 2024 | Intercontinental Hotel Lusaka, Zambia

Networking Cocktail 17:00-18:30

CABI ISRIC

Welcome- Day 2

Zambia Soil Information System Roadmap Development Workshop

17 and 18 of April 2024 | Intercontinental Hotel Lusaka, Zambia
Wifi IHG one rewards password: LUNHA

Recap of Day 1 Breakout Sessions

Summary: users and beneficiaries needs, constraints, and opportunities

Summary of the data producers & contributors breakout session

Needs

- Irrigation information; soil depth and texture; drainage
- Capacity building soil erosion mapping
- Capacity building for extension officers
- Combining soil data with data from other disciplines

Constraints

- Soil samples and legacy data often not georeferenced
- Data scattered and held on individual desktops
- No data sharing policy in place

Opportunities

- Create soil data policy on how to collect and report soil samples
- Create a mandate that new soil data should be uploaded to the SIS
- Engage with ZAMREN as potential data storage and back up
- Use the SIS as a model for other information systems in different Ministries

Coffee Break 9:45-10:00

Breakout Session 10:00-12:00

Data Requirements
Room: Curate

System Requirements
Room: Chembeshi

CABI ISRIC

Welcome to breakout session 2

Data ecosystem mapping

Action planning sessions – Validation of the requirements for ZamSIS (Part 1)
10:00 – 12:00

Survey & Interview Responses

"data is fragmented"
"there is a lack of legacy data"
"limited availability of comprehensive soil datasets"
"limited awareness of available soil data sources"
"many of the data sources have not been digitized"
"data...has been archived on individual desktops"
"previous initiatives...are often not great at making the information available"
"the organizations [who] collect the data [need to] see the benefit of sharing data"

Review of needs and requirements

- Accessibility for different categories of users
- Different data formats for the categories of users
- Up-to-date data and technologies
- System is open for further contributions
- Compile data that are currently scattered
- Combining soil data with data from other disciplines
- Irrigation information; soil depth and texture; drainage
- Capacity building soil erosion mapping
- Capacity building for extension officers

Zambia Data Ecosystem

Value	Definition
Data	Data refers to raw facts, figures, or information that is typically in the form of numbers, text, symbols, or multimedia. It is the building block of reasoning, knowledge and information, and can take various forms. Data can represent anything from measurements and observations to descriptions and representations of objects or concepts.
Raw Data	Raw data refers to unprocessed and unorganized information that is collected directly from a source. As the most "basic" form of data, it has yet to undergo any analysis, manipulation or transformation. Additionally, it may contain errors, redundancies or inconsistent information.
Collected Data	Collected data is information gathered or acquired through systematic methods or processes. It can come from various sources, including surveys, sensors, experiments, observations, transactions, or interactions. Data collection is a vital step in obtaining information for analysis, decision-making, and research.
Derived Data	Derived data describes information or results obtained from existing data. In other words, derived data is generated through the transformation, computation, or analysis of raw (or original) data.
Open-Source Code	Open-source code refers to computer program source code that is made freely available to the public. With this model, the source code is released under a license that allows anyone to view, use, modify, and distribute the code.
Insights	By analyzing or synthesizing a combination of the data types described above, a professional (in any specialization) can extract a deeper understanding or perception from these data. This understanding is highly valuable in extracting the most value from data.
Funding	Funding refers to the financial resources or capital that are used to support a project, activity, or initiative. This can include the allocation of money or financial assistance in exchange for the provision of services.
Capacity Development	Capacity development is the process of enhancing abilities, skills and knowledge, as well as providing the necessary resources to meet certain challenges.

Zambia Data Ecosystem:

- Are there any missing stakeholders?
- Are there any missing connections?
- Is the flow of data and value exchange accurate?
- What are the roles of each stakeholder?
- Is it clear who holds (and can therefore share) what data related to the needs?

