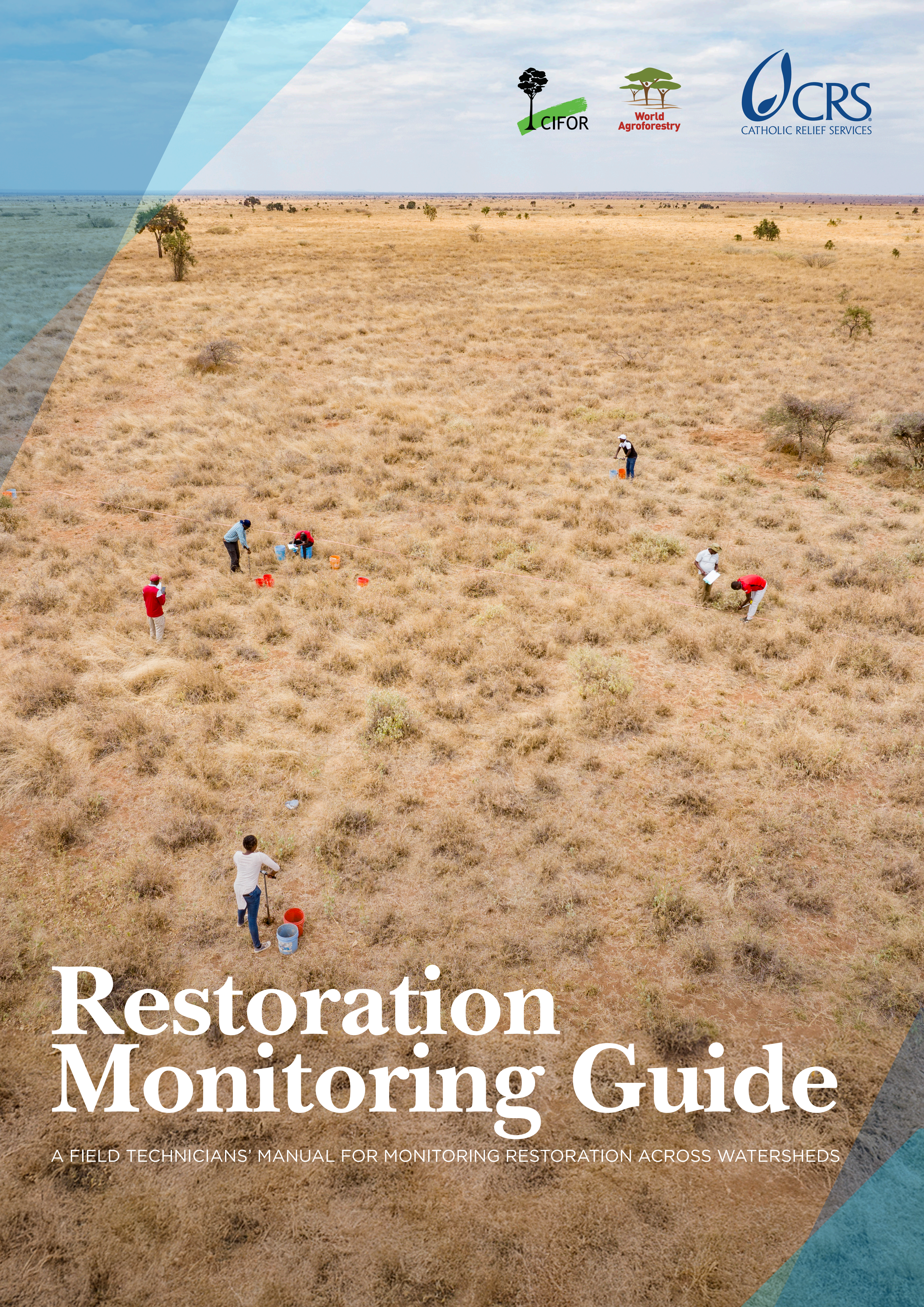

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CRS CATHOLIC RELIEF SERVICES

Restoration Monitoring Guide

A FIELD TECHNICIANS' MANUAL FOR MONITORING RESTORATION ACROSS WATERSHEDS

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The guide draws on and builds upon CIFOR-ICRAF's extensive experience in land health assessment and restoration monitoring. In particular, we acknowledge the Land Degradation Surveillance Framework (LDSF)—a systematic methodology for collecting biophysical data on land and ecosystem health—and the Regreening App, a citizen science data collection innovation designed to empower local communities and field practitioners in tracking on-the-ground restoration progress.

By integrating these proven approaches, this guide seeks to strengthen CRS's ability to generate reliable, field-based evidence for decision-making, learning, and accountability in its restoration programming in Ethiopia and other country contexts. We also recognize the broader community of scientists, practitioners, and community members whose insights and ongoing engagement continue to shape and enhance these tools.

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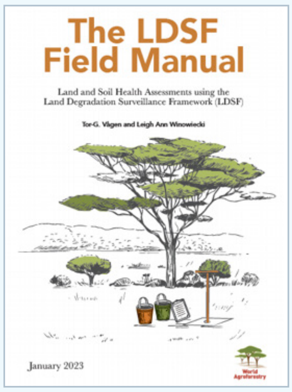
For more information
See the following training manuals produced by CIFOR-ICRAF:



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Acronyms

AFR100 – African Forest Landscape Restoration Initiative

CO_2e – Carbon Dioxide Equivalent

CRGE – Climate Resilient Green Economy

CRS – Catholic Relief Services

DAP – Development Assistance Program

DFSA – Development Food Security Activity

DRS – Data Reporting System

EO – Earth Observation

EVI – Enhanced Vegetation Index

FMNR – Farmer-Managed Natural Regeneration

GHG – Greenhouse Gas

GoE – Government of Ethiopia

ICRAF – World Agroforestry Centre

LDN – Land Degradation Neutrality

LDSF – Land Degradation Surveillance Framework

MIR – Mid-Infrared

MYAP – Multi-Year Assistance Program

NDVI – Normalized Difference Vegetation Index

NDC – Nationally Determined Contribution

PSNP – Productive Safety Net Program

REAAP – Resilience through Enhanced Adaptation Action-learning and Partnership

RFSA – Resilience Food Security Activity

SCP3 – Strategic Change Platform 3

SDGs – Sustainable Development Goals

SOC – Soil Organic Carbon

tC/ha – Tons of Carbon per Hectare

UNCCD – United Nations Convention to Combat Desertification

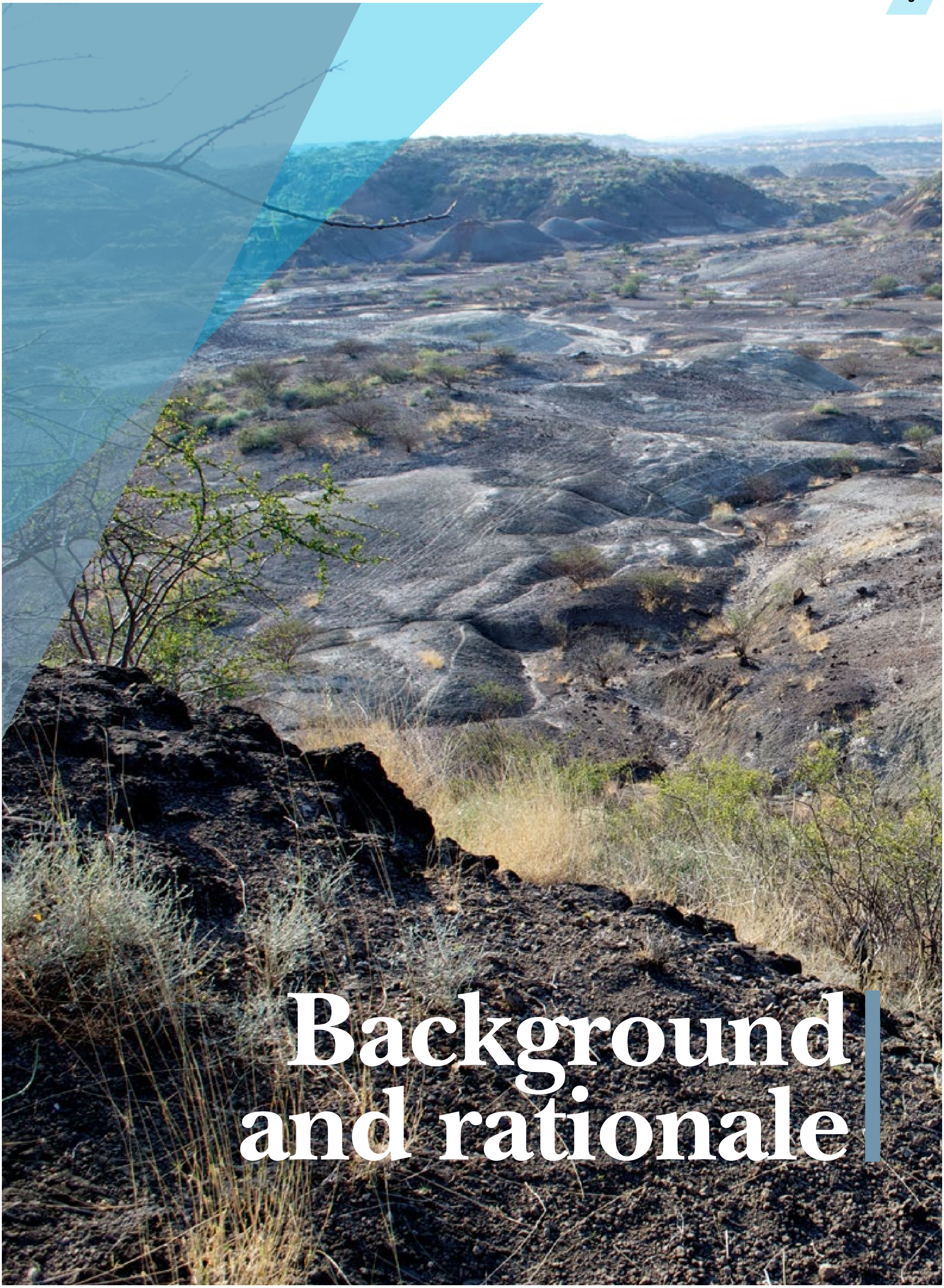
About this guide

Despite its importance, many national restoration monitoring frameworks still lack robust systems for tracking management practices at finer scales. Most reporting focuses on broad targets such as tree cover increase or total hectares restored—yet these figures alone don't tell us whether restoration efforts are truly improving ecosystem function. Without clear data on soil health, vegetation recovery, erosion reduction, or water availability, restoration risks being implemented without understanding its actual effectiveness on the ground.
This Restoration Monitoring Guide addresses that gap. It provides a hands-on, field-ready approach for monitoring restoration outcomes at both plot and watershed levels. Developed for district-level field agents, extension staff, and natural resource management officers, the guide supports locally grounded, scientifically robust monitoring that enhances decision-making, accountability, and adaptive management.

Created through a partnership between **Catholic Relief Services (CRS) and the Center for International Forestry Research** and **World Agroforestry (CIFOR-ICRAF)**, the guide covers key areas essential for integrated restoration monitoring:

- Use of the **Land Degradation Surveillance Framework (LDSF)** for systematic data collection on soil, vegetation, and land degradation.
- Application of **assisted citizen science** through the **Regreening App**, empowering communities to document and georeference restoration efforts.
- Integration of **remote sensing data** (e.g. NDVI, EVI) to assess large-scale trends in land and vegetation health.
- **Community watershed monitoring**, including spring discharge measurements to evaluate hydrological recovery.
- Tools for **data analysis, mapping,** and **visualization** that transform field data into actionable insights for project teams and local decision-makers.

By combining structured protocols with participatory approaches and digital tools, this guide helps ensure restoration is not only being carried out—but is measurably improving the land, ecosystems, and livelihoods it aims to support.



Background and rationale

The global context for monitoring restoration

Land degradation is one of the most pressing environmental challenges, threatening biodiversity, food security, water availability, and climate resilience. It is defined as the long-term decline in the productivity, health, and ecosystem services of land due to factors such as deforestation, unsustainable agriculture, overgrazing, urban expansion, and climate change.

The United Nations Convention to Combat Desertification (UNCCD) estimates that over 25% of the world's land is degraded, affecting nearly 3.2 billion people, particularly in dryland regions that are highly vulnerable to desertification.

The consequences of land degradation include reduced soil health, loss of vegetation cover, diminished capacity to sequester and store soil carbon, and heightened risks of extreme weather events such as droughts and floods.

To address this crisis, ecosystem restoration has emerged as a key strategy aimed at reversing land degradation and restoring the ecological functions of landscapes. Restoration involves a range of approaches, from afforestation and reforestation to agroforestry, regenerative agriculture, and wetland rehabilitation.

The United Nations Decade on Ecosystem Restoration (2021–2030) underscores the global urgency to restore degraded lands by scaling up successful restoration initiatives. Similarly, Land Degradation Neutrality (LDN), a flagship goal under the UNCCD, seeks to ensure that any land degradation is counterbalanced by land restoration, leading to a net neutral or positive outcome.

In Africa, the African Forest Landscape Restoration Initiative (AFR100) exemplifies large-scale restoration efforts, aiming to restore 100 million hectares of degraded land by 2030. By enhancing soil health, restoring tree cover, and improving water retention, restoration efforts contribute to sustainable agriculture, biodiversity conservation, and climate adaptation. Ethiopia has committed to restoring 15 million hectares and increasing tree cover by 22% within the AFR100 framework.

> The restoration of degraded landscapes is closely aligned with, and relevant to, Ethiopia's national development policy and ambitious Climate Resilient Green Economy (CRGE) strategy, launched by the Government of Ethiopia (GoE) in 2011. Ethiopia's Nationally Determined Contribution (NDC), updated in 2021, plans to reduce greenhouse gas (GHG) emissions by 68.8% (equivalent to -277.7 Mt CO_2e) by 2030, in line with the Sustainable Development Goals (SDGs) and Ethiopia's international climate commitments.

The goals for natural resource management set out in the Second Growth and Transformation Plan (GTP-II) include treating an additional 19 million hectares with physical soil and water conservation structures, increasing national forest coverage from 15 to 20%, and providing land use certificates to more than seven million households. Furthermore, the government has recently set a long-term target to restore 22 million hectares of land for broader landscape restoration by 2030. This commitment includes the restoration of 12 million hectares of forest land, including through the 'Green Legacy' initiative.

The need for more coordinated national-level monitoring of restoration

Despite global commitments to restoration, a critical gap remains in the coordination and standardisation of national-level monitoring systems. Although initiatives such as the United Nations Decade on Ecosystem Restoration, the African Forest Landscape Restoration Initiative (AFR100), and Land Degradation Neutrality (LDN) set broad restoration targets, **national monitoring efforts often lack consistency in approaches, methodologies, and indicators**. Many countries rely on fragmented systems, with different agencies using diverse metrics to assess land degradation and restoration progress. This lack of coherence makes it difficult to compare progress across regions, track long-term impacts, and effectively align national efforts with global goals.

