World Agroforestry

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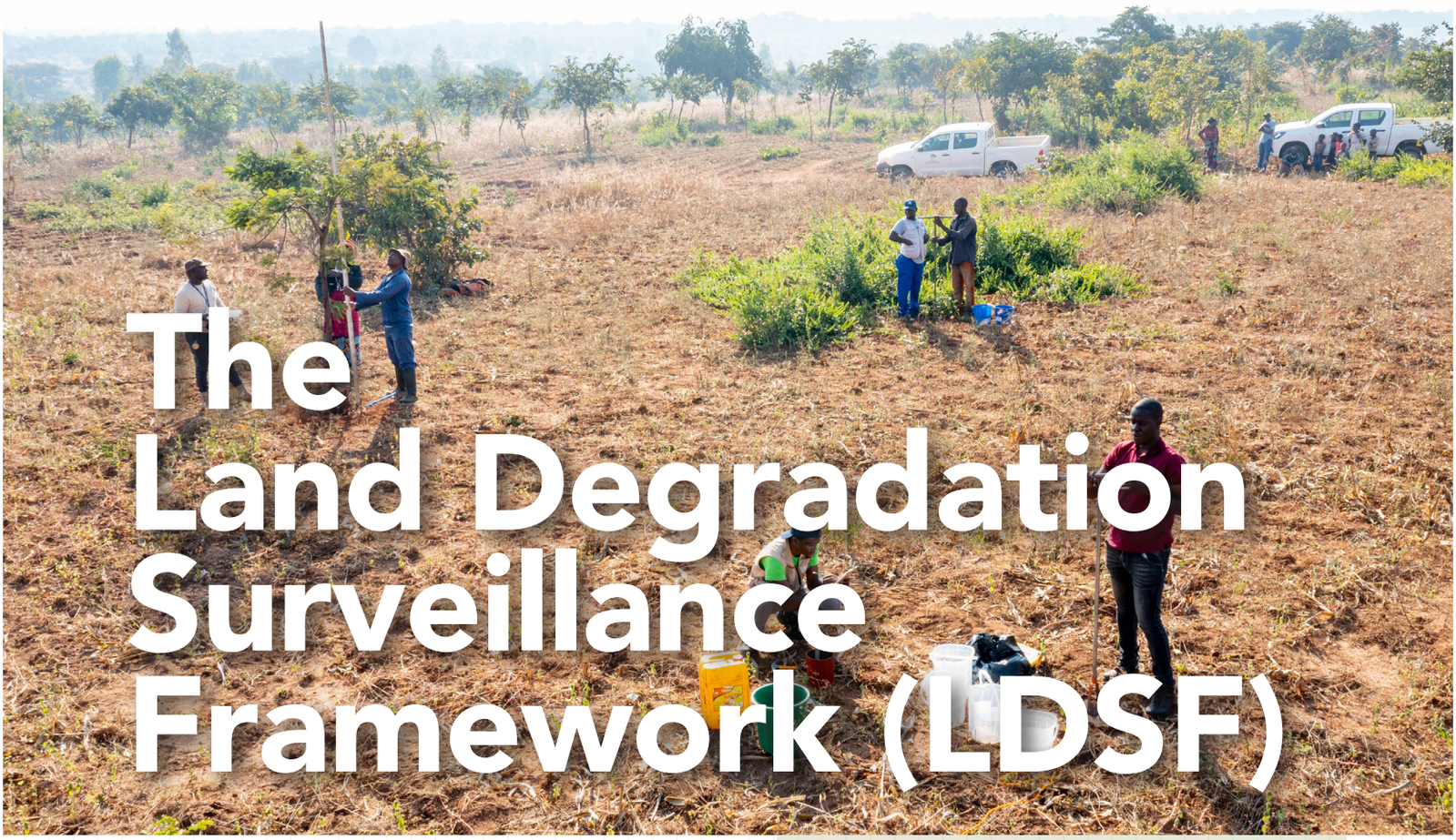


The Land Degradation Surveillance Framework (LDSF)

The Land Degradation Surveillance Framework (LDSF) is a comprehensive method developed by World Agroforestry (ICRAF) scientists, that provides a science-based field protocol for measuring land and soil characteristics, as well as vegetation composition and land degradation status over time.