Welcome to breakout session 2

System requirements

Action planning sessions – Validation of the requirements for ZamSIS (Part 1)
15:10 - 16:40

Knowledge and requirements of the SIS system

Frontend software interface selection

1. What should ZamSIS contain?
   a) *For example: raw soil data, laboratory analysis, metadata of records, soil models, soil maps, use case description and examples, soil standards, ..*
2. Which functionalities should ZamSIS have?
   a) *for example: catalogue, repository, mapviewer, dashboard software, ZamSIS community, ..*

Content ZamSIS	Functionalities ZamSIS
Raw data; processed data; spatial data bounded at agricultural extension camps; interlinkages between raw and processed / interpreted data and other related data sources; attribute data and/or maps for agroecological zones; lab analysis; interpreted information for farmers	interactive map with optional spatial and nonspatial information overlays; ZamSIS community model bringing together users and providers by answering questions; decision support tools. USSD interactivity; traffic monitoring / tracking with a dashboard

Knowledge and requirements of the SIS system
User interaction

1. Should there be a log-in function in ZamSIS for different users? If yes, why? If not, why not?
2. What type of communication tools should be in ZamSIS?

Log in	Community tools
Yes, for some categories of users – to track what types of users and how they are using the system; hybrid system can help generate usage metrics that translate into value estimations; general information on the website that is freely viewable, and additional information after log-in;	Translation of information to 7 local languages; forum for data users and data providers to communicate; user feedback mechanism for the system and information (for example, how accurate were the recommendations?); option for audio delivery of information; presentation of the data through apps Documentation about the system and guidelines on how to use it; additional resources and information

Knowledge and requirements of the SIS system
Data management considerations

1. How should ZamSIS capture, manage and organise data?
2. How can ZamSIS ensure my data is secure?

Data management	Security
Mapping; need to find a way to compile the data that are scattered; user upload of data followed by QC and processing to meet standards; data harmonisation; describe the metadata; cataloguing the data; data filter on district level; User citation of the data; Data validation	Get permission from the client to use and share their data; house metadata on ZamSIS and then facilitate direct request to client for access; Log-in access to the system

Knowledge and requirements of the SIS system
Data security and privacy

1. Is there a guideline on data quality assurance available?
   1. If not, how should the quality of datasets in ZamSIS be guaranteed?
2. Is there a policy available for data privacy?
   1. If not, how should data privacy in ZamSIS be guaranteed?

Data quality	Data privacy
FAO standards, USDA standards Joined GLOSOLAN	May be part of the policy on soil; currently using institutional policies; data privacy act for ZAMSIS to consider; user acceptance of agreement regarding privacy; user creates account and log-in;

Knowledge and requirements of the SIS system
Metadata

1. Is metadata available for your datasets?
   If yes, specify metadata formats: iso19139, iso19115-2, FGDC, DCAT,...
2. Is there a decision on which soil standards should be used?

Metadata available	Standards
Currently there is not a metadata standard or format defined;	FAO standards for soil data (for example, soil type classification); need to identify the relationships between different standards/systems; GLOSOLAN standards for labs;

Knowledge and requirements of the SIS system
Backend system architecture

1. Is there a preferred catalogue system for ZamSIS (metadata publication)?
   for example: GeoNode, GeoNetwork, CKAN, Dataverse, ESRI Geoportal Server,..
2. Is there a preferred repository system for ZamSIS?
   for example: Zenodo, GIThub, Re3Data, GEE,...

Catalogue system	Repository system
Not decided yet – to check with smartZAmbia	Not decide yet. To check with Smart Zambia

Knowledge and requirements of the SIS system
Ongoing efforts

1. What IT or technology-oriented projects are currently ongoing within your organization?

(Improve network access, Improve continuity of power supply, Update hardware infrastructure etc.)

IT projects
Website is sitting with Smart Zambia (SZI) Organisational emails with SZI

Wrap up

10-minute break

ZamSIS Partnership Model
12:10-13:00

Prof Lydia Chabala – University of Zambia

Assistant Dean Research, Associate Professor – University of Zambia

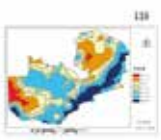
Professor Lydia M. Chabala joined the university as a lecturer in February 2003. Prior to that, she worked briefly as Agricultural Officer/Specialist in the Ministry of Agriculture in land husbandry and agricultural extension. Since joining the UNZA she has been involved in teaching, research, and consultancy and community service. She currently teaches both undergraduate and postgraduate courses in land use, pedology and pedometrics. She is also involved in teaching application of geographical information system in land management as well as agriculture in general.

