Land Soil Crop Hubs

POLICY BRIEF

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Assessing the need for establishing land, soil, and crop information hubs to support climate-smart agriculture in Ethiopia, Kenya, and Rwanda

Land, Soil, and Crop Information Services to support Climate-Smart Agriculture (LSC-IS) project.

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Introduction

The Land, Soil, and Crop Information Services (LSC-IS) to support Climate-Smart Agriculture project (2021-2025) aims to establish sustainable data hubs within national agricultural research organisations in Ethiopia, Kenya, and Rwanda.

To ensure the hubs are relevant and sustainable, the project began with a comprehensive needs assessment. This included identifying data and information needs of users, as well as institutional and staff needs and expertise of data providers in the three countries.

Users

The project targeted two main groups of users. The primary users, operating at the national level, include policy bodies, knowledge organisations, development partners, and private sector. The secondary users —who work more directly with small-scale farmers at sub-national levels—include local landscape and watershed planning and management bodies, public rural extension services, NGOs, farmer organisations, and private sector. Currently, these stakeholders either lack access to land, soil, and crop (LSC) information, or have access to scattered information. The information they use is of unknown quality. Moreover, many stakeholders have never used LSC information; have not yet experienced how it can help them in decision-making, planning, and implementing climate-smart agriculture (CSA).

Long-term sustainability strategy

Based on the needs assessments, the project developed a long-term sustainability strategy. This strategy focused on how the hubs will be sustained through ongoing technical, financial, and institutional support. Care was taken to ensure active representation and participation of women and youths in the needs assessment.

This policy brief summarises the approach and findings from the assessments.

Objectives

The needs assessment had two objectives:

1. **Assess demand**

Assess the demand among stakeholders for LSC knowledge and information.

2. **Identify requirements**

Identify strategic, technical, operational, and institutional requirements for LSC hubs.

Needs assessments

Needs assessments are important to ensure the success and sustainability of information systems development. They are considered an integral part of the Soil Information Workflow of ISRIC [1], recommended as the first stage of grant programmes [2,3], and essential to ensure that digital agriculture services align with evolving needs of users [4]. Guidelines for conducting needs assessments have been presented, for instance, by Sonneveld et al [5].

The results from the needs assessment formed the basis for defining user and system requirements, capacity gaps, and institutional needs, and for creating an initial strategy for embedding, long-term maintenance and sustainability of LSC hubs. Additionally, they defined and initiated multi-stakeholder engagement for the design and co-development of the LSC hubs, and the further user engagement at national, district, and local levels for awareness raising, training, embedding, and sustainability strategies.

Methods

The LSC-IS project developed the methodology for the needs assessment in two key deliverables. The first outlines the methodology for assessing the demand and capacity for LSC information in Kenya, Rwanda, and Ethiopia. The second details how to conduct an institutional assessment of potential host organisations within their broader institutional context [6, 7].

Our methodology consisted of four steps:

1. Quick scan of the current Agricultural Knowledge and Innovation Systems (AKIS) in the three countries, including mapping of stakeholders, policies, initiatives and projects.
2. Conduct multi-stakeholder workshops with focus group discussions (FGDs) to identify stakeholder roles, expectations and challenges.
3. During the workshops, identify existing and required skills and competences.
4. Explore sustainability models of LSC hubs.

Five groups

The approach considered five groups at national, regional, and local levels:

1. Public institutions
2. Development organisations and NGOs
3. Private sector
4. Knowledge institutes
5. Farmers representatives and organisations

In addition, criteria were developed for the selection of sub-national project areas and relevant initiatives.

Use cases

Based on the key purpose of current soil and agriculture information systems in the three countries, two use cases were defined to focus the assessments: i) **soil fertility management**, and ii) **soil and water conservation**. Using these use cases, ideal information flows and challenges were mapped out.

Stakeholder interviews followed the multi-stakeholder workshops to further clarify the acquired information and provided input on how to create sustainability of the hubs (step 4 of the methodology). The entire methodology gave special emphasis on appropriate data demand for advancing climate smart agriculture.