The LDSF is a **comprehensive method for assessing soil and land health**, from the field to the use of new and advanced data analytics. Land health generally refers to the degree to which the integrity of the soil, vegetation, water and air, as well as ecological processes, are balanced and sustained.

The LDSF provides a consistent set of indicators and field protocols to assess the "health" of an ecosystem. This includes **vegetation cover and structure, tree, shrub and grass species diversity, current and historic land use, infiltration capacity, soil characteristics and land degradation status**. It can also be used as part of monitoring frameworks to detect changes over time.

Value of the LDSF

The LDSF has been applied systematically across a wide range of ecosystems and land uses across the global tropics. It is now one of the largest geo-referenced databases of soil and land health indicators, globally.

The LDSF allows you to:

- Understand variability of ecological indicators
- Establish a biophysical baseline
- Quantify above and below ground carbon stocks
- Better understand drivers of land degradation
- Target land management interventions in landscapes and monitor
- Assess the impact of land management practices on key biophysical indicators
- Enable evidence-based decision making
- Improve crop/rangeland/climate models
- Provide evidence to decision and policy makers
- Communicate with farmers, communities, governements, donors and investors
- Implement spatial and temporal assessments and mapping of a range of soil and land health indicators
- Allows for consistent and robust tracking of interventions overtime.

Data collection and analyses

LDSF was developed as a response to a lack of methods for systematic landscape-level assessment of soil and ecosystem health, using a robust and consistent indicator framework. The LDSF is designed to provide a biophysical baseline at landscape level, and a monitoring and evaluation framework for assessing processes of land degradation and the effectiveness of rehabilitation measures (recovery) over time.

This is of particular importance for understanding land degradation processes, predicting changes in climate, prioritizing site-specific land management options and tracking the impact of interventions on the ground.

By applying a multi-scale approach, the LDSF framework can be used to conduct robust statistical analysis and inference, including spatial assessments and predictive maps with a high level of accuracy. These outputs can in turn be used to improve the targeting and design of land management, including land restoration efforts, and to monitor the effectiveness of different practices in terms of meeting restoration targets and ensuring sustainability.

LDSF PROCESS

1. **Data is collected in the field** at multiple spatial scales in a nested hierarchical sampling design, enabling robust spatial statistics that are important for setting baselines and tracking changes over time.

2. All georeferenced LDSF data are stored in the **ICRAF LDSF Database** for efficient and safe storage, fast retrieval and to facilitate analysis. Data quality is checked.

3. All data are subjected to **advanced data analytics and robust statistical analysis**. Soil samples are analysed using soil spectroscopy to predict key soil properties.

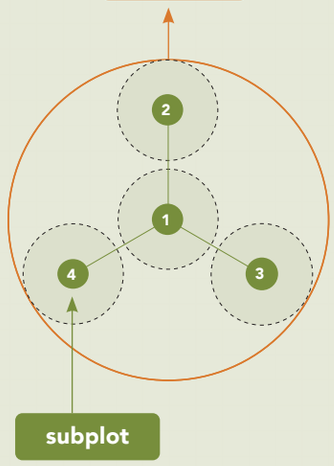
4. Outputs: The LDSF measures measures **multiple key indicators** of soil and land health at the same geo-referenced location. Data from muliple locations are used to develop **predictive maps** of the various indicators, at scales relevant to stakeholders.

5. **Capacity development and engagement** is central to the LDSF, from field surveys to data analysis and dashboard development.

6. Data generated with the LDSF provides **valuable input** into co-designed, online dashboards to enhance evidence-based decision making.