ZamSIS partnership model

Prof. Lydia M. Chabala
Zambia Soil Information System: Roadmap Development workshop:
17 to 18 April 2024, Lusaka, Zambia

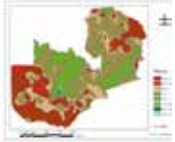
1. Challenges

- Disaggregated legacy soil information
- Ad hoc organization soil information sharing
- Slow pace of generation and updating of soil information



2. Opportunities

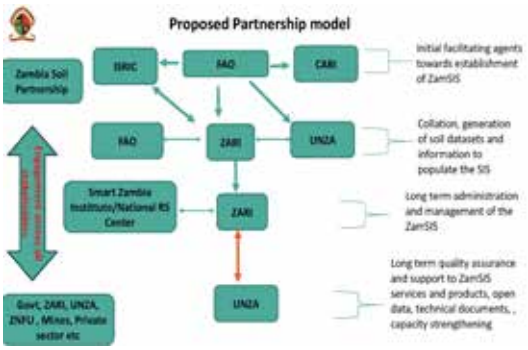
- Systematic digitization and storage of legacy soil information
- One stop portal for all soil information
- Efficient system of updating soil information with all the relevant meta data



Characteristics of partnership model

1. Clear processes and procedures (e.g. data management and information use)
2. Easy and simple access of soil information products by would be end users
3. Integrated capacity and cooperation among partners including map/data integration
4. Sustainability (sense of ownership, institutionalization based on key roles, funding)

Proposed Partnership model



END
THANK YOU

Q&A

Annex V: Defining the problem and intention statement

Drafting your Problem and Intention Statement

Authored by CABI and Data Pop Alliance as part of **Enabling Data Access Project**. Please note this is a draft copy shared with the ZamSIS team- an updated version of this content will be live as part of **Component 1: Envisioning in the Initiation Phase of the SIS Framework**.

Define the Data Problem

Whether your investment is still in the planning stages or already launched, it is important to clearly define the issue or challenge that your data-driven work is designed to solve. Also known as a Problem Statement, this 1-3 sentence description should identify the gap between the current state of affairs (what exists) and the desired state your investment seeks to create (what should be). It focuses on highlighting the specific problem, its context, scope, impact, and why it matters.

Does your investment address problems regarding women being disproportionately excluded from the marketplace? Child nutrition gaps? Climate shocks? Though this work may be complex, try to condense this information into two or three sentences at a maximum in the box below, using the guiding questions as reference:

Problem Statement

What is the problem the investment is trying to solve?

Tell the story about how you got to this problem.

How would the beneficiary describe the problem?

What evidence is there that this is an actual problem?

Case Study: AgriConnect's Problem Statement

Farmers in Dataland lack a centralized, reliable source of information regarding farming input pricing and market rates for crops. Farmers are making decisions based on traditional practices, personal knowledge, and instinct, which can cause them to be left behind by technological advances and state-of-the-art farming techniques. Smallholder's limited access to this information prevents them from producing greater yields and, therefore, threatens the stability of their livelihoods and food security.

Define the Intention Statement

Equally important is the articulation of your investment's **Intention Statement**. Whereas a Problem Statement addresses the underlying motivation for an investment, the Intention Statement describes the desired **outcomes** or **goals** to be achieved by this work.

Is this investment designed to reduce child mortality rates? Improve crop yields? Measure or track an indicator of success? Consider the overarching components of the investment and, in the box below, write your investment's Intention Statement in 2-4 sentences maximum, emphasizing the **vision**, **purpose**, or desired **end-state** without necessarily specifying the existing problem or challenge, using the guiding questions as reference:

Intention Statement

What is the outcome of the investment?

How would the beneficiary describe the outcome?

Does the outcome have a tangible in-country benefit?

How would the beneficiary describe the benefit?

Case Study: AgriConnect's Intention Statement

Users of AgriConnect's digital platform will identify where to acquire the best-value agricultural inputs and financing options, as well as receive educational materials related to crop cultivation and precision farming. The knowledge from this platform will exceed that of traditional practices or farmer instincts by uniting reliable, verifiable data. Farmers will be better able to monitor crop productivity, manage risk, and make more informed decisions to increase yields and, ultimately, livelihoods.