Our methodology tools and survey for the assessment of the enabling environment, institutional setting, and hub host's capacity were carried out with the Ethiopian Institute of Agricultural Research (EIAR), the Kenya Agricultural & Livestock Research Organization (KALRO), and the Rwanda Agriculture Board (RAB), together with a selected group of LSC data providers as depicted in Box 1.

Box 1: Key activities in LSC information demand and capacity assessment

Step 1: Assess LSC information flow and key challenges and opportunities to improve the use of LSC information

Step 2: In-depth assessment of the enabling and inhibiting conditions for the institutionalisation and scaling of the LSC-Hub

Step 3: Assessment of the hub host and its organizational technical and functional capacities and capacity requirements.

Step 4: Assessment of potential sustainability models for the LSC-hub per country

Levels

Initially, the project planned to work at the **national** and **local** levels.

However, during the quick scans (step 1 of the approach), it became clear that in each of the countries, agricultural extension, the agriculture sector, and spatial planning are devolved and decentralised to district (woreda, county, regional) authorities. Therefore, the project decided to include the **district** level.

Two districts were selected in each country: one representing a moister, higher potential area, and the other representing a drier, lower potential area. The selected districts were based on earlier climate-smart agriculture projects and their known responsiveness.

In **Ethiopia**, the woredas included Basona Worena and Adami Tulu Jido Kombolcha.
In **Kenya**, the selected counties were Taita Taveta and Busia while in **Rwanda**, Musanze and Rwamagana districts were selected.

From each district, two villages were selected to carry out local-level activities.

Following the aforementioned methods, the needs assessments were conducted in 2022 and 2023.

Key findings

The needs assessment activities resulted in two immediate outcomes:

1. A set of clearly defined **user requirements** that guide the design of the LSC-hubs.

2. Assessment of the **capacity and institutional requirements** for the design of the LSC-hubs.

These were presented first in the quick-scan and the full needs assessment final report [8].

User requirements

Hub data

The decision-making process and corresponding data needs of potential users of LSC-hub services at national, district and local levels were gathered from participating organisations and representatives. Table 1 below summarises this for the public sector.

Table 1: Summary of public sector LSC data requirements by level, in Ethiopia, Kenya, and Rwanda

Level	Main aim	Decision making	Types of data
National			
National Agricultural Research Centres Ministries of Agriculture, Environment	Agricultural, environmental sector policy development and planning Agricultural subsidy programs Land use planning	Increase agricultural production and food security Input subsidy programs Land use planning	Soil types, indices Crop type and production fertiliser use, yield gap, land suitability, existing land use, climate Social and economic: demography, population density, household characteristics, gender roles, income sources, market access, and livelihoods
District (region, county)			
District agricultural officers and staff	District development and spatial plan Extension manuals	District land use planning Development of agro-advisories, erosion hotspots Liming requirements	Actionable advisories in local language for soil fertility (mineral and ISFM), soil and water conservation; crop types, nutrient requirements, yields; weather, seasonal forecasts
Local			
Public agricultural extension	Extension manuals	Support farmers with farm planning: Selection of crop and agronomic practices, inputs including fertiliser, lime. Recommended SWC measures and GAP	Local land use, erosion, cropping patterns, DEM, water -Social and economic data -Admin, catchment boundaries.
Village development and catchment management committees	Village development and investment plans Catchment management plans Planning of community services, including water	Advise on village and farm level soil fertility management and soil and water conservation, SLM, farm inputs requirements, good agricultural practices	Local land use, erosion, cropping patterns, DEM, water Social and economic data Admin, catchment boundaries

Hub functionalities

The desired scope and functions of the LSC hubs are listed in Table 2 below.