A major challenge is that **many national monitoring frameworks are not yet fully integrated with global restoration tracking systems**, such as those developed under the United Nations Convention to Combat Desertification (UNCCD), the Food and Agriculture Organization (FAO), and the Global Restoration Observatory. Some countries use remote sensing, while others rely on ground-based field assessments, often without a clear system to cross-validate data. Additionally, **national reports on restoration progress can vary widely in frequency, accuracy, and transparency**, further complicating global assessments. The absence of standardized indicators—such as those measuring soil health, vegetation recovery, water retention, and carbon sequestration—limits the ability to assess whether restoration efforts are delivering intended ecological and socio-economic benefits.

To address this, **there is an urgent need for harmonized national monitoring approaches using surveillance frameworks and tools, such as remote sensing and citizen science-led ground-based assessments, which can all feed into national reporting systems**. Countries need to align their indicators with international standards, ensuring that restoration progress is measurable, comparable, and scalable. Establishing common guidelines for data collection and reporting would not only improve national decision-making but also strengthen the ability of global initiatives to track progress effectively. Without such improvements, restoration risks becoming a symbolic commitment rather than a measurable and impactful solution to land degradation. Restoration must be systematically monitored at global, regional, and national levels.

The critical role of tracking management practices at the plot and watershed level in restoration monitoring

Effective restoration is not just about replanting trees or rehabilitating degraded land—it is about ensuring that management practices lead to tangible, lasting ecological and socio-economic benefits. To achieve this, **tracking the impact of restoration activities at both the plot and watershed level is essential.** These localised assessments help determine whether interventions, such as agroforestry, soil conservation, or reforestation, are truly restoring ecosystem functions, improving land productivity, and enhancing resilience to climate change.

> Integrating plot- and watershed-level monitoring into national and global restoration tracking systems is essential to ensure that restoration is not only happening but is effective, sustainable, and resilient in the long run.

Cost-effective and locally-led robust monitoring is essential to ensuring that restoration efforts are both impactful and scalable:

- To track changes over time accurately, data collection methods must be robust, enabling advanced data analytics and statistical modelling that provide meaningful insights into restoration progress.
- A **systematic sampling design** is crucial to capture the variability across the landscape, ensuring that monitoring reflects real ecological and management differences.
- At the same time, the **methodology must be simple**, allowing for easy implementation and scaling by local stakeholders without requiring highly specialised expertise.
- **Keeping monitoring cost-effective** is key, as it enables local partners—such as community organisations, farmers, and government agencies—to actively participate and sustain data collection efforts over the long term.

By incorporating **site-specific data** with remote sensing, field measurements, and participatory monitoring, restoration efforts can become more adaptive, evidence-based, and impactful in reversing land degradation. With systematically collected baseline data and subsequent impact measurements, restoration practitioners can generate evidence for adaptive management, refining interventions as needed.

How will this help my restoration work?

At the **plot level,** monitoring provides crucial insights into how specific restoration techniques influence soil health, vegetation regrowth, biodiversity, and carbon sequestration. For example, measuring soil organic carbon, infiltration rates, and plant diversity can help assess whether regenerative agriculture practices or assisted natural regeneration are effective. Without this fine-scale monitoring, restoration efforts may be implemented without understanding their true long-term impact or potential unintended consequences, such as invasive species spread or soil degradation from poorly planned tree planting.

At the **watershed level**, tracking management practices is even more critical, as restoration has far-reaching implications for water availability, erosion control, and downstream ecosystem health. Poorly managed restoration efforts at the plot level can lead to landscape-scale failures, such as ineffective erosion control measures that fail to reduce sedimentation in rivers or afforestation projects that inadvertently reduce water flow in arid regions. Conversely, well-planned watershed-level monitoring can reveal how improved land management enhances water retention, prevents landslides, and supports hydrological cycles, benefiting both local communities and ecosystems.

Additionally, a well-structured monitoring system strengthens the credibility of land restoration approaches, providing proof of impact that can influence policy decisions and support the scaling up of successful restoration strategies.

Context for Restoration Monitoring in CRS Ethiopia

Catholic Relief Services (CRS) is actively engaged in restoration monitoring across Africa. CRS has worked in Ethiopia since 1958, responding to natural and human-made disasters affecting the country's most vulnerable communities.

Since the 1990s, CRS has implemented various projects, including the Development Assistance Program (DAP), Multi-Year Assistance Program (MYAP), Development Food Assistance Program (DFAP), Resilience through Enhanced Adaptation Action-learning, and Partnership (REAAP), Development Food Security Activity (DFSA), Resilience Food Security Activity (RFSA), and Regreening Africa, among others.

For CRS, watershed management and land restoration have been key strategies for increasing food security and resilience among vulnerable households in Ethiopia. Furthermore, CRS has supported the Productive Safety Net Program (PSNP) since its inception in 2005, with soil and water conservation activities being integral to these efforts. CRS envisions breaking the cycle of poverty by collaborating with farmers to restore soil health and enhance water availability.

These initiatives aim to support and improve government extension services, and to promote a more systematic approach to monitoring programmes, initiatives, and projects. In Ethiopia, CRS has a longstanding commitment to integrated watershed management (IWM), aiming to restore degraded landscapes and enhance community resilience. A comprehensive evaluation of CRS's IWM programmes in Ethiopia highlighted the need for improved project proposals, budgeting, and reporting to facilitate effective monitoring and evaluation (M&E) of results, costs, and benefits.[1]

To address these challenges, CRS Ethiopia collaborated with the International Centre for Research in Agroforestry (ICRAF) to develop a comprehensive indicator monitoring system and baseline study linked to the Resilience Food Security Activities (RFSA) project in Ethiopia. The establishment of a monitoring system focuses on CRS-implemented watersheds in the Eastern Hararghe zone of the Oromia region.[2]

1. https://www.crs.org/sites/default/files/tools-research/transforming-lives-evaluation-integrated-watershed-management-ethiopia.pdf
2. Ten watersheds located within nine woredas in the East Hararghe region in Ethiopia

CRS Livelihoods and Landscapes Strategic Platform (SCP3)

As part of CRS's Vision 2030 agency strategy, CRS is focusing on transformational change at scale through six strategic change platforms (SCPs), including transforming livelihoods and landscapes (SCP3). SCP3 aims to catalyse systems change to achieve scale with land restoration approaches that regenerate vital ecosystem services and rural livelihoods.

The SCP3 platform globally has three impact indicators:

- **Number of hectares under restoration** – land is considered restored based on the application of eight land restoration principles.
- **Number of farmers reached** with land restoration methods.
- **Percentage increase in yields** due to the implementation of land restoration practices.

These three indicators are being measured across all CRS country programmes. SCP3 has selected nine CRS country programmes to pilot the approach of catalysing systems change to achieve scale with land restoration practices. The different land restoration models among these nine country programmes include dryland regreening, water-smart agriculture, watershed management, and multi-storey agroforestry. **CRS Ethiopia** is one of the nine country programmes (CPs) selected to pilot the SCP3 systems change approach. Currently, CRS Ethiopia is developing its land restoration roadmap and strategy, which clearly defines a pathway leading to improved food and livelihood security and adaptation to climate change in Ethiopia.

In addition to the three global targets outlined above, SCP3 has also developed impact indicators to measure the environmental impact of land restoration practices within the nine SCP3 target countries. These impact indicators specifically measure the effects of land restoration on land, soil, or water. The impact indicators for soil and water are higher-level measures.

> This monitoring guide highlights which of these Impact Indicators were prioritized for Ethiopia and what methods/data sources are being used to monitor those indicators.

Table 1: SCP3 Global Impact Indicators

	Indicator	Metric
Core	**Carbon stock (aboveground and/or belowground)**	Change in soil carbon stock (tC/ha)
		Change in aboveground carbon stock (tC/ha)
	Tree cover	Hectares with positive change tree cover (%) and/or tree density
	Community water monitoring	# Communities monitoring water
		% Communities reporting positive changes in water
Additional	**Farmer soil health monitoring**	# Farmers monitoring soil health
		% Farmers reporting positive changes in soil health
	Rainwater productivity	% Change in rainwater productivity
	Water quality	% Change in water quality
	Water quantity	% Change in water quantity

Monitoring guide

INTRODUCTION

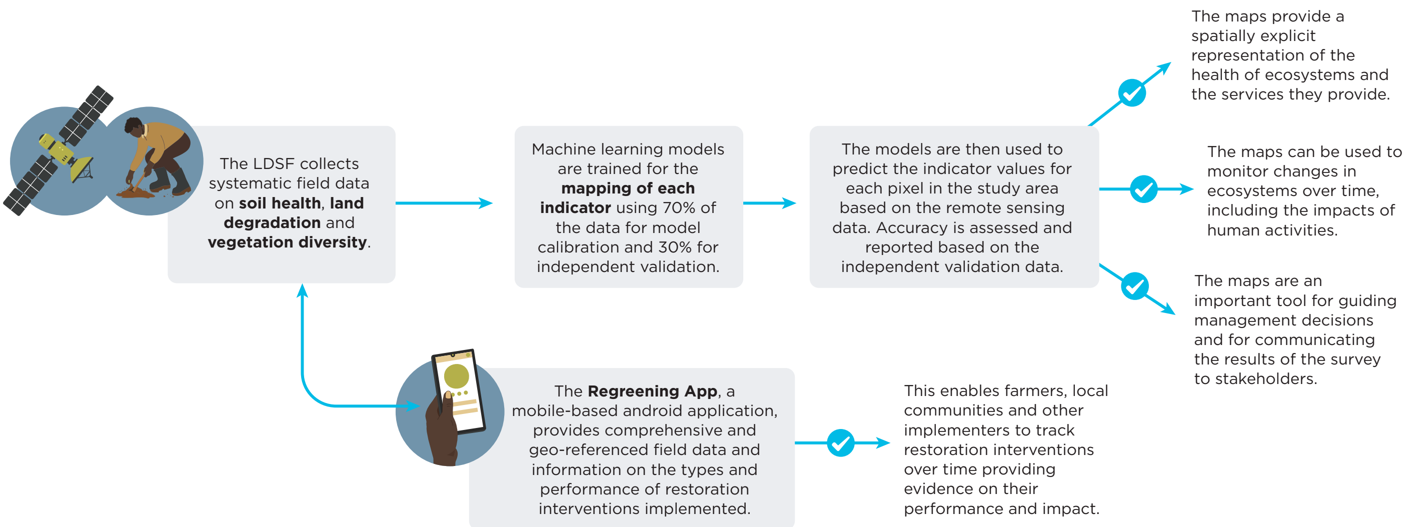
Establishing a monitoring guide

The partnership between CIFOR-ICRAF and CRS Ethiopia has identified specific soil and water parameters to monitor, establishing a monitoring system for those impact indicators, obtaining baseline values, and providing a robust framework for designing, implementing, and evaluating restoration interventions.

The indicators and suggested monitoring approach build on the baseline data collection using the LDSF and the Regreening App, which have been implemented across watersheds situated in Eastern Harerghie zone of Oromia region.

The monitoring guide provides a systematic approach that integrates both surveillance methods and citizen science to ensure comprehensive and participatory data collection. With a step-by-step approach for monitoring from baseline assessments to post-baseline evaluations, supporting long-term tracking of restoration impacts, the guide is designed for technical field staff within CRS, natural resource management (NRM) officers and development agents (DAs), extension workers working directly with the farmers.

The guide provides a practical methodology for effective monitoring, built upon hands-on experiences in restoration data collection. It ensures scientific rigour while remaining accessible for local implementation, enhancing decision-making and adaptive management in restoration efforts.



By structuring restoration monitoring efforts around three core aspects—**indicators**, **data collection** and **generating outputs**—projects can build robust, scalable, and actionable monitoring systems that enhance both accountability and impact.

1

INDICATORS

Selecting appropriate indicators is essential to ensure that monitoring activities are meaningful and aligned with project objectives. Indicators represent what is tracked over time, providing measurable evidence of ecological changes, land restoration progress, and social outcomes. These indicators guide data collection priorities and allow for standardised comparisons across sites and projects.

2

DATA COLLECTION

- **Systematic monitoring using LDSF:** This approach provides a structured method for collecting data on land health indicators across landscapes.
- **Citizen science through the Regreening App:** This tool enables local communities, farmers, and field agents to collect restoration data in real time, fostering broad engagement and extensive geographic coverage.
- **Earth observation data collected from remote sensing:** additional EO data on vegetation indices such as Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI). These vegetation indices are both used in remote sensing to monitor plant health, vegetation cover, and ecosystem productivity from satellite or airborne imagery. EVI improves upon NDVI by correcting for atmospheric conditions and canopy background noise, and is more sensitive in areas of high biomass. NDVI or EVI can be generated and combined with the data from the Regreening App in the same way. These land cover indices like EVI are not collected in the field, but rather calculated directly from satellite imagery.
- **Citizen science through CRS programming data collection:** trained community members conduct georeferenced discharge rates using simple volumetric methods from water points, mostly from existing and/or newly emerging springs as a result of watershed restoration work in the upstream of the water points.

3

GENERATING OUTPUTS

Effective monitoring requires not just data collection but also the systematic entry, management, and processing of data to produce useful outputs. A key output includes the development of **maps**, which spatially visualize restoration activities, land health changes, and other critical indicators across landscapes.

Maps generated from monitoring data—such as soil organic carbon levels and erosion prevalence—facilitate powerful spatial analysis and communication. They support decision-making by identifying priority areas for intervention, tracking progress over time, and demonstrating the geographic impact of restoration efforts.

In addition to maps, other outputs—such as **summary reports**, **dashboards**, and **statistical analyses**—help translate raw data into actionable information for project teams, donors, and policy audiences. Mapping key indicators across watersheds enhances the understanding of land management, including restoration efforts, and supports monitoring the effectiveness of different practices.

KEY TERMS

Spatially explicit stratified sampling design
Landscapes are diverse. A sampling design must capture the variability in biophysical characteristics at multiple scales (plot, landscape, regional). In order to cost-effectively sample a landscape, a stratified sampling is recommended. Intentionally dividing the landscape into relatively homogeneous units, based on a specific variable of characteristic (e.g., soil type, elevation zone, management practice, land use), so that each stratum is sampled. Stratification increases statistical power and ensures a balanced sampling across the landscape.

Once strata are identified, it is important to have a spatially explicit sampling design. We propose that 1km^2 clusters are randomized within each stratum. Each cluster will have 10-1000m^2 plots randomized within it.

Within the LDSF protocol the hierarchy is explicitly codified (subplots > plots > clusters > sites). LDSF clusters are generated, each containing 10 randomly selected 1,000m^2 sampling plots, within which field observations are made using systematic and standardized approaches.

All measurements in the field will happen in the sampling plots. This multi-scale sampling layout in which smaller observational units are embedded within larger units. This facilitates capturing variability at different ecological scales and supports the development of predictive models through integration with earth observation data. These models are locally relevant but can be scalable to regional or global levels.

Indicator
An indicator is a specific, measurable characteristic or a compositive variable derived from one or more raw metrics, that provides information about the condition, trend, or change in land health over time. Indicators assess key aspects of ecosystems—such as soil health, vegetation cover, water availability, or biodiversity—and help determine whether restoration or land management practices are achieving the desired outcomes.

Effective indicators are scientifically robust, practical for field measurement, and relevant to local environmental and social contexts. They enable a functional interpretation of land health.

KEY TERMS CONT'D

Watershed
A topographical unit defined by the land area that funnels surface water to a common outlet point. Watersheds can serve as a natural unit of analysis for stratification and as upslope interventions are directly linked downslope impacts.