Annex VI: Data Sharing Policy Template

Created by CABI 2023

Please note this document is not legal advice. If you are uncertain, seek guidance from a legal professional.Please contact Martin Parr m.parr@cabi.org if further information is required.

1. Data Sharing Policy Attributes

Version Number	Action / Update	Approved by	Approval date	Effective date	Next review date

2. Definitions

Terms/Acronym	Definition

3. Relevant Policies

Policy	URL/Link	Notes

4. Data Sharing Policy

Executive summary

4.1. Purpose, scope and goals

4.1.1: What is the purpose of the data sharing policy? Why does the data sharing policy exist?

4.1.2: Who and what are within the scope of this policy?

4.1.3 What are the goals and intended outcomes to data sharing and “INSERT PROJECT NAME HERE”?

4.2 Laws and other policies that relate to the sharing of data

4.2.1: Supporting the “INSERT PROJECT NAME HERE” to share data in line with laws and other policies.

4.3 Intellectual property considerations for data sharing

4.3.1: For any third-party data identified in data management plan, are there restrictions on “INSERT PROJECT NAME HERE” sharing the third-party data OR data derived from it?

4.3.2: What is the process for agreeing intellectual property rights to ensure “INSERT PROJECT NAME HERE” can reshare third-party data AND/OR data derived from it?

4.4 Supporting responsible data sharing decisions

4.4.1: Are there any actions that must be ensured in all circumstances of data sharing?

4.4.2: What is a valid data access request when the data in question is not published/publicly accessible?

4.4.3: What are the preferred terms when sharing data that is not already published?

4.4.4: What are the preferred licenses that the “INSERT PROJECT NAME HERE”

will use when publishing data?

4.4.5: Considering commercial reuse of data shared by “INSERT PROJECT NAME HERE”

4.5 Process for data sharing – data publication

4.5.1: For each type of data identified in the data management plan, outline if it is suitable to be published.

4.5.2: For each type of data identified in the data management plan, outline if “INSERT PROJECT NAME HERE” plans to publish it.

4.5.3: For each type of data that is intended to be published, where will it be published?

4.6: Publication - metadata publication and assigning identifiers

4.6.1: For each type of data identified in the data management plan, will the data have metadata published online?

4.6.2: For each type of data identified in the data management plan that will have associated metadata published online, how that metadata will be published?

4.6.3: How will identifiers be assigned to metadata and data that are published by the “INSERT PROJECT NAME HERE”?

4.7 Processes for data sharing – unpublished data (responding to data requests)

4.7.1: How to make a third-party request to access data?

4.7.2: Internal requests to access data.

4.7.3: How do “INSERT PROJECT NAME HERE” stakeholders decide whether to accept or deny a third-party request to access data?

4.7.4: Accepting or denying internal requests for data.

4.7.5: Data sharing agreement considerations.

4.7.6: What will be the technical processes for sharing data resulting from a data access request?

4.7.7: How will data access requests be recorded by the “INSERT PROJECT NAME HERE”?

4.7.8: How will requests for data access be prioritised, should they need to be?

4.7.9: Who will be required to cover costs associated with data sharing via data request?

4.7.10: Spreading awareness of compliance regarding legislation, laws and other policies that relate to sharing of data when acting on a request for data access.

4.7.11: Spreading awareness of compliance regarding intellectual property rights considerations that relate to sharing of data

4.8 Alternative processes to share data

4.8.1: Will access be provided to any data following a process that is not already described in other sections of the data sharing policy?

4.9 Restricted data access and exclusive use

4.9.1: Please outline here any considerations regarding “INSERT PROJECT NAME HERE” stakeholders exclusive use of data during “INSERT PROJECT NAME HERE”.

4.9.2: What are the timescales that access to “INSERT PROJECT NAME HERE” data may be temporarily restricted?

4.10 Compliance and Enforcement

How can the data sharing policy be complied with more effectively?

4.10.2: How will the data sharing policy be enforced?

5. Roles and responsibilities

What roles have you defined, who will take them, and what will their responsibilities be?