Table 2: Summary of desired hub functionalities by level, in Ethiopia, Kenya, and Rwanda

No.	Functionality
1	Data repository (collection, storage, QA)
2	Data analysis and visualisation (dashboards, graphs, plots, charts)
3	GIS and mapping capabilities
4	Data access and sharing (including formats, offline use, guidelines for metadata, licensing, intended use)
5	Real-time monitoring and alerts
6	Climate-smart agriculture support: advisories, crop planning tools
7	Knowledge base and documentation-resource library and user manuals
8	Reporting and exporting with custom reports and data sharing links
9	User communication: commenting, tagging, sharing, messaging
10	Mobile accessibility
11	Data backup and security
12	Scalability and performance: ensure system can handle increasing data and traffic
13	User training resources and support system
14	Feedback and improvement mechanism
15	Cost-effective deployment option
16	Success stories that users can relate to
17	Define layered access for user groups with different needs and permissions

Capacity and institutional requirements

The quick scan and subsequent needs assessment activities conducted in Ethiopia, Kenya, and Rwanda included assessing the enabling environment. This included policies, initiatives and projects, as well as the institutional setting, including resources. The assessment also focused on priorities for strengthening capacity in the provision of land, soil, and crop information.

Policies

Each country has developed national agricultural policies that focus on climate adaptation, intensification of agricultural production systems, and enhanced production through the increased supply and use of both mineral and organic fertilisers and liming. These policies also emphasise soil and water conservation, soil health, and integrated soil fertility management as essential components of climate-smart agriculture, aiming to improve productivity, resilience, and sustainability.

Recent data sharing policies and directives on Findable, Accessible, Interoperable, and Reusable (FAIR) and open data have been established in all three countries. In Ethiopia, the Coalition of the Willing (CoW) advocated for the development of these policies and their integration into the legislation. However, the procedures for accessing datasets are often unclear, which poses challenges in acquiring, using, and referencing datasets. In Kenya, counties such as Busia and Taita-Taveta have developed policies for data protection and data sharing.

Initiatives

There is a large number of past and ongoing initiatives focused on climate-smart agriculture, improvement of agricultural productivity, soil and water conservation, and soil health related to information systems. Several ongoing projects relate to Developing Smart Innovations through Research in Agriculture (DeSIRA) initiative.

Key national initiatives relevant the LSC-IS scope

Ethiopia: Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) supports the Ministry of Agriculture (MoA) in the development of the AgDataHub, a national hub for all agricultural data and the National Soil Information System (NSIS) succeeding EthioSIS under the MoA.

Kenya: Kenya Digital Agriculture Platform, developed under KALRO, provides various services and data to end users. Kenya Climate Smart Agriculture Project (KCSAP) worked on tools and adaptive agriculture in selected counties.

Rwanda: Rwanda Soil Information System (RwaSIS) developed a soil information hub, linked to agronomic data. The user interface consists of soil fertility advisories. The RwaSIS hub is linked to the Smart Nkunganire System (SNS), a digital platform developed to improve advisories and subsidies for agricultural inputs. An umbrella national Agricultural Management Information System (AMIS) is being prepared.

Institutional setting

The national agricultural research institutes formed the point of departure for the project. There are existing collaboration models between data providers and data users, and support for the spatial data infrastructure (SDI) and IT. There were both similarities and notable differences between the three countries involved.

Ethiopia

EIAR is mandated to provide agricultural and natural resource information, and crop research data, while the Regional Agricultural Research Institutes (RARIs) provides context-specific information to the respective regions. Soil data is being managed and provided by NSIS under MoA. In the context of the AgDataHub, support on SDI and IT is provided by ACATECH, a private company. The national Department of Agricultural Extension is tasked with coordinating agricultural extension messaging. Regional Departments of Agriculture are responsible for regional agricultural development and agricultural extension from the regional to the kebele level.

Kenya

KALRO is mandated to provide agricultural research data, including soils. It has sub-national offices in selected counties. The KALRO IT department provides support for SDI and IT services. County Departments of Agriculture are responsible for agricultural development and extension at county, sub-county, ward, and village levels and coordinate activities of other organisations.

Rwanda

RAB is the mandated institution for agronomic and soil data. The Rwanda Department of Water provides soil erosion data. The Meteorological Department provides weather and climate data. The Rwanda Space Agency, a government institution, is providing SDI and IT support to RAB. District Departments of Agriculture are responsible for agricultural development and extension to village level. The MoA is preparing the development of AMIS which provides single access point and support for databases and apps from different departments.

Capacity strengthening

LSC hub management requires data management, along with systems development and maintenance. Different organisations provide these services. The topics listed in Table 3 were identified by participants in the needs assessment workshops, FGD and KIIs as a priority for training hub hosts.