Assisted citizen science
A collaborative approach to data collection and monitoring in which citizens—such as community members or farmers—are actively engaged in the monitoring process. Unlike traditional citizen science, assisted citizen science involves structured engagement and facilitated interactions with scientists and data specialists to build local capacity, ensure data quality, and foster sustained participation. Community members are well placed to geo-reference and record on-the-ground interventions, filling a key gap in restoration monitoring. Assisted citizen science enables scaling of the monitoring across large areas while enhancing community engagement in the monitoring process.

Earth Observation (EO) is the process of collecting information about the Earth's surface. This typically involves the use of satellites, aircraft, drones, and ground-based instruments to monitor and measure natural and human-made phenomena. Key aspects of Earth Observation include:

- **Remote sensing:** The use of sensors (e.g., visible light, infrared, radar) reflected or emitted from the Earth.
- **Monitoring and analysis:** Continuous or periodic observation of environmental changes, land use, climate patterns, and natural disasters.
- **Data integration:** Combining EO data with models, and statistical tools to interpret and visualize changes over time.

SECTION 1

Indicators

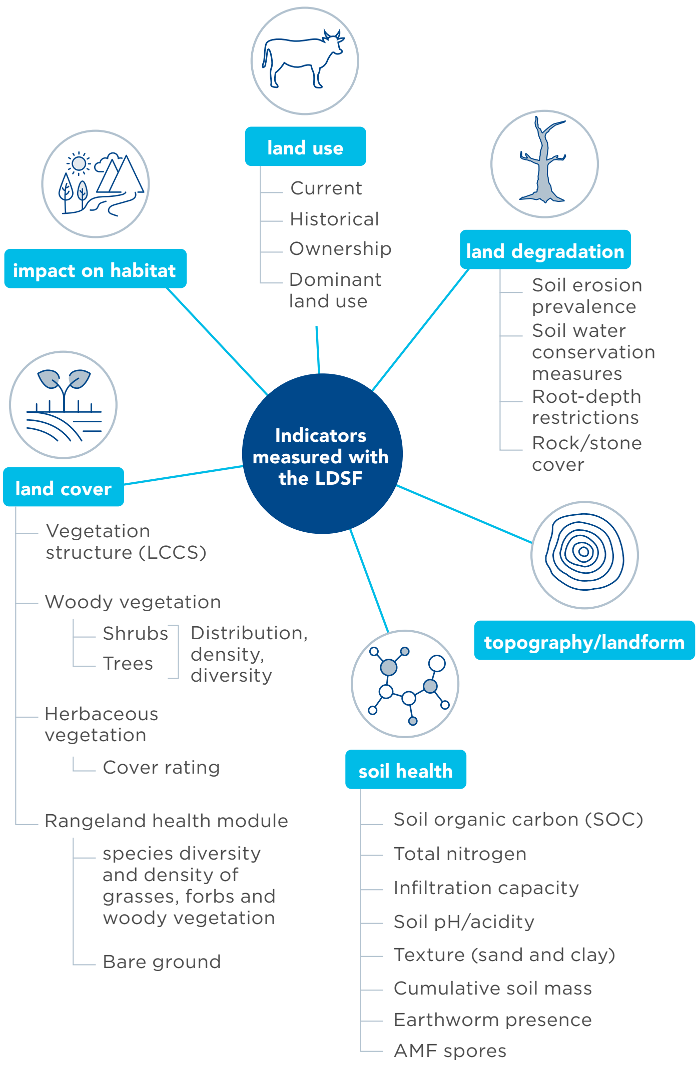
Well designed indicators reveal functional changes across key landscape domains (e.g., soil-health, vegetation productivity, hydrology) and signal whether that change is moving a landscape toward or away from the restoration goals.

What am I learning about here?
This section of the manual gives an overview on land restoration impact indicators which allow us to translate raw metrics into meaningful outputs.

They allow practitioners, managers, or policy makers to compare sites, see emerging risks, communicate progress to investors and communities, and adjust management strategically. In short, indicators turn diverse data streams into actionable insights, underpinning adaptive, accountable, and transparent restoration programmes.

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.



Full suite of indicators collected using the LDSF

Application to CRS Ethiopia:
In Ethiopia, the baseline data collection entailed implementing the LDSF across ten learning watersheds, with the target woredas and watersheds located in the East Hararghe region of Ethiopia. The indicators collected by LDSF in Ethiopia are detailed in Table 2 below.

	Indicator	Metric	Data source and methods	Specific measurement	Collection frequency
Core	**Carbon stock (aboveground and/or belowground)**	Change in soil carbon stock (tC/ha)	LDSF	Soil sample collection, measuring soil carbon in the lab	Every 5 years
		Change in aboveground carbon stock (tC/ha)	LDSF	Tree species identification, Tree measurements (height/ and dbh)	Every 3 - 5 years
	Tree cover	Hectares with positive change tree cover % and / or tree density	LDSF	Counting trees in each subplot to get density, woody cover estimates at each subplot	Every 3 - 5 years
	Community water monitoring	# of communities monitoring water	CRS programming	Number of communities with georeferenced discharge rates from water points	Annually
Additional	**Farmer soil health monitoring**	# of farmers monitoring soil health	Household socio-economic surveys		
		% of farmers reporting positive changes in soil Health	Household socio-economic surveys	Specific questions asking farmers' perception of soil health linked with the actual soil measurements	
			Soil health variables from LDSF	Soil erosion prevalence, pH, soil organic carbon, soil infiltration	
	Water quantity	% change in water quantity	LDSF soil infiltration measurements		
			CRS Programming	Georeferenced discharge rates from water points, mostly springs.	Annually during dry season (January)

SECTION 2

Data collection

Combining systematic field sampling using the Land Degradation Surveillance Framework (LDSF) with assisted citizen science using the Regreening App and earth observation data provides a deeper understanding of the drivers of land degradation and the ability to target more effective context specific restoration interventions.

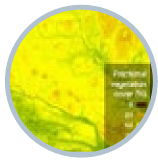
What am I learning about here?
This section will give a detailed overview and step-by-step process on systematic soil health, land degradation and vegetation diversity monitoring using the Land Degradation Surveillance Framework and the use of assisted citizen science for data collection via the Regreening App and Earth Observation data.

WHAT DOES THE **LDSF** MEASURE?

Land health assessed using LDSF's representative sampling process

Species-level data is generated, allowing a detailed understanding of species in a landscape

Land-health and soil data collected in the field is tested through soil spectroscopy in the laboratory

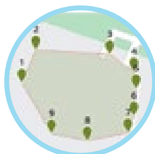


The field data is analysed with earth observation data to produce predictive maps of soil organic carbon, soil erosion, and tree cover

The LDSF sets a baseline to measure change in land health over time

WHAT DOES THE **REGREENING APP** ADD?

Data on key indicators of land restoration is collected (e.g. tree species planted, tree nursery stocks, FMNR, training offered to farmer groups, etc.)



Intervention areas down to the farm plots are georeferenced and these polygons allow for real-time monitoring of change

WHY USE THE LDSF AND THE REGREENING APP **TOGETHER**?

The citizen science of the Regreening App can be added to the systematic data collection of the LDSF to track changes in landscape health over time. This provides a deeper understanding of the drivers of land degradation and the ability to target more effective context-specific restoration interventions.

Details of what the LDSF measures and how the Regreening App data is linked together to understand trends

2.1 Data collection using the LDSF

The LDSF is a comprehensive method 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 was developed in response to the 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 the landscape level and
- a monitoring and evaluation framework for assessing land degradation processes and the effectiveness of rehabilitation measures (recovery) over time.

This is particularly important for:

- understanding land degradation dynamics,
- predicting climate change impacts,
- prioritising site-specific land management options, and
- tracking the impact of interventions on the ground.

The LDSF is suitable for application in various ecosystems, including forests, grasslands, croplands, and rangelands, and is currently used in more than 20 countries worldwide. It is now one of the largest geo-referenced databases of soil and land health indicators worldwide.

Indicators measured through the LDSF include vegetation cover and structure, diversity of tree, shrub, and grass species, current and historical land use, and various soil properties—such as soil organic carbon (for assessing climate change mitigation potential), total nitrogen, infiltration capacity, texture, and soil erosion prevalence.

How can I learn more about this?
The indicators measured through the LDSF are explained in greater detail in sub-section 2.5.

> The LDSF is based on a set of simple, standardised protocols for collecting data on land cover, land use, soil health, and land degradation. These protocols can be adapted to local conditions and are designed for use by a wide range of stakeholders including government agencies, non-governmental organisations, research institutions, and local communities with limited technical expertise.

THE LDSF ENABLES THE FOLLOWING:

- Establishing a biophysical baseline of soil health, land degradation and vegetation diversity
- Implementing spatial and temporal assessments and mapping of various soil and land health indicators
- Quantifying above- and below-ground carbon stocks
- Gaining insights into the drivers of land degradation
- Targeting land management interventions within landscapes and monitoring their outcomes
- Assessing the impact of land management practices on key biophysical indicators
- Facilitating evidence-based decision-making; Improving models related to crops, rangelands, and climate
- Effectively communicating with farmers, communities, governments, donors, and investors
- Ensuring consistent and robust tracking of interventions over time

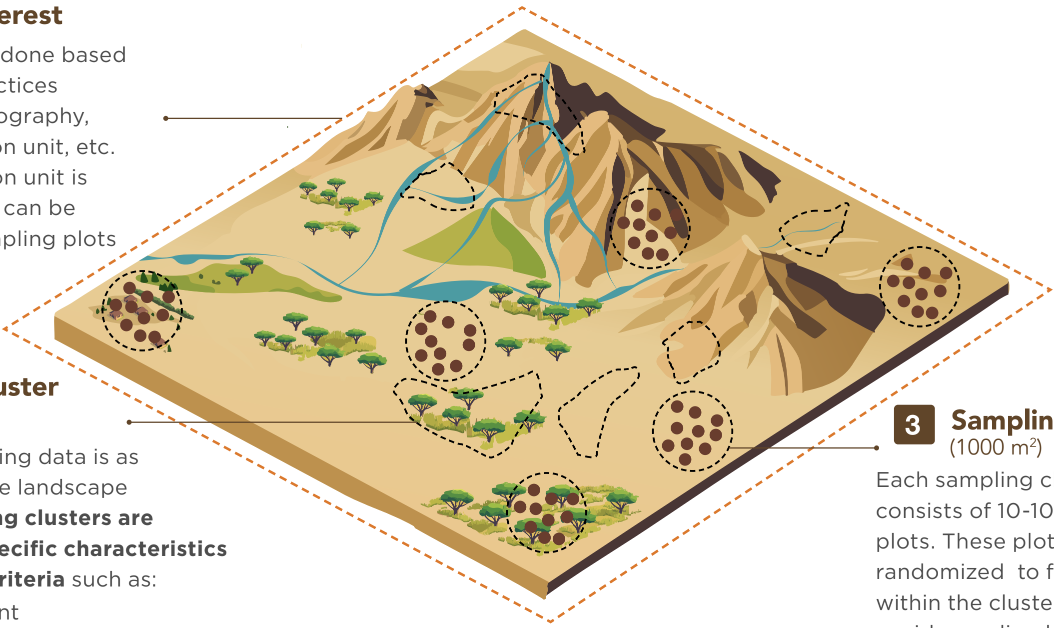
2.2 Developing a sampling procedure

The LDSF is built around a hierarchical field survey and sampling protocol, using sites that cover an area of 100 km² (10 × 10 km). LDSF sites may be randomly selected across a region or watershed, or they may represent areas of planned activities (interventions) or particular interest. In this project, we randomized clusters across watersheds, each cluster having 10-1000m2 plots.

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

The LDSF employs a nested hierarchical sampling design to provide the multiple perspectives needed to understand the complex nature of ecosystems. This approach is useful for developing predictive models with global coverage while maintaining local relevance.

Sampling clusters, each consisting of multiple plots (10 plots per cluster in the LDSF), are stratified across the landscape of interest to ensure that the resulting data is as representative as possible. This stratification results in a nested sampling design, where plots are located within clusters, which are in turn situated within watershed boundaries.



1 Region of interest

Stratification can be done based on management practices (conservancies), topography, soil type, stratification unit, etc. Once the stratification unit is determined, clusters can be randomized and sampling plots established.

2 Sampling cluster
(1km x 1km)

To ensure the resulting data is as representative of the landscape as possible, **sampling clusters are stratified across specific characteristics based on specific criteria** such as:

- Land management
- Administrative boundaries
- Topography
- Vegetation type

3 Sampling plot
(1000 m²)

Each sampling cluster consists of 10-1000m2 plots. These plots are randomized to fall within the cluster to avoid sampling bias and increase statistical power.

How will this help my restoration work?
Randomising the plots is important to minimise biases that may arise from convenience sampling. This type of stratification ensures variability is captured across a project or intervention area. 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. A nested hierarchical sampling design is useful for developing predictive models with global coverage, while maintaining local relevance.

LDSF surveys in CRS project watersheds in Oromia region, Ethiopia

Project intervention areas, in the form of watersheds, were the basis for the sampling frame. The watersheds were stratified to ensure a representative sample of watersheds—larger watersheds had more sampling points. The LDSF survey was conducted in CRS project watersheds in the Eastern Hararghe zone of the Oromia region in Ethiopia. Sampling clusters were generated for each watershed using a stratified random sampling design. The LDSF survey covered 12 watersheds selected for land health monitoring, incorporating 22 clusters and 214 sampled plots.

Here we show an example of such a stratified sampling design in Ethiopia. As you can see from the map, all of the clusters look different in terms of the arrangement of sampling plots. This is because the locations of the clusters are randomized to fall within a certain distance of the center of each cluster. This randomization step is another important element of a robust sampling design as it helps avoid bias.

Application of stratified sampling design in the Oromia region in Ethiopia.

The following section of the monitoring guide details specific steps for the LDSF, these can be found in more detail within the **LDSF Field Guide.**

2.3 Preparing for the field

Proper preparation before going to the field is critical to ensure a successful field sampling campaign, and for the safety and wellbeing of the field team. Prior to any field campaign, it is recommended that you complete the following:

- **Have a good understanding of the area to be surveyed**, including its topography, climate and vegetation characteristics, accessibility, and security situation. You can source pre-existing information about an area through maps (topographical, geological, soils and/or vegetation), satellite images and/or historical aerial photographs, long-term weather station data, government statistics, census data etc
- **Undertake a reconnaissance survey** when conducting field campaigns in new areas, in order to establish local contacts and assess arrangements.
- **Plan your timeframe.** Ideally, a 4-to 5-person field team can complete 10 sampling plots per day; this includes completing 3 infiltration tests per cluster
- **Obtain permission from the land owner(s) to sample a given area**, and make sure that he/she understands what you are doing. Informing local government officers and community leaders about your activities is also a good idea.
- **Load coordinates of sampling locations into the GPS units before leaving for the field**. If possible, load local maps into the unit to aid in navigation in the field.
- **Do a thorough equipment check before leaving for the field**, including the items illustrated on the following page (see Appendix 1 for a full equipment list). This includes making sure you have enough water to complete the infiltration tests.