Annex VII: Example FAIR Aligning Principles

Authored by CABI

For further information on how to develop FAIR Aligning Principles please contact Martin Parr m.parr@cabi.org

In 2020 there was a data sharing principles workshop conducted by CABI as part of the development of a new national soil information system. The different questions asked to the participants included:

- What needs to be in place so data can be accessed?
- What does Accessible mean to you?
- How do we make data interoperable?
- What are the constraints in reusing the data?
- How do you know what you can do with the data?

Based on the feedback of the participants, the following FAIR aligning Principles were created:

FAIR	Principles
Findable	Datasets should have open and searchable metadata
	If any dataset is considered sensitive data, it will still have a metadata record
	Datasets should have persistent identifiers
Accessible	Datasets should be stored in agreed electronic formats
	Each dataset will have a clear owner
	Datasets should be shared using a standard process
Interoperable	Datasets should be collected to a published open standard
	Metadata should indicate the provenance and lineage of the data
Reusable	Datasets should be shared with a clear license
	Datasets will be published as open data wherever possible
	Metadata will indicate the original purpose the dataset was collected for
Other	A (long term) capability and capacity building programme for (potential) users of datasets needs to be in place
	The SIS should have a user community developed and supported to agree on standards, training and processes etc.

Annex VIII: Enabling environment for the development of a national soil information system in Zambia

Synthesis report: Enabling environment in Zambia for the development of a sustainable soil information system

The ***enabling environment*** for soil information system (SIS) development is the underlying social, political, institutional, and financial context that influences, enables, or inhibits one or more of the stages of SIS development. As part of the ***Process Toward Strengthening National Soil Information Services*** project, CABI and ISRIC developed a set of eight enabling environment components that encompass key success factors and challenges in SIS development.[4] This report utilizes these eight components to describe the enabling environment for SIS development in Zambia. Information in this report is synthesized from work conducted by CABI and ISRIC including desk research, key informant interviews with soil data stakeholders and experts in Zambia, and the two-day ***Zambia Soil Information System: Roadmap Development Workshop*** held in Lusaka in April 2024. These eight components altogether describe the enabling environment, ***circa*** mid-2024, for the successful and sustainable development of the Zambia Soil Information System (ZamSIS).

The institutional environment around soils and soil data

Presence of a SIS or soil data champion, and clarity on who is the institutional host of the SIS

The Zambia Agricultural Research Institute (ZARI) is a Department in the Ministry of Agriculture (MoA) and will serve as the owner of the ZamSIS project and as the SIS champion. ZARI is well-networked with other institutional stakeholders in soil data, including the University of Zambia (UNZA), SMART Zambia, and regional and international actors conducting programs in soils and related domains. These include, among others, the UN FAO, the US State Department, Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA), and the Southern African Development Community (SADC). Because of ZARI's centrality in this network, it is well-positioned to function as a host and champion of ZamSIS who can liaise among many soil data stakeholder institutions.

The inherent motivation or mandate of the SIS champion is a key factor of their commitment to advocate for the SIS through future changes in funding and wider support. ZARI, along with other stakeholders, aim to utilize the enhanced soil data and information that will be available from ZamSIS to improve fertilizer blending and site-specific fertilizer application practices. This is a critical use case for ZamSIS that is anticipated to improve the efficiency of government subsidies for fertilizer, improve the quality of farmer advisory and extension services, and increase farm productivity.

4. Enabling environment components, criteria, and examples are provided in the report New Evidence for a SIS Development Framework.

Institutional partners/supporters of the SIS outside of the host institution

While it is critical to have a strong and committed institutional host of the SIS, for a national SIS to be well-supported and sustained in the long term it is also important to have a wider group of institutions who have an interest or stake in soil data. In Zambia, UNZA, the SMART Zambia Institute, and the Zambia Statistics Agency (ZamStats) are involved in technical and institutional aspects of the development of ZamSIS. For each, the successful development of soil data and information within ZamSIS serves their mandate or mission in some way. The presence of these additional stakeholders of the SIS may help to motivate and support ZARI in sustaining ZamSIS into the future.

Continuity of the SIS/soil data: presence of other / related initiatives in soils or agronomy

The presence of related initiatives and programs in soils and other domains, such as agronomy, environmental conservation, or water management, can serve as a strong indicator of the level of interest within the country in supporting data resources and tools for these areas of development. In Zambia, several related initiatives are active in soils and adjacent domains, including the AgData Hubs project implemented by the International Livestock Research Institute (ILRI) in Zambia and other countries, the USAID and US State Department's Feed the Future Space to Place project, and the FAO Soil Mapping for Resilient Agri-Food Systems (SoilFER) project.