Table 3: Priority topics for training hub hosts and data providers

No.	Topic
1	Data collection and management
2	Data analysis and interpretation
3	GIS and spatial analysis
4	Data security and privacy
5	SDI and ICT use
6	Data sharing incl metadata and API
7	Data governance, policies, QA, ethics
8	Providing technical support, troubleshooting, helpdesk
9	Data policy and compliance including regulation, licensing, IPR
10	Data dissemination, visualisation and feedback
11	Climate-smart agriculture, integrating climate data and support climate-sensitive decision-making
12	Sustainability and resource management

Recommendations

Key components of an effective sustainability strategy include the following: institutional, technical, financial, and usage at different levels. These components were developed in subsequent activities of the LSC-IS project.

Institutional

- **Embedding:** The LSC hubs hosted by the national agricultural research institutes confirmed their institutional setup and plans, and inclusion of LSC hub activities in their yearly plan and budget. The institutional structure should include LSC hub team. Essential to create roadmaps to integrate the LSC hubs into existing agricultural information systems in the three countries.
- **Governance:** Define regulations, processes, standards, protocols for quality assurance, data protection, including IPR of LSC hub services. A governance structure should be developed for LSC hub as a network of hub host, hub users, and data providers. Develop Memorandums of Understanding (MoU) between various actors. Thereby, the mandate for the management of databases should be clearly defined to avoid overlap and redundancy.
- **Resources:** Strengthen the network of stakeholders to sustain financial and human resources and ensure the LSC hub is updated and innovated. Create incentives for data providers from the private sector and development partners to contribute to LSC hubs. The LSC-IS project to follow the pooling of resources for SDI and ICT by dedicated government departments (Kenya, Rwanda) or private sector (Ethiopia).
- **Policy:** Support the application of conducive policy environment, for example, the FAIR data policy.

Technical

- **Human capacity:** The staff of the LSC hub hosts require training in system and data management. Due to the likelihood of staff turnover, training materials should be developed to allow for repeated training without the need for external experts.
- **Infrastructure:** ICT requirements should be planned with hub hosts and relevant IT departments/ministries. Adequate resources should be allocated in the post-project budgets.
- **Data:** Each of the country already has various large databases and last-mile digital agro-advisory tools. These should be linked and built upon. The LSC-IS project should align with prevailing data protection laws and regulations, apply common standards to make data FAIR and harmonise existing data.
- **Quality assurance:** Hub hosts to implement quality assurance procedures and evaluations and ensure compliance with technical data standards and International Organisation for Standardisation requirements.

Financial

- **Strategy:** Include a self-sustaining mechanism to support the long-term viability of the LSC hub.
- **Scenario:** Include a dedicated core financing through the national agricultural research institutes, earmarked for LSC hub management.
- **Supplementary sources:** Explore options for membership fees, download charges and public-private partnerships (PPPs).

National level use

- **Embedding:** LSC hub usage embedded in existing national and subnational structures and aligned to strategic public services for agricultural development (sector and spatial planning, input subsidies, climate advisory services, insurance).
- **Training:** Provide training to staff utilising the LSC hub.
- **Governance:** Link the LSC-IS to international conventions and agreements (Convention on Biological Diversity – CBD, United Nations Framework Convention on Climate Change – UNFCCC, United Nations Convention to Combat Desertification – UNCCD, and the Sustainable Development Goals – SDGs); this may provide additional institutional support and possibly financial resources.

District and local level use

- **Data and testing:** Data and soil testing can be expensive for farmers. Utilise the LSC hub in district-level programs that support agricultural extension, sector and spatial planning.
- **Training:** Engage and train district agricultural research centers in the operation and use of LSC hub and its application to agricultural research in extension.
- **Participatory testing:** Pilot participatory testing using farmer field schools and demonstration farms.
- **Partnership:** District-level agricultural departments to coordinate public agricultural development and extension and be key partners for the LSC-IS project, as they are trusted partners of local stakeholders and farmers and can act as 'info-mediaries'.
- **Decision-making:** Ensure the LSC hub contains actionable data that supports decision-making by end users and can also be converted to paper-based formats, as the availability of digital devices cannot be assumed at a local level.

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