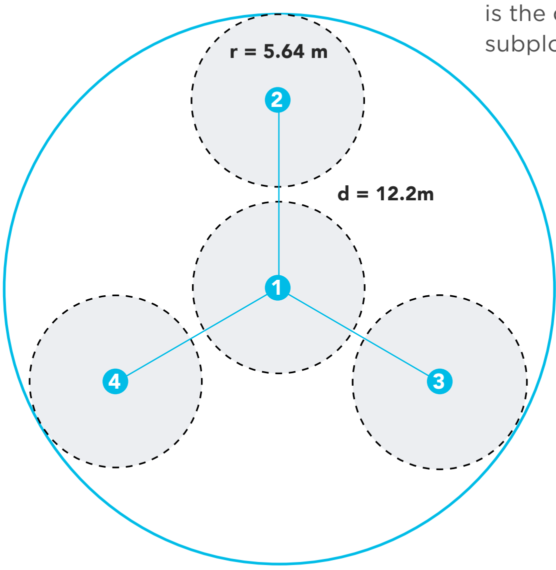

field clipboard
auger
buckets
hand shovel
measuring tape
jerrycan of water
sampling plate
clinometer
GPS unit
hammer
infiltration ring
stopwatch
ruler
block of wood

2.4 Setting up the plot

Navigate to the center of subplot 1 using the GPS. Once you arrive, use a measuring tape to measure and mark the center of each remaining subplots:

- Measure the distance (12.2 m) from the center of subplot 1 down-slope to the center of subplot (2) (or south if flat).
- Mark the centre of each subplot with buckets.
- Subplots 3 and 4 should be offset 120 and 240 degrees from the center of subplot 1, respectively.

‘r’ is the subplot radius, ‘d’ is the distance between subplot center-points.

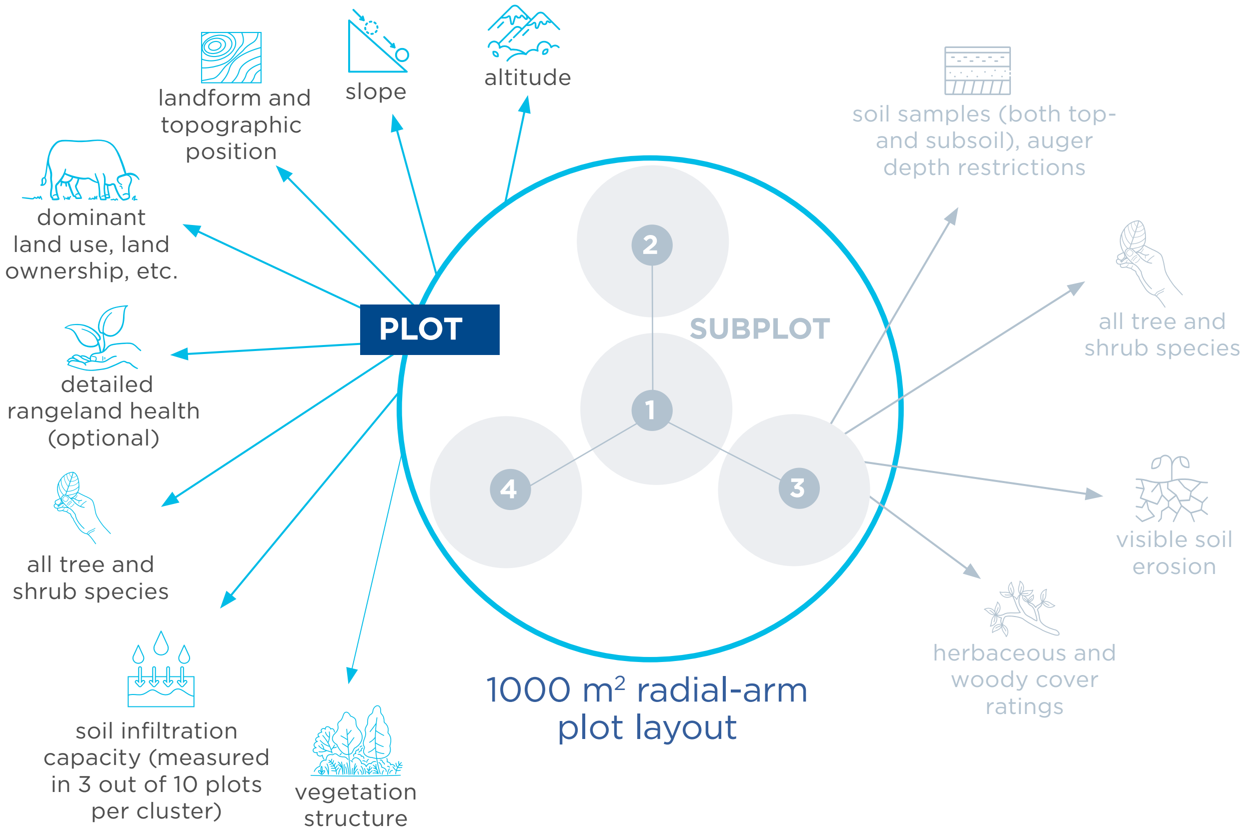


The dashed circles represent 100 m² subplots.

1000 m² radial-arm plot layout

2.5 Field measurements

Plot-level

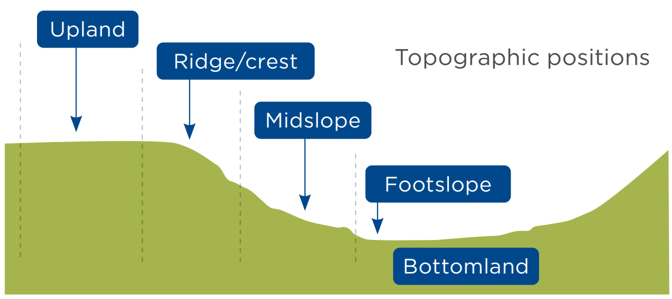


GEOREFERENCING

Initially, georeference the centre of the plot by letting the GPS average the position for at least 5 minutes. Store this as a waypoint in the GPS, and record the easting (longitude), northing (latitude), elevation and position error on the field recording sheet.

TOPOGRAPHIC POSITION

To complete the section describing topographic position, visually inspect the area surrounding the plot and select the appropriate categories provided on the field recording sheet.



SLOPE

Stand in the centre of the plot and take an up-slope sighting. Use a clinometer to measure the site in degrees, and then repeat the process in the down-slope direction. Often the downslope measurement is toward subplot 2.

- Note: Ensure that you sight to a location that is at the same height as the observer's eye level.
- In steep terrain (slope >25 degrees), use the following formula to calculate the distance from the centre point to the other subplots: *slope distance = horizontal distance/cos(Slope)*

IMPACT ON HABITAT

This is a score of observed disturbance or impact from 0 to 3, with 0 meaning none and 3 meaning severe. The impacts are scored by category.

LAND COVER CLASSIFICATION

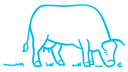
Land cover data can reflect general vegetation cover, or how much of an area or region is covered by agriculture (croplands), forests, wetlands, impervious surfaces, and other land and water types (where water types include wetlands or open water).

- Land cover is recorded in all plots using a simplified version of the FAO Land Cover Classification System (LCCS) (www.africover.org). Furthermore, scores are made of "impact on habitat", adapted from Royal Botanic Gardens in Kew (www.kew.org).
- The LCCS further differentiates primary land cover systems on the basis of dominant vegetation life form (tree, shrub, herbaceous), vegetation cover, leaf phenology and morphology, and spatial and floristic aspects.

How can I learn more about this?
The questions in the field recording sheet (see Appendix 2) are designed to guide you through the classification process.

VEGETATION STRUCTURE

Type	Description
Forest	A continuous stand of trees, their crowns interlocking
Woodland	An open stand of trees with a canopy cover of 40% or more. The field layer is usually dominated by grasses.
Bushland	A mix of trees and shrubs with a canopy cover of 40% ore more
Thicket	A closed stand of bushes and climbers usually between 2 and 7 m tall
Shrubland	An open or closed stand of shrubs up to 3 m tall
Grassland	Land covered with grasses and other herbs, either without woody vegetation or with less than 10% woody cover
Wooded grassland	Land covered with grasses and other herbs, with woody vegetation covering between 10 and 40% of the ground
Cropland	Cultivated land (or land being prepared for cultivation, if sampling during the dry season) with annual or perennial crops
Mangrove	Open or closed stands of trees or bushing occurring on shores between low and high water mark
Freshwater aquatic	Herbaceous freshwater swamp and aquatic vegetation/wetland
Halophytic	Saline and brackish swamp vegetation
Distinct/restricted	Formation of distinct physiognomy (vegetative formations) but restricted distribution (e.g., bamboo, inselbergs, etc.)
Other	



LAND OWNERSHIP AND USE

Land ownership is recorded as private, communal or government

Land use shows how people use a given area or landscape whether for development, conservation, tree planting, cropping, or mixed uses. Agroforestry, for example, is a mixed land use system that combines trees and/or shrubs with crops and/or livestock.

LDSF options for land use include: annual crop, perennial crop, annual agroforestry, perennial agroforestry, fallow, woodlot (a tree plantation grown for timber), protected area, pasture rangeland, natural vegetation, and other.

Use the following table to record the dominant land use for the plot. This is different to vegetation structure.

If a plot is cultivated, the following agricultural questions need to be considered:

- Management of crops cultivated in the last 12 months;
- Was crop rotation practiced in the last 12 months?
- Was intercropping practiced in the last 12 months?
- Was farmyard manure applied to any of the crops in the last 12 months?
- Was inorganic fertilizer used on any of the crops in the last 12 months?

Agricultural practices: fallowing and burning.

- Is fallowing (leaving part of the land uncultivated for one or more seasons) being practiced on this plot?
- Number of years in which fallowing has been practiced on this plot?
- Is burning practiced on this plot?
- How often is burning practiced on this plot?

Case description	Is the plot cultivated?	Structure of the vegetation	Land use
Eucalyptus plantation	Yes	woodland	woodlot
***Leucaena luecocoephala* plantation**	Yes	woodland/shrubland/bushland*	woodlot
Citrus plantation	Yes	woodland/shrubland/bushland*	perennial crop
Mango plantation	Yes	woodland/shrubland/bushland*	perennial crop
Palm tree plantation	Yes	woodland/shrubland/bushland*	perennial crop
Castor plantation	Yes	cropland	annual or perennial crop (dependent on variety)
Banana plantation	Yes	cropland	perennial crop
Grape plantation	Yes	shrubland	perennial crop
Tea plantation	Yes	shrubland	perennial crop
Cotton plantation	Yes	shrubland	perennial crop
Agricultural field where annual crops are planted and grown during the wet season, but visited during the dry season when no crops are present	Yes	cropland	annual crop
Agricultural field that is fallow and has been so for more than one year	No	grassland/wooded grassland/ shrubland*	fallow
Cowpea field with no trees	Yes	cropland	annual crop
Cowpea field with scattered trees	Yes	cropland	annual agroforestry
Paddy field	Yes	cropland	annual crop
Grasses present with no trees or shrubs	No	grassland	rangeland pasture
Grassland with few trees	No	wooded grassland	rangeland pasture

RANGELAND HEALTH

The LDSF rangeland module aims to assess the health of a rangeland and can be applied in each LDSF plot (1000 m^2) in both the dry and wet seasons.

The rangeland health assessments are conducted using the **transect method**. A stick/pin is placed every 2 m along two 28 m transects (one N-S and E-W). At each point the nearest annual grass, perennial grass, forb and woody vegetation is identified.

How will this help my restoration work?
Rangelands are important ecosystems and can harbour a high biodiversity of grass species and high soil organic carbon (SOC) content. There is a real need to collect systematic data on rangeland health to assess degradation status, productivity and biodiversity measures.

Key rangeland health indicators measured through the LDSF rangeland module include:

- Nearest perennial grass species
- Distance to nearest perennial grass
- Nearest annual grass species
- Distance to nearest annual grass
- Bare ground
- Nearest forb species
- Distance to nearest forb
- Nearest woody plant species (<1.5 m height)
- Distance to nearest woody plant
- Rock cover

SOIL INFILTRATION CAPACITY

Soil infiltration capacity is a key indicator of **soil health**. It is a measure of how quickly water can move into the soil.

- Soil infiltration capacity measurements are the most **time consuming** aspect of the field measurements, so these should be set as soon as possible.
- A minimum of three infiltration measurements should be conducted per cluster. Allocate these randomly to the different plots in the cluster. We usually recommend to use Plot 1 as the reference plot and to conduct infiltration there.
- These data will be used to plot **infiltration rates of water into soil** and to calculate the **saturated hydraulic conductivity**. By repeating measurements across the landscape, we will be able to assess the effects of land management and vegetation types on soil hydrological properties.
- The LDSF uses **single-ring infiltration testing** as a robust method for calculating infiltration rates. While double-ring tests may also be used, they are often too time consuming and require very large quantities of water, not allowing for repeated measurements across a landscape.

You will need:

- an infiltration ring with a 17 cm diameter and ~20 cm in height.
- a ruler
- a hammer and block of wood
- approximately 25 litres of water
- a small cup for scooping water
- a timer
- an infiltration form

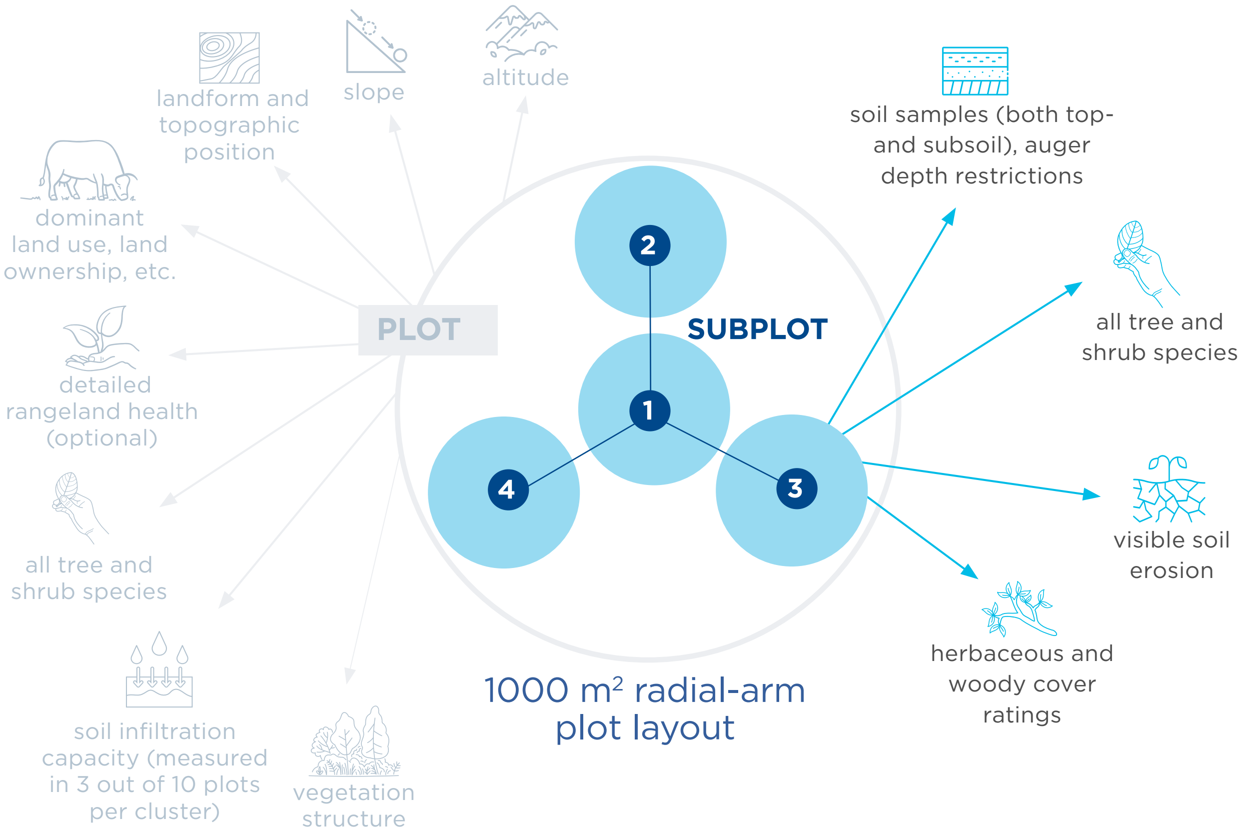
How to measure infiltration:

1. Place the infiltration ring at the center of subplot 1. Using the hammer, drive the ring at least 2 cm into the soil, taking care to not disturb the soil surface. Make sure that the beveled end of the ring is inserted into the ground, and that the infiltration ring is level.
2. Place and stabilise the ruler inside the ring.
3. Fill the infiltration ring with water, pouring slowly so as not to disturb the soil surface. Continue pre-wetting for 15 minutes. Ensure that the ring does not leak! If it leaks, remove the ring and place it elsewhere. If there is floating litter inside the ring, you can remove it to allow for accurate readings on the ruler.
4. To start the test, fill the ring to the start level. The start level should be easy to read on the ruler and at the top of the ring (i.e., 16 or 17 cm). When pouring the water, be sure not to disturb the soil surface
5. Start the timer and record the exact start level (in cm) on the infiltration form
6. Record the end level of the water on the ruler at the end of each time interval, refilling the ring back to the start level to proceed with the test. Do not stop the timer; let the time run continuously.