Initial funding for the SIS

The origin of funding for the initial development of the SIS is a key factor in the sustainability of the SIS into the future. Projects that are at least partially funded by the national government have a greater chance of successfully navigating a transition out of donor-provided support and into full government funding. The source of finance for the initial stages of ZamSIS development is funding from the FAO SoilFER project.

The business case for the SIS; current and future financial model and sustainability

Business case for the SIS

It is anticipated that improving soil data will have wide benefits. ZamSIS developers have identified the target users of the system to include government ministries, policymakers, environmental managers, private sector, and higher learning institutions. These users provide products and services to beneficiaries including farmers and farmer associations / groups, who are not necessarily expected to access the SIS directly but who will benefit from the improved access and quality of soil information available to the users listed above.

Financial model

It is recognized that not all stakeholders and potential beneficiaries will be able or willing to pay for data, and the SIS owner and developers are already engaged in designing a business model that will provide user-targeted soil information products and appropriately allocate the cost recovery of the SIS across user groups.

Users and beneficiaries: soil data users, user needs, and primary use cases

Formal user needs assessment and identification of user groups of the SIS

Identification of the primary user groups of the SIS, and an understanding of their needs in terms of the decisions they need to take regarding soil management, is a key factor in the development of a sustainable SIS. While a formalized assessment has not been undertaken to date in Zambia, users

and user needs are at least partially understood. First, ZARI itself will be one of the main users of the SIS. As one of several government entities in Zambia that will utilize data from ZamSIS, ZARI is well-positioned to synthesize user needs across this group of government stakeholders. Second, recent efforts by ZARI and partners have included initial listing and mapping of the target users, and discernment of users from ZamSIS beneficiaries. While users are defined by their direct access of the SIS and its data and information, beneficiaries are those served by users. An example of a beneficiary would be a farmer association, which receives advisory services from MoA, private sector companies, and other users. These efforts to date demonstrate that ZamSIS developers possess at least an initial understanding of the target users of the SIS and are actively engaged with linking this identification of users with decision-making about ZamSIS design and implementation.

Use cases for soil data and the SIS

While a well-curated soil data repository can flexibly serve many current and future uses, decisions about the initial SIS design and implementation should be responsive to the priority use cases that the SIS will serve. ZARI and partners have identified several specific use cases that ZamSIS will target across a range of domains including agricultural production, research and training, policymaking, and land use planning.

Data governance, policies, and licensing

No established policies exist to guide agricultural or soil data sharing, licensing, or governance. There is, however, the Data Protection Act of 2021 which may serve as a foundation for articulating a data privacy policy around the soil data to be included in ZamSIS. Discussions within ZARI and its partners have raised a set of priority issues to be addressed around data governance, including soil data privacy, usage guidelines, quality assurance / quality control, the implementation of ISO standards, and ethical concerns around soil data collection and dissemination.

Technical expertise and capacities for building and maintaining the SIS

Capacities within Zambia for implementing various components of SIS development are relatively high, but there are areas in which further development and support will be needed. A large amount of legacy soil data exist, but are scattered among several institutions, and in some cases require digitizing and consolidation. Capabilities for data collection and laboratory analysis of new soil samples exist, but may require investment in enhancement of equipment and training of personnel to align with regional and international standards. ZamSIS partners have cited capacity-building in data analysis and interpretation as a key area in need of further development, including developing skills of data scientists in modeling and mapping soil data, and expertise in integrating soil with meteorological, land use and land cover, and other related data toward generating higher-level comprehensive information products that can inform policy and practice. During the initial stages of ZamSIS development, technical expertise and capacities that may be limited within Zambia may be filled by the project's external partner organizations.

Digital and computing infrastructure

Through its operation by SMART Zambia, ZamSIS will be able to be hosted and managed on capable IT infrastructure and equipment. This arrangement seems to be sufficient for the initial development of ZamSIS. As with SIS platforms in many other countries, the future growth and enhancement of the system may need to be accompanied by additional investment in digital and computing infrastructure to support, for example, spatial-temporal modeling of soil properties or advanced analyses of biogeochemical cycling.