DATA COLLECTION IN THE FIELD

LDSF site → cluster → plot



Each site is 100 km² and has 16 clusters

Each cluster is 1 km² and has 10 plots, each measuring 1000 m²

4 subplots per plot, each measuring 100 m²

In each plot, we describe and record basic plot characteristics, including:

- plot centre-point coordinates
- altitude
- slope
- landform and topographic position
- vegetation structure
- dominant land use, land ownership, etc.
- soil infiltration capacity (measured in 3 out of 10 plots per cluster)
- herbaceous and woody cover using ratings
- detailed rangeland health module (optional)

In each subplot, we:

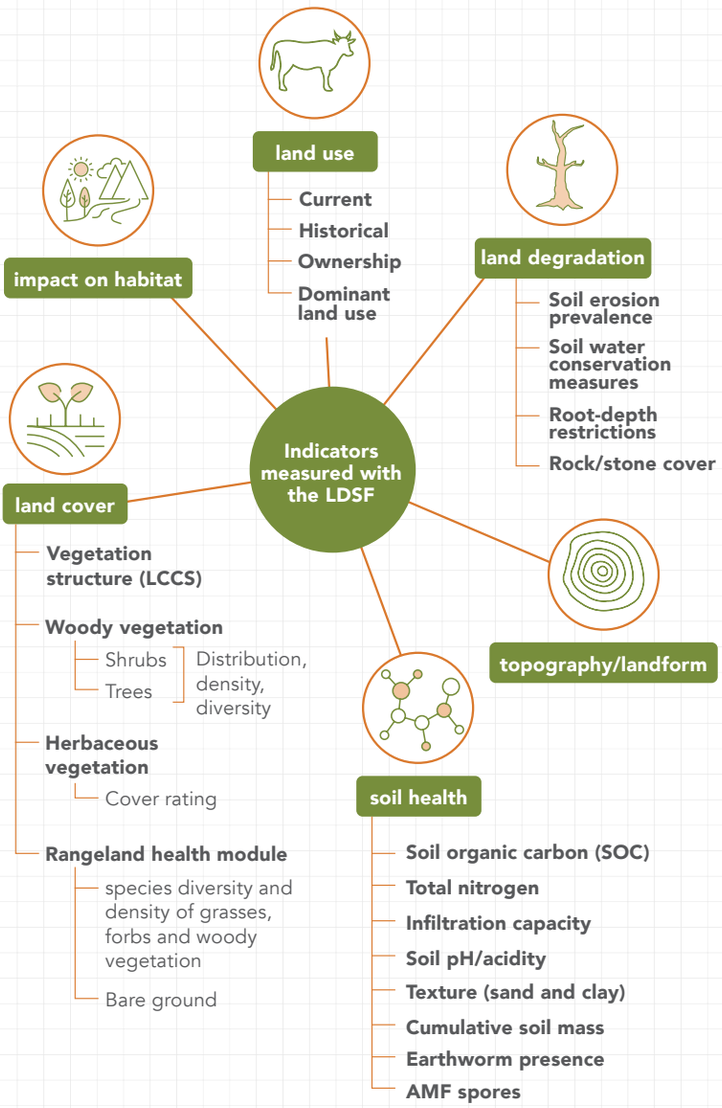
- collect soil samples (both top- and subsoil) using an auger and record auger depth restrictions
- measure and identify at species level all trees and shrubs
- record and classify visible soil erosion
- assess herbaceous and woody cover using ratings

Outputs

LDSF INDICATOR FRAMEWORK

The LDSF enables **systematic and science-based** assessment and monitoring of soil and ecosystem health at scale, using a robust and consistent indicator framework that is:

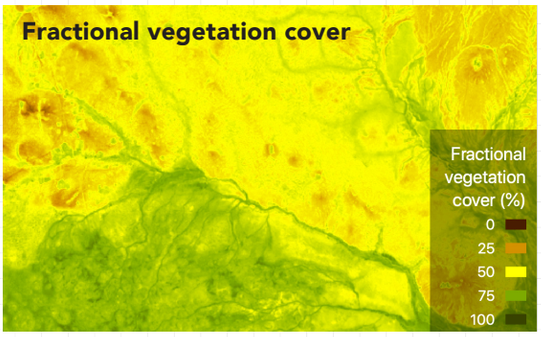
- **Specific:** The indicator should accurately describe what is intended to be measured, and should not include multiple measurements in one indicator.
- **Measurable:** Regardless of who uses the indicator, consistent results should be obtained and tracked under the same conditions.
- **Attainable:** Collecting data for the indicator should be simple, straightforward, and cost-effective.
- **Relevant:** The indicator should be closely connected with each respective input, output or outcome.
- **Time-bound:** The indicator should include a specific time frame.

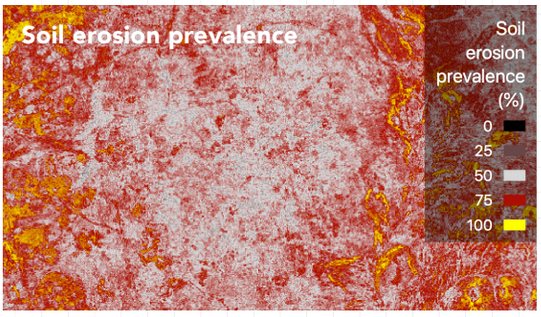


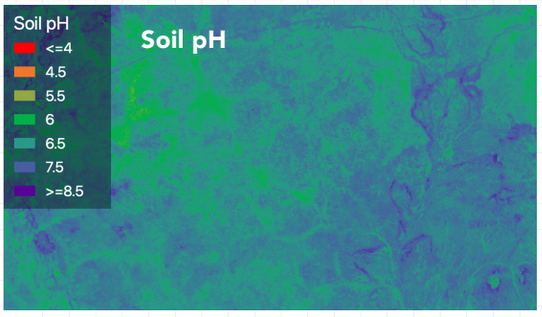
PREDICTIVE MAPS

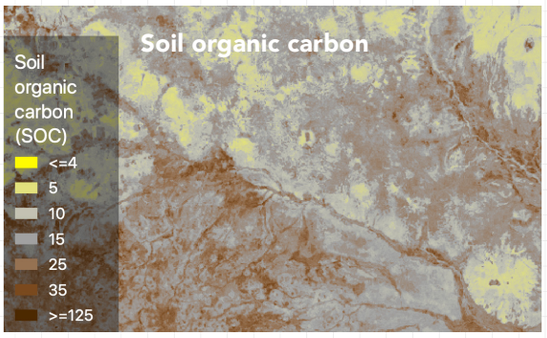
The LDSF provides on the ground evidence, generated through systematic data collection, that can form an invaluable tool for policy- and decision-makers.

Data from multiple global sites are used to create **predictive mapping** outputs at multiple spatial scales (see below), with fine-resolution maps produced at 5-10 m resolution or lower, high resolution maps at 20-30 m resolution, and moderate resolution maps at 250-500 m resolution. This enables you to zoom in to a specific area of your site and assess the possible indicators therein.









Data for land planning

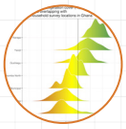
The LDSF biophysical indicators, spatial assessments, and predictive maps have many practical applications, and are invaluable tools for policy- and decision-makers to be applied in real decision contexts.

CAPACITY DEVELOPMENT WITH PARTNERS

Field training includes all aspects of the LDSF such as: GPS navigation; electronic data entry and upload; LCCS vegetation classification; soil sampling; infiltration measurements; woody biodiversity measurements; and land degradation assessments.

Participants include:

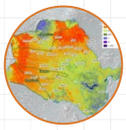
- field technicians
- members of the LDSF field team
- partners interested in learning new techniques for land and soil health assessments



Data analytics training to explore the LDSF data with R statistics: tidying and visualizing data; applying mixed-effect models to assess key indicators of land and soil health; database development; data management.