Tips:

- Never allow the ring to empty completely.
- Always be sure you can clearly read the end level on the ruler.
- This may mean you need to reduce the time interval if infiltration is fast (e.g., take a measurement every two minutes). Likewise, if infiltration is too slow, you may need to increase the time intervals to be able to read the drop in water level. Record these changes on the infiltration form.

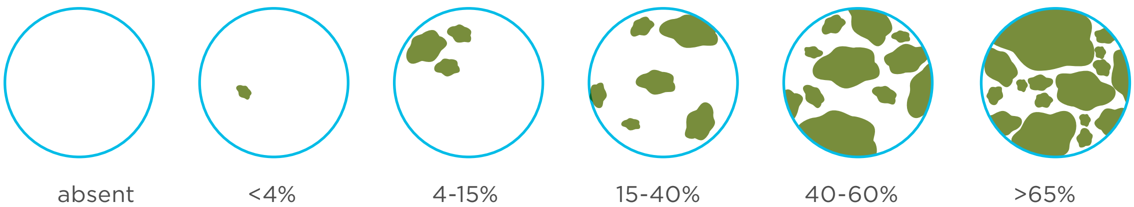
Field measurements
Subplot-level



VEGETATION MEASUREMENTS (DENSITY AND DIVERSITY)

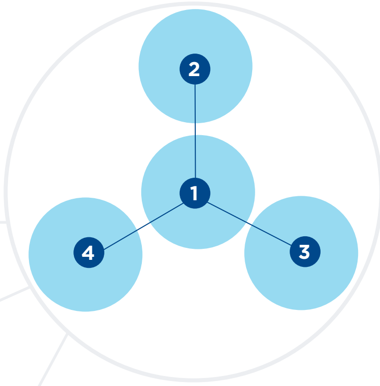
In each subplot, count each shrub and tree and enter these data in the field form. Woody and herbaceous cover ratings are made using a Braun- Blanquet (Braun-Blanquet, 1928) vegetation rating scale from 0 (bare) to 5 (>65% cover).

The LDSF cover ratings are as follows:



SOIL SURFACE AND SOIL EROSION CHARACTERISATION

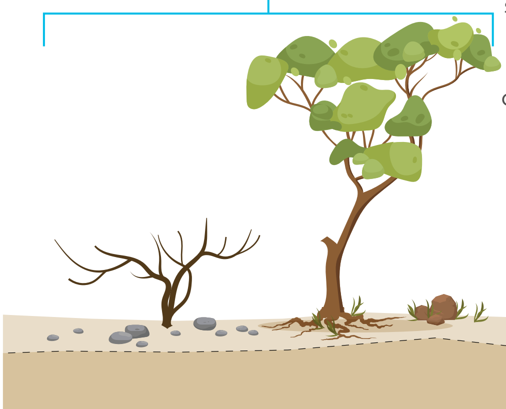
Erosion is arguably the most widespread form of land degradation in the tropics. There are many forms of soil erosion; in the LDSF, **each sub-plot (n=4) is classified according to erosion status as None/Sheet/Rill/Gully.**

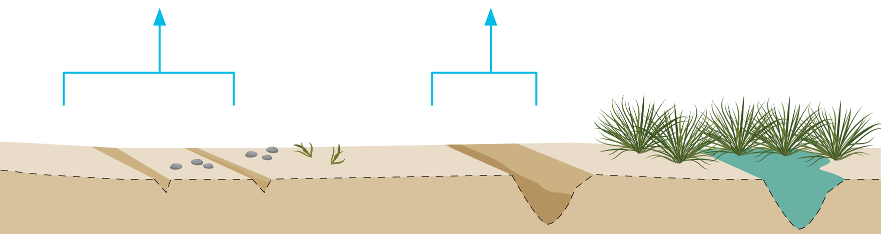


Sheet erosion is the uniform removal of soils in thin layers. Overgrazed and cultivated soils are most vulnerable to sheet erosion, and signs of sheet erosion include: bare areas, water puddling on the surface as soon as rain falls, visible grass roots, exposed tree roots, and exposed subsoil or stony soils.

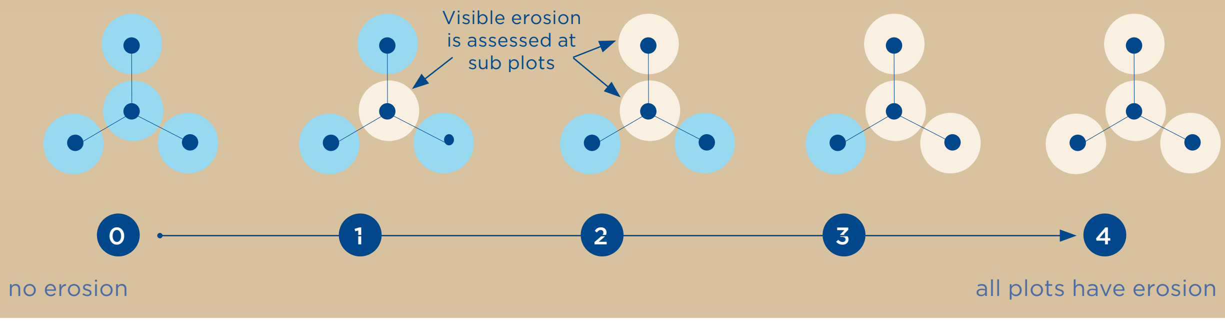
Rill erosion is the intermediate stage between sheet and gully erosion. Rills are shallow drainage lines less than 30 cm deep. The channels are shallow enough that they can usually be removed by tillage.

Gully erosion is a consequence of water cutting into soil along the line of flow. Gully channels are deeper than 30 cm. In contrast to rills, they cannot be obliterated by ordinary tillage.





Based on this classification, a **visible erosion score is calculated by aggregating the erosion observations.** Note - all 4 subplots have at least one of the 3 forms of erosion visible to be categorised along the scale.



How can I learn more about this?
The complete list of site characteristics to be recorded in each subplot can be found in the field recording sheet in Appendix 2.

Modelling the probability of erosion
We take the observations of erosion and classify each plot as eroded (1) if 3 or more subplots have visible signs of erosion and non-eroded (0) if not. We then use covariates from remote sensing platforms to develop a model that estimates the probability of erosion in each plot in %.

Keep in mind that after an eroded field has been tilled, it makes it hard to assess in many/some cases whether the soil losses resulted from sheet or rill erosion.

We model the prevalence of soil erosion for each plot by considering plots with a visible erosion score of 3 or higher. Visible erosion is how assessed in the sub-plots.

MEASURING BIOMASS AND BIODIVERSITY

For both trees and shrubs, measure the height of each individual plant using either the height pole or a clinometer.

For each tree in each subplot, measure the circumference at breast height (1.35m above ground level). Where a tree branches below this level, measure the main trunk or the diameters of all branches, and average these. For trees that are tilted, determine the 1.3 meter level from the down-slope direction and measure the diameter there.

For each shrub in each subplot, measure the width and length.

Biodiversity of aboveground woody vegetation will be assessed. Record the species of each tree and shrub in each subplot, using the form in Appendix 2.

- If you do not know the scientific names of the shrubs or trees, record the common or local names.
- Trees and shrubs are measured separately.

SOIL SAMPLING

Two types of soil samples are collected at each plot: composite soil samples and cumulative mass soil samples.

Composite soil samples are a representative sample of the plot. Topsoil samples are collected at the center of each subplot (from 0-20 cm) and combined into one composite topsoil sample. The same is done for subsoil (20-50cm) samples.

Cumulative mass sampling is used to calculate stocks on a soil mass basis rather than using bulk density. The idea is to auger in 20 cm increments to 110cm, collecting ALL of the soil from each depth increment. The cumulative mass sample is collected from the centre of the plot. A sampling plate is used to easily capture any soil that falls out of the auger before transferring it to the bucket and to prevent collapse of the auger hole.

You will need:

- a soil auger marked at 20, 50, 80 and 110cm
- sturdy plastic or paper bags
- a mixing trowel
- a permanent marker
- labels
- buckets in different colours for topsoil and subsoil samples
- a sampling plate (for cumulative mass soil sampling only)

Helpful notes:

- If you hit a restrictive layer when you are augering (known as auger depth restriction), record the depth of this restriction on the form for each subplot. If you do not have a restriction, enter 50 cm.
- Labelling is critical! Site, cluster, plot and depth code and date should be legibly recorded with a permanent marker on the outside of the soil sample bag. A paper label containing the same information (written with a permanent marker or pencil) should be placed inside the bag. Samples should be double-bagged.

A note on soil sampling methods

CUMULATIVE MASS SOIL SAMPLING METHOD

1 Press the sampling plate firmly onto the soil, so the plate is flush with the soil surface.

2 Place the auger in the centre of the hole in the plate and begin to auger straight down. Note: If the soil is very dry, it may be difficult to auger. Pre-wetting the soil before augering each increment may help.

Note: Depending on soil texture, a clay, combination or sand auger can be used, but use the same auger for the entire depth (profile). Changing augers may change the volume of the auger hole. Record auger diameter!

3 Be careful not to overfill the auger as this will distort the volume of the hole. To avoid this, empty the soil from the auger after every ~3 full turns.

4 Auger down to 20 cm, collecting ALL of the soil from the auger into the bucket. Be sure to collect any soil that has fallen onto the sampling plate.

5 Then transfer all of the soil to a clearly labelled plastic bag. The next samples to be collected are from 20-50, 50-80 and 80-110 cm.

COMPOSITE SOIL SAMPLING METHOD

1 Collect **topsoil (0-20 cm)** from the center of each subplot using an auger and put the sample in a labelled bucket.

2 Collect **subsoil (20-50 cm)** samples from the center of each subplot using an auger and put the sample in a labelled bucket. When augering the subsoil, ensure that no topsoil falls into the auger hole.

3 Pool (composite) all of the **topsoil** samples from each subplot into one bucket, and mix the soil thoroughly.

4 Pool (composite) all the **subsoil** samples from each subplot into one bucket, and mix the soil thoroughly.

5 Take a representative **~500g sub-sample of the topsoil** and place it in a labelled bag. Complete the same for the subsoil.

Source: The LDSF Field Manual, 2023

Note: There should be one bag of topsoil and one bag of subsoil for each plot. Auger depth restrictions are recorded (in cm) for each subplot, if they occur during sampling.

2.6 After the field — soil sample analysis at CIFOR-ICRAF

After getting back from the field, the samples should be air-dried as follows:

- Air-dry soil samples by spreading a sample out as a thin layer into a shallow tray or by placing in shallow plastic bowls. Break up clods as far as possible to aid drying.
- Drying can be done in large room, a custom-made solar dryer, or a forced-air oven at 40° C.
- It is important to ensure that no material from a sample is lost or discarded as weights of soil fractions are to be recorded on processing. Contamination from dust, plaster or other potential contaminants should be avoided.
- Drying time depends on the samples and ambient conditions, but the samples should be thoroughly dry (i.e. constant weight).

Once air-dried, soil samples are either **processed locally** (weighed, sieved, coarse fragments weighed) or sent to **ICRAF's Soil and Land Health Laboratory in Nairobi**, where they are pre-processed and analysed using mid-infrared (MIR) spectroscopy to enable landscape scale analysis.

- Reference soil samples are analysed using traditional wet chemistry (pH, organic carbon, total nitrogen, base cations, etc)
- Predictions are made using the spectra

- Soil cumulative mass samples (0-20,20-50,50-80,80-110 cm) are analysed for carbon stock calculations

Field and laboratory data collected using the LDSF are stored in open source databases, hosted at ICRAF. All data are subjected to advanced data analytics and robust statistical analysis.

How can I learn more about this?
ICRAF's Soil Plant Spectral Diagnostics Laboratory leads advances in soil spectroscopy and hosts the largest systematic, georeferenced library of soil infrared spectra in the world. For more information, visit https://www.cifor-icraf.org/research/theme/soil-and-land-health/.

2.7 Data collection using the Regreening App: documenting and georeferencing implementation activities

Assisted citizen science plays a crucial role in scaling up restoration and land health monitoring by actively engaging and training communities, particularly farmers, to participate in data collection efforts.

> This approach not only helps to gather valuable, on-the-ground insights but also fosters a sense of ownership and stewardship in restoration and monitoring projects. Through co-design processes and capacity-building initiatives, communities become integral to monitoring efforts, enhancing both the quality and scope of the data collected.

A major challenge for restoration monitoring has been how to scale data collection in a cost-effective manner. This is where assisted citizen science, particularly through mobile applications like the **Regreening App**, becomes so powerful.

Another persistent barrier in restoration monitoring has been the lack of comprehensive georeferenced data and detailed information on the types of interventions implemented—gaps that assisted citizen science is continually evolving to effectively address. A key innovation with the Regreening App is the **Data Reporting System** (DRS), the back-end online support that allows users to log in, upload data, and visualize geospatial polygons in real time. This empowers contributors, enables real-time quality control, and provides each project administrator with unique access credentials to monitor incoming data.