Further information

For more information on the project visit: **cabi.org/projects/soil-information-systems-review-a-process-toward-strengthening-national-soil-information-systems**

To access similar resources and explore the framework visit: **resources.isric.org/sis-framework**

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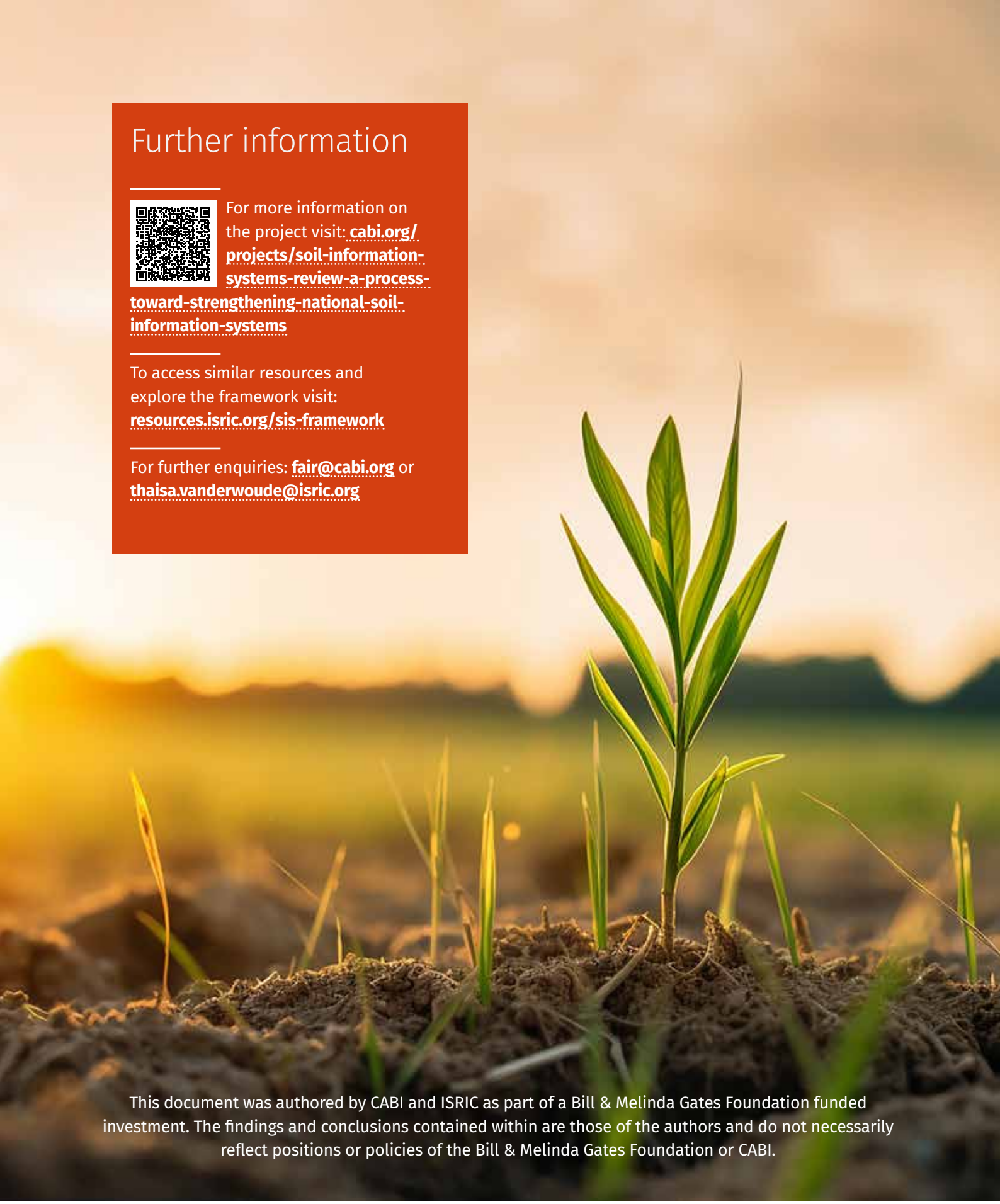

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