Participants include:

- technical staff interested in data analysis and data management
- those who will continue to work with the LDSF datasets



Remote sensing (RS) training to explore key concepts, methods and applications of RS, including: the use of open source GIS and remote sensing software; basic analysis using RS data (creation of image composites, image calculations, generation of vegetation indices and soil maps, etc).

Participants include technical staff familiar with RS and GIS principles.

GENERATE EVIDENCE FOR DECISION MAKING

The LDSF provides on the ground evidence combined with other knowledge sources and models to provide the overall picture of land health to support evidence-based decision making.

This allows programs, projects and government agencies a systematic way to provide both a baseline on ecosystem health and track critical indicators of soil and land health over time.

Evidence is generated through systematic on the ground data collection, citizen science to crowd source data from apps and models to produce data and maps. This evidence is applied through capacity support, training and stakeholder engagement to ensure the critical value of having the right information in the right format, demonstrating relationships in the systems (vegetative cover, soil health, etc.) to support decision making around land health.

The LDSF provides data and information that is valuable to:

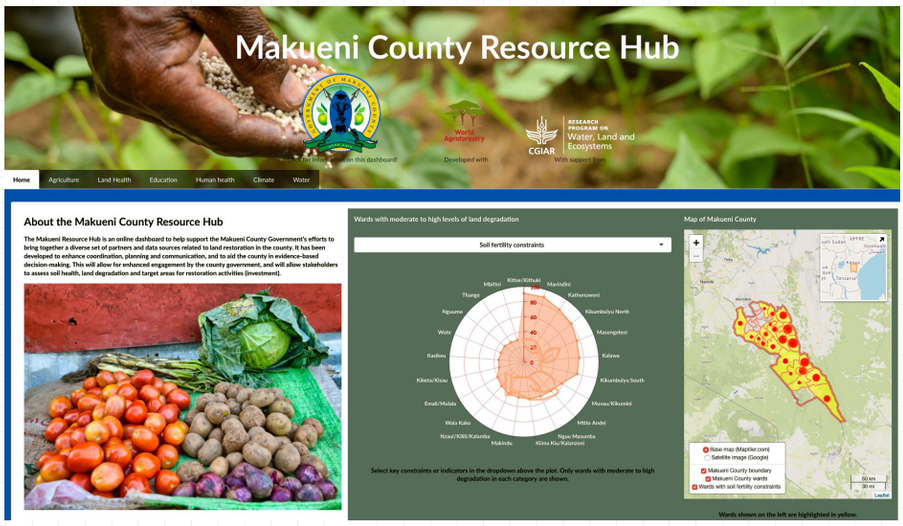
- Farmers and extensionists
- Project managers and monitoring focal points
- National and district level decision makers

VIEW DATA INTERACTIVELY THROUGH A DASHBOARD

Outputs of the LDSF including the indicator calculations and the high resolutions maps can be interactively visualised through a dashboard. A dashboard is a visual display of interactive information and data in a central online point.

Dashboards allow information and data to be quickly and easily communicated to key users and decision makers.

For more information, visit
http://landscapeportal.org.



ACCESS POWERFUL PREDICTIVE DATA FROM A GLOBAL NETWORK OF SITES

The LDSF allows for assessments of key indicators of soil and land health at multiple scales across landscapes. The ICRAF LDSF database, is the largest set of coherent and georeferenced ecosystem health indicators to date.

Hosted within the ICRAF Spatial Data Science and Applied Learning Lab (previously dubbed GeoScience Lab), these data provide an excellent opportunity for partnerships and collaboration around big analytics.

Contacts

Tor Gunnar Vagen
Senior Scientist
T.Vagen@cifor-icraf.org

Leigh Ann Winowiecki
Soil Systems Scientist
L.A.Winowiecki@cifor-icraf.org

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Land Degradation Surveillance Framework
http://landscapeportal.org/blog/2015/03/25/the-land-degradation-surveillance-framework-ldsf/

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