Looking ahead, **the goal is to transition toward pure citizen science models, where farmers and communities generate actionable data at scale.** Future enhancements, including a back-end recommendation engine, aim to deliver tailored guidance directly to users, transforming citizen-generated data into impactful restoration and land management decisions.

How will this help my restoration work?
By equipping local users with simple, guided technology and follow-up support, data collection can be expanded significantly without the high costs typically associated with large-scale monitoring programs.

Overview of the Regreening App

Designed for farmers, field agents, and restoration champions, the Regreening App allows for robust landscape level monitoring and empowers users to easily record, track, and monitor land restoration activities — all geo-referenced and recorded in real time.

The Regreening Africa App ecosystem is a digital data collection and reporting system developed to support land restoration initiatives. It consists of two main components:

- the **Regreening App**, a mobile-based android application that allows users to collect data at farm level on a range of land restoration practices, and
- the **Data Reporting System** (DRS), a web-based platform for aggregating, reviewing and managing data across projects.

Each record submitted through the app is tagged with the enumerator's identity, project name, date, and geographic coordinates, which allows for efficient filtering, monitoring, and spatial analysis of restoration efforts.

The DRS complements the mobile app by providing a platform for project teams to access, organize, and analyze the data in near-real-time. This integration supports progress tracking, verification of results, and reporting to stakeholders, including donors and implementing partners.

The ecosystem was developed by World Agroforestry (ICRAF) in collaboration with project stakeholders, with the goal of enhancing transparency, improving data quality, and strengthening the evidence base for restoration decision-making.

How will this help my restoration work?
Through assisted crowdsourcing, the Regreening App captures critical data from across countries and diverse landscapes, delivering deep insights into the drivers of land degradation. This data paves the way for more contextually relevant restoration efforts that deliver real results on the ground.

UNIQUE FEATURES OF THE REGREENING APP

The App **merges field data with spatial assessments of land health**, enabling powerful insights such as monitoring soil organic carbon and assessing soil erosion, information which can directly support climate neutrality goals and national restoration targets.

The App enables stakeholders including farmers to record and track their land restoration practices, tree nursery activities, and species diversity in real time. Through the back-end data reporting system, this geo-referenced **field data is transformed into actionable insights** for farmers, project managers, and policymakers.

The App enables offline data collection, thus making data submission possible when internet connectivity is not available.

The Regreening App ecosystem is continually evolving to allow for robust data interpretation. In the future, it will include management recommendations based on soil and land health maps developed at CIFOR-ICRAF.

Although citizen science data can be 'messy' requiring good data analytics, the app allows data to be captured at a huge scale, in context-relevant locations.

Data collected through the App is freely and instantly available to the users and various outputs from the synthesis of the data, such as critical land health indicators, are then shared with the public through the Regreening Africa Dashboard.

The app allows users to evaluate land conditions to inform better restoration strategies, and to track critical soil indicators that influence restoration success.

Data collected through the App is available to users in real-time through DRS. The data is securely stored and users (or projects) manage their own data and can determine how they want to share data.

Overview of the Regreening App (continued)

REGREENING APP MODULES

The Regreening App includes dedicated modules for recording a variety of restoration-related activities, including:

Tree planting

- Record the targeted households/communities which have adopted tree planting practices
- Record the number of hectares regreened by tree planting
- Geo-reference the tree planting plots
- Identify tree species and record planting date
- Record management practices and uses of the trees
- Evaluate the performances of the planting practices
- Track the growth of the trees by measuring them and assessing the management practices
- Geotag selected trees

Farmer-Managed Natural Regeneration (FMNR)

- Document and geo-reference plots that where FMNR is being implemented
- Record the number of hectares greened through FMNR
- Record the tree species composition of the FMNR plot
- Record the management practices
- Track the growth of the trees by measuring them and assessing the management practices
- Geotag selected trees

Nursery registration (to assess the availability and quality of planting materials)

- Record the nurseries
- Record seedling production (species composition, production capacity,seedlings quality)
- Record and assess the seedling production practices
- Geotag the nurseries
- Link people to nurseries

Engagement module - capacity building and stakeholder engagement activities

- Document the engagement carried out: the number of participants,location, topic, etc.
- Connect the topic of the engagement carried out in a given location to the practices and issues identified that will guide the training schedule(s)
- Document participation in the engagement in terms of number and gender

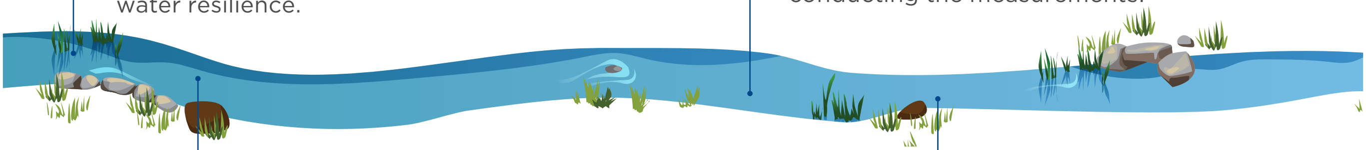
Soil/water conservation and Rangeland module - recording rangeland health restoration interventions

- Half moons
- Reseeding
- Soil water conservation/erosion control
- Mobile bomas
- Invasive species removal
- Georeferencing interventions
- Recording grass, forb and tree species

2.8 Community watershed and restoration monitoring using citizen science

As part of the RFSA program's integrated watershed management approach, **community-based geo-referenced water monitoring** is being implemented as a form of citizen science, engaging both project staff and local government development agents in systematically tracking changes in water availability—particularly at spring sources.

How will this help my restoration work?
This is an approach that can be easily replicated and scaled into different watershed restoration initiatives.



1 Purpose and link to natural resource management
The initiative aims to assess the impact of watershed restoration and source water protection efforts on water availability. After identifying key water sources—mainly springs—watershed interventions such as upper catchment treatment and soil and water conservation were carried out to improve groundwater recharge. Monitoring changes in spring discharge serves as an important indicator of ecosystem recovery and community water resilience.

2 Monitoring methods and tools
To measure spring discharge, two standard hydrological methods are employed, depending on the nature of the water source:

- Volumetric Method – suitable for small, steady flows.
- Velocity-Area Method – used for larger or irregular flows.

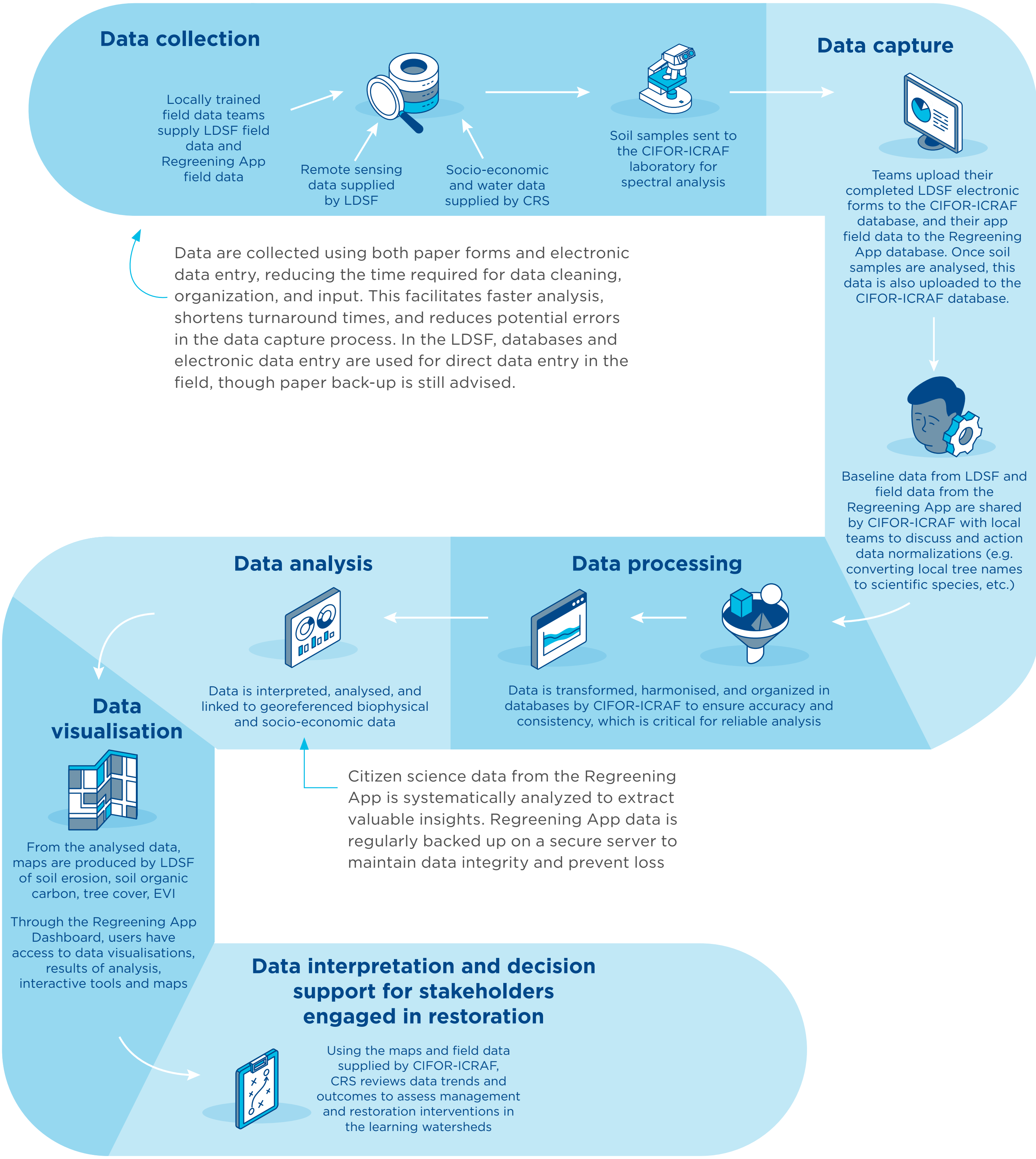
The measurements are taken annually during the driest month (January), which provides consistent baseline conditions and makes trends over time easier to track.

3 Training and capacity building
Prior to launching the monitoring activities in 2024 (Year 3 of implementation), the project organized technical training on discharge measurement techniques for both RFSA program staff and government natural resource management (NRM) agents. These trained staff are now responsible for conducting the measurements.

4 Adaptive monitoring and inclusion of emerging springs
An important innovation in the program is the inclusion of newly emerged springs in the monitoring system—springs that have appeared since the implementation of NRM interventions. This demonstrates the dynamic impact of restoration and allows the monitoring framework to evolve with changing local conditions.

2.9 Electronic data entry, management and analysis

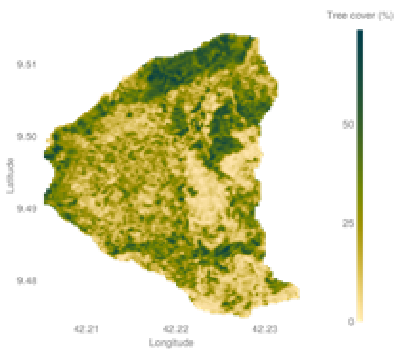
Effective data management is critical when comparing projects, as it ensures that data can be easily retrieved and utilized. Robust systems for data storage support consistent access, analysis, and informed decision-making. Data management is key to rigorous and reproducible assessments of soil and ecosystem health.



SECTION 3

Generating outputs

Effective monitoring requires not just data collection but also the systematic entry, management, and processing of data to produce useful outputs. Key outputs are as follows:



LDSF field data is analysed with earth observation data to produce **predictive maps** of soil organic carbon, soil erosion prevalence, and tree cover

Once the maps are created, **data from the Regreening App** (specifically the field polygons where interventions such as tree planting, FMNR, etc. are taking place) **can be superimposed on these maps and information on indicators can be extracted**

The Regreening App has a dedicated Data Reporting System where results of the Regreening App surveys in the watersheds are available immediately

Data is used to **inform local decision-making**

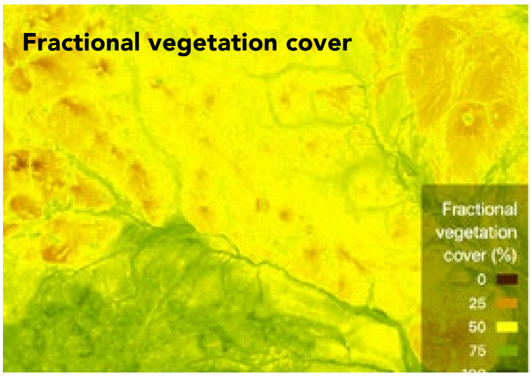
3.1 Maps from LDSF

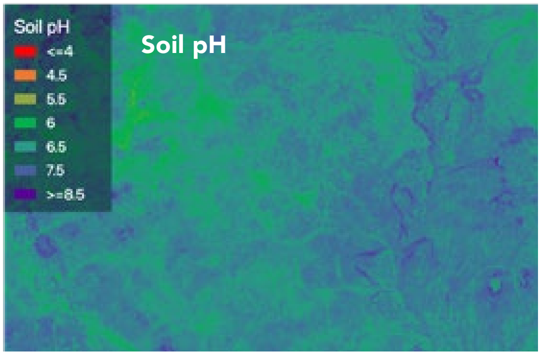
Key outputs from the LDSF include maps of soil organic carbon, soil erosion prevalence and tree cover. The LDSF uses data from multiple global sites to create predictive mapping outputs at multiple spatial scales:

- 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.

> This on-the-ground evidence, generated through systematic data collection, can form an invaluable tool for policy- and decision-makers. The maps provide a spatially explicit representation of the health of ecosystems and the services they provide, and can be used to monitor changes in ecosystems over time, including the impacts of human activities.





How will this help my restoration work?

To effectively target interventions to restore degraded land and enhance productivity, multiple indicators and their thresholds should be considered. The maps provide thresholds that can be useful in identifying areas where land restoration interventions are needed, or should be targeted.

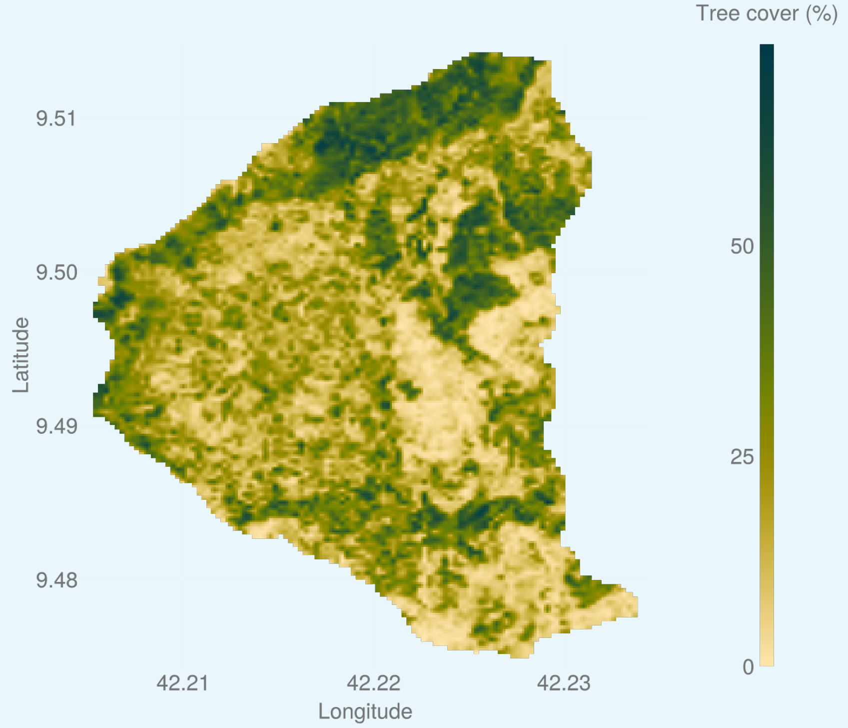
For example, where erosion prevalence is higher than 60%, land degradation is likely to be severe so these areas would be considered hotspots of land degradation.

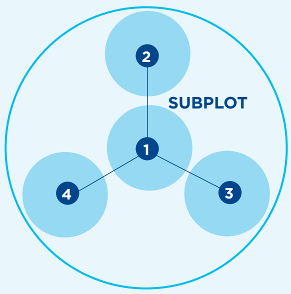
In terms of soil health, thresholds of soil organic carbon (SOC) are important. Where SOC is lower than 10 g/kg there will be constraints to agricultural production, which means that interventions to increase SOC such as the application of organic matter will be important to enhance productivity. Another important indicator of soil health is soil infiltration capacity, which is also influenced by SOC. In other words, some indicators such as SOC are often considered core indicators as they influence a range of ecosystem functions, including biodiversity.

Analysis from tree cover maps

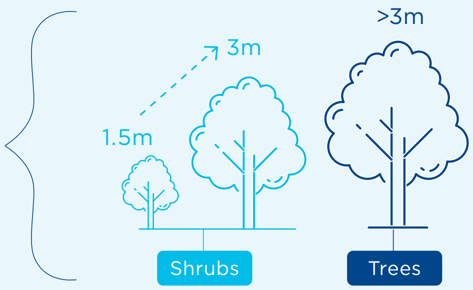
In the LDSF, we assess both the **density and diversity of shrubs and trees**. The adjacent map of tree cover (%) in Jarso-El-Tokke watershed shows variance of percentage tree cover.

As well as tree cover the methodology allows a detailed understanding of species. This is very useful in restoration monitoring, to allow a detailed understanding if species are indigenous or exotic as well as the range of species present in an area. As shown on page 46 - 47 the dominant species in the learning watershed were *Terminalia brownii* and *Eucalyptus globulus.*

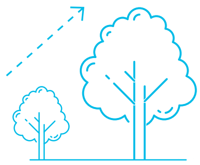




In each subplot (n=4) per LDSF plot, trees and shrubs are counted.



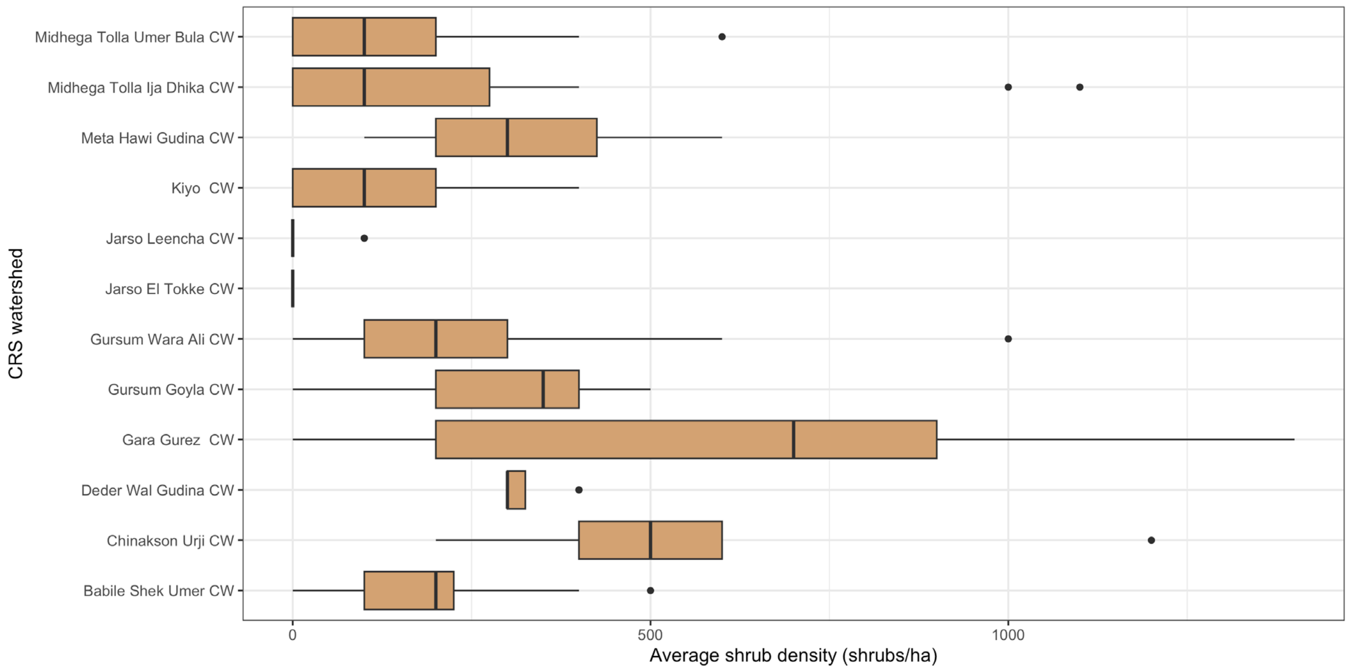
Trees are woody vegetation above 3m and shrubs are woody vegetation between 1.5-3 m tall.

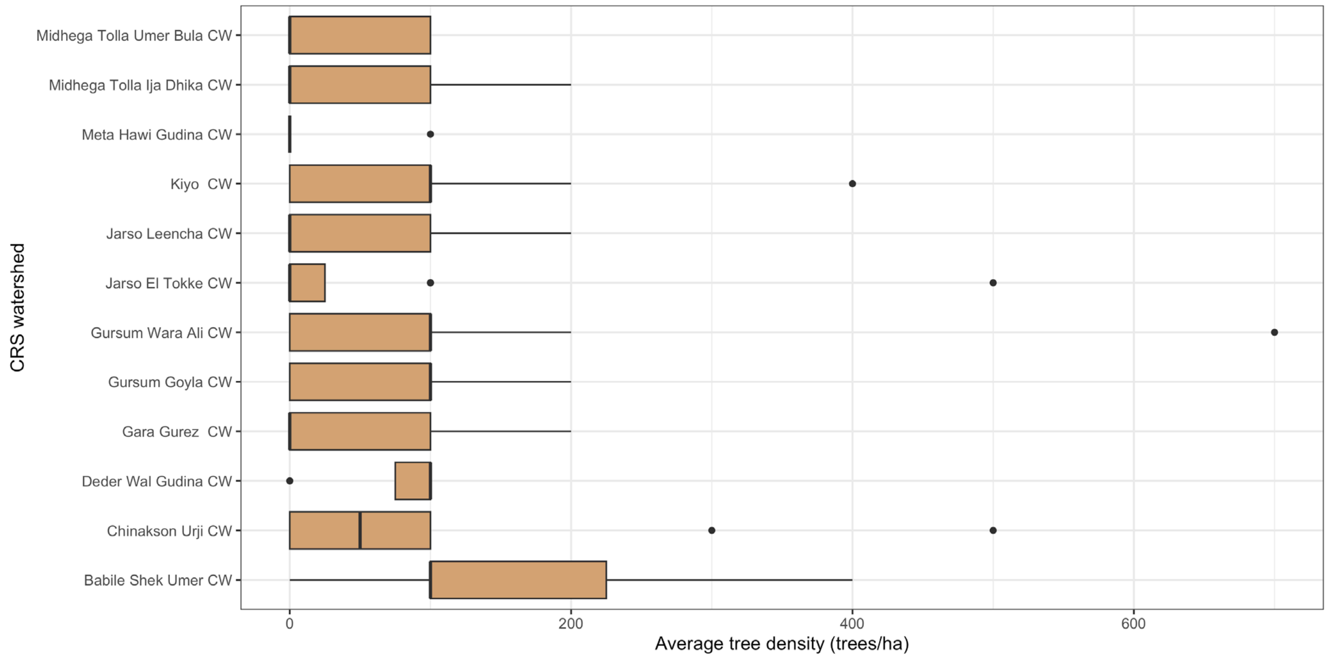


These graphs show the variation in tree and shrub density across the watershed.

FOR EXAMPLE

- Gara Gurez had both the highest density and greatest variation in shrub density
- Meta Hawi had the lowest tree density
- Babile Shek Umer had the highest tree density.
- These data are important when looking at opportunities to scale agroforestry interventions.

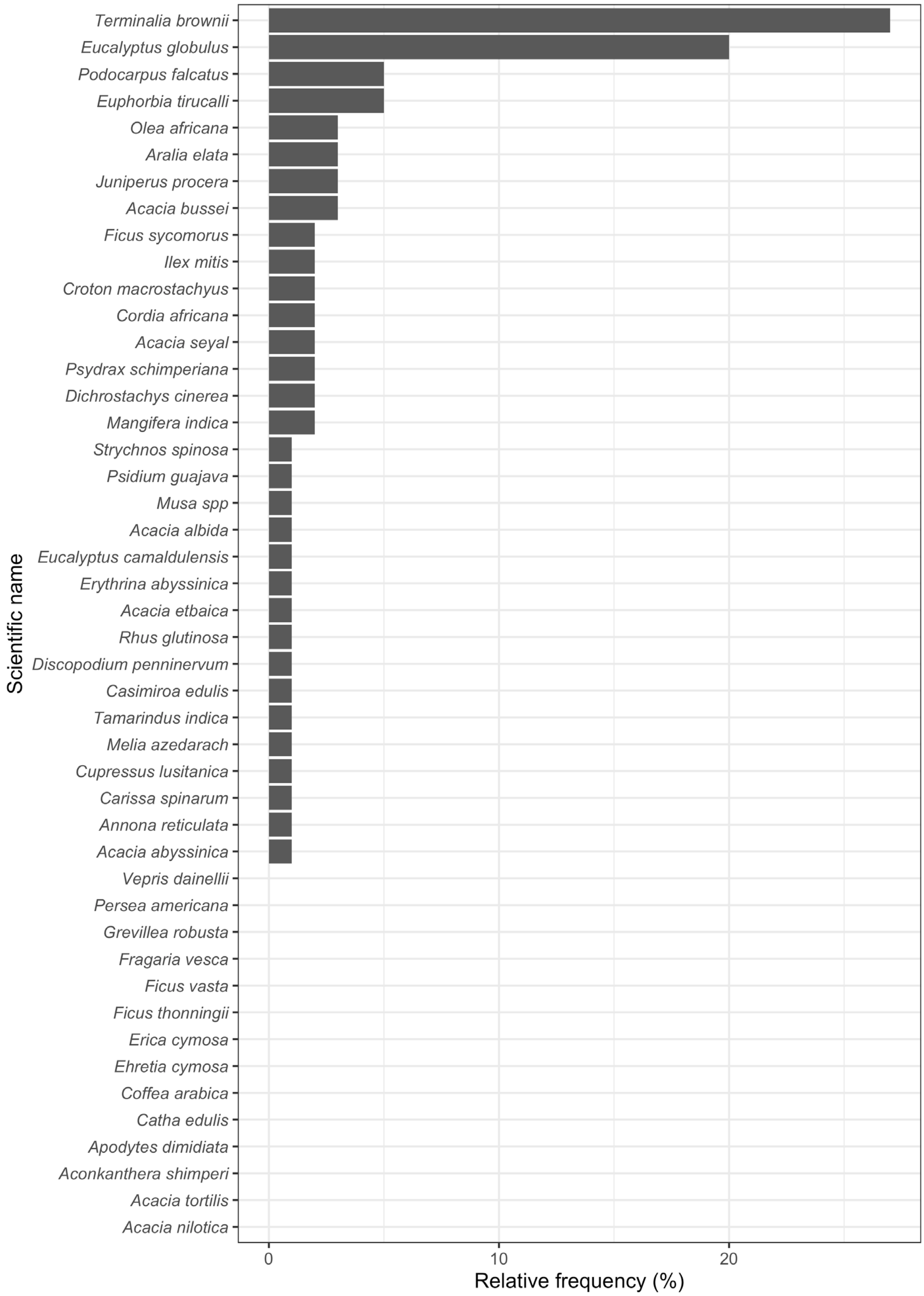




While tree and shrub densities are important, it is also important to identify the species that exist. This graph shows the frequency of occurrence of tree species across the sampled watersheds.

FOR EXAMPLE

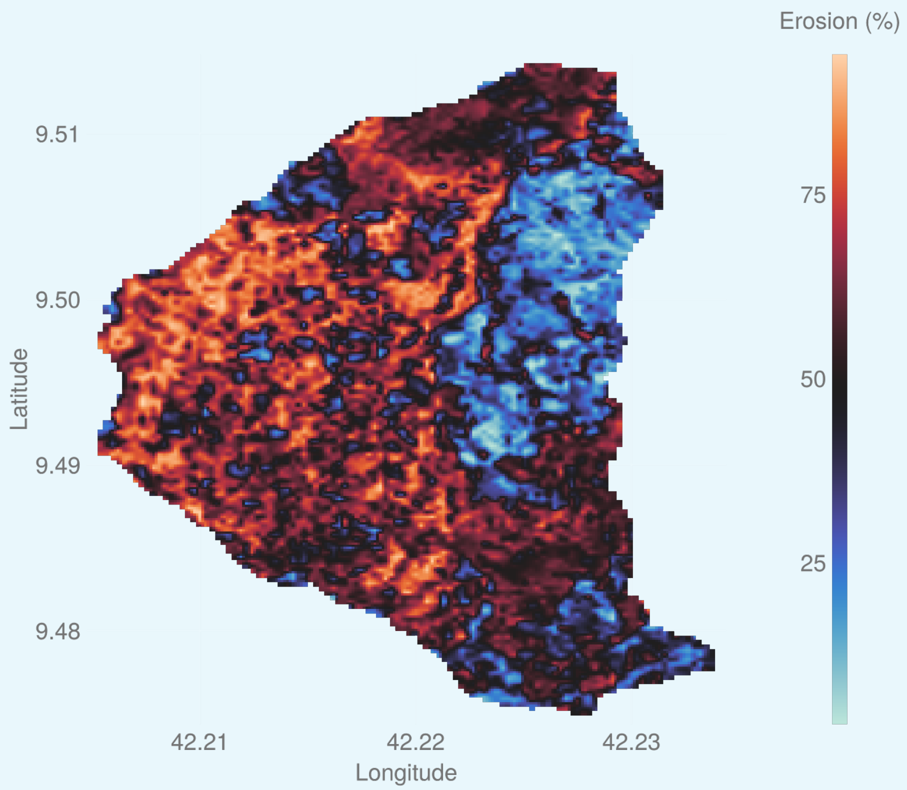
- Forty-five species were recorded across the watersheds, with *Terminalia brownii,* an indigenous species being the most common.
- Following that *Eucalyptus globulus*, an exotic species planted for timber, was the second most common.
- These data highlight the opportunity to increase the diversity of native as well as food tree species across the landscape.



Analysis of erosion prevalence in Ethiopia Watersheds

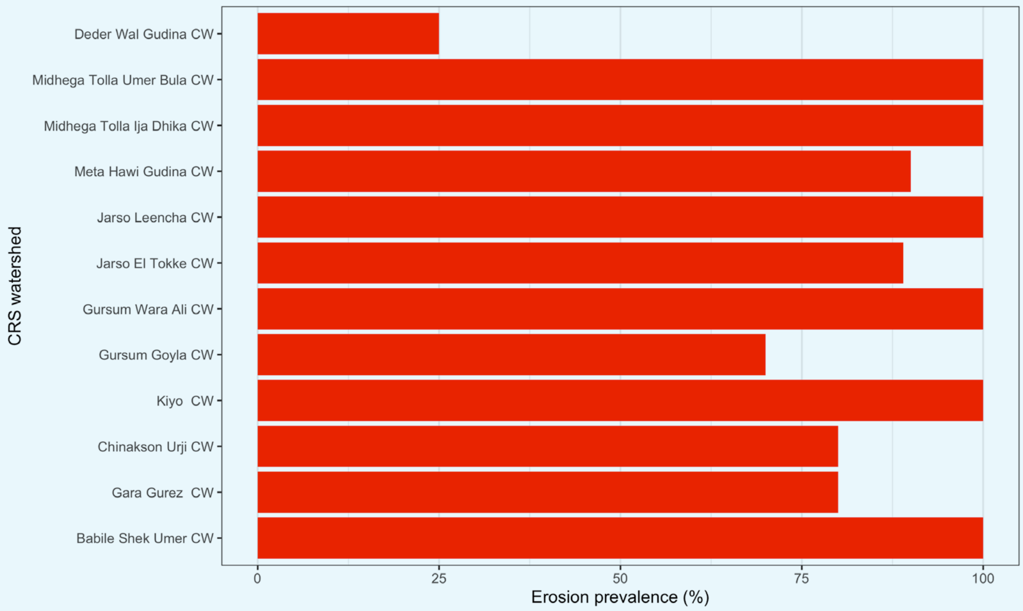
Erosion prevalence was moderate to high in the sampled watersheds, with the exception of Deder Wal Gudina watershed where there is low soil erosion (<25%). In restoration interventions, we aim to decrease soil erosion and increase soil organic carbon, so tracking soil erosion is critical to ensure restoration interventions are having an impact.

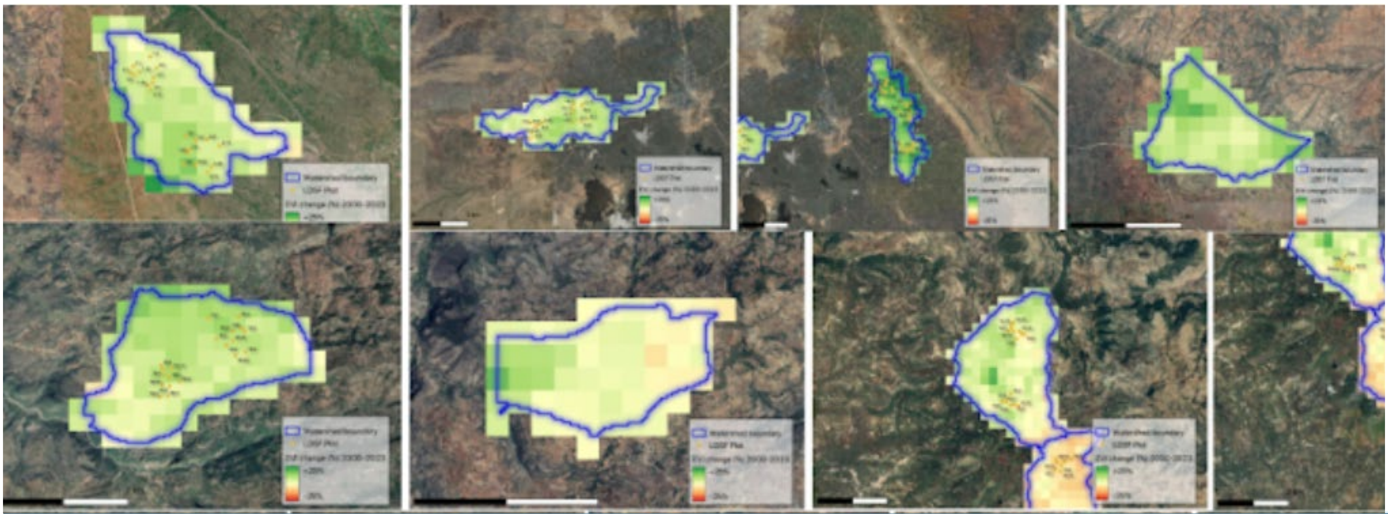
> ⚠ Where erosion prevalence is higher than 60%, land degradation is likely to be severe



(Right) Map of erosion

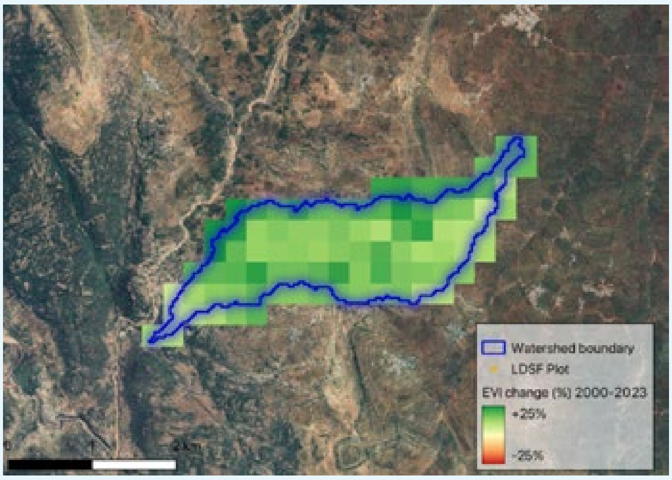
(Below) Erosion prevalence by cluster across the watersheds



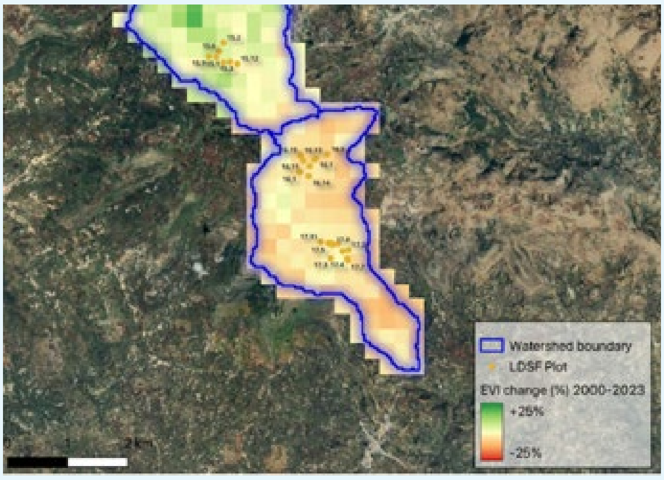


Remote-sensing based analysis of vegetation change

To assess greening trends in different locations, the Enhanced Vegetation Index (EVI) from the MODIS satellite was used. This is a form of data collection using remote sensing. For the analysis for the 10 watersheds, the years 2000–2005 as a reference period were selected to represent the 'normal' vegetation conditions. Vegetation changes were then compared in later years to this baseline to see whether areas became greener (more vegetation cover) or less green.



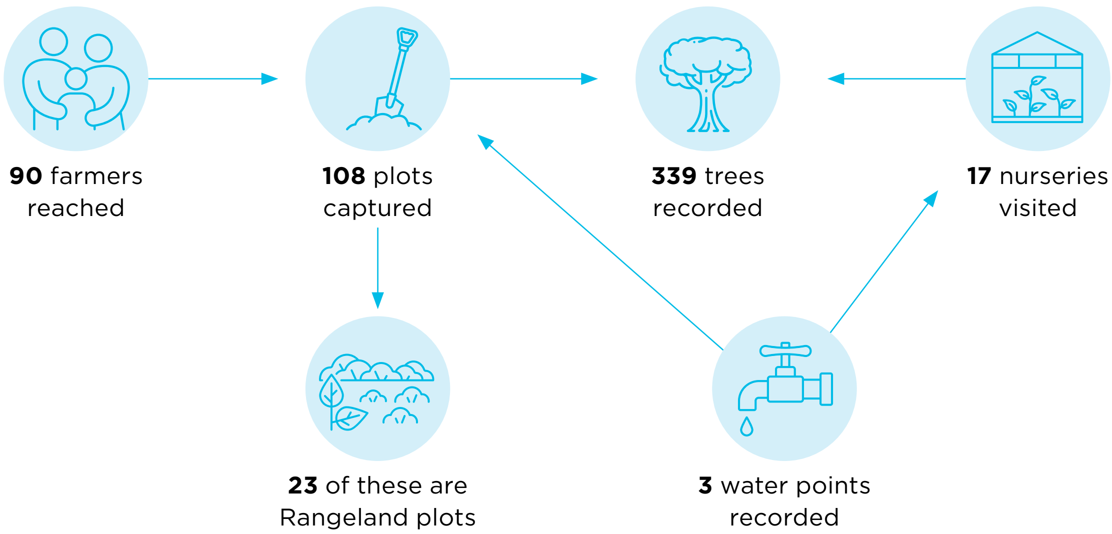
Vegetation cover (EVI) change in Fedis Umer-Kule watershed. The trend from 2000 to 2024 is positive overall within this watershed.

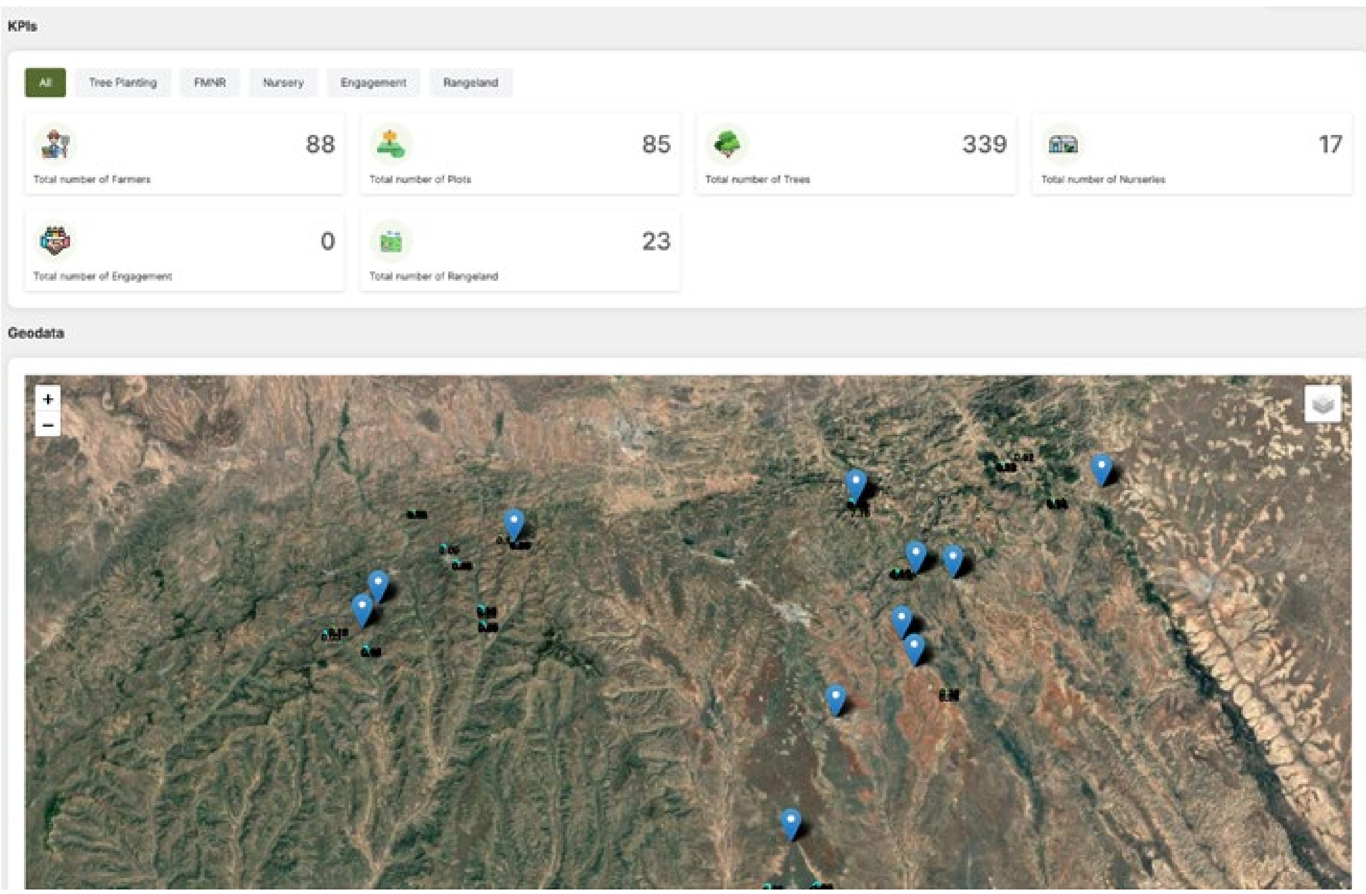


Vegetation cover (EVI) change in Jarso Leencha watershed (bottom). The trend from 2000 to 2024 is negative overall within this watershed.

3.2 Indicator extraction from Regreening App

In the CRS Ethiopia watersheds, 21 data collectors participated in data collection. The following data was collected using the Regreening App:





The data sourced from the Regreening App is displayed as above on the Regreening Dashboard.

Examples of polygons from the Regreening App data

3.3 Using data to inform local-level decision making

> In a region where data shows 50% erosion prevalence, immediate action is required. Such insights drive the implementation of soil and water conservation measures including bunds, contour planting, and terracing, ensuring timely and appropriate responses at the community level.

Identify priority areas for intervention. Data helps pinpoint regions most in need of action, enabling targeted responses where they are most impactful.

Inform practices and approaches. Evidence-based data supports the selection of the most appropriate interventions and practices, tailored to local conditions.

Track changes over time. Ongoing data collection enables the monitoring of environmental changes and providing insights into the effectiveness of interventions.

Support adaptive management. Data-driven feedback loops allow for real-time adjustments in strategies, improving outcomes and resource efficiency.

Appendix 1

LDSF field equipment check list

ITEM	QUANTITY	SOURCE	COMMENTS
Electronic equipment			
☐ Trimble TDC100, 4G (Android) (charged)	1-2		Ideally 2 GPS units in the field would be best. We use either the Trimble TDC100, 4G (Android) has proven to be quite rugged , though quite expensive.
☐ digital camera	1	There is a camera on the trimble GPS unit, so not always necessary	
Field forms			
☐ LDSF field forms (double-sided)	~180	Print	One form per plot, print 20 extra
☐ infiltration forms	~60	Print	One form for each infiltration measurement, print 12 extra
☐ field clipboard	2	Secure locally	-
☐ permanent markers	6	Secure locally	-
☐ pens	6	Secure locally	-
☐ certificates for hired labor	-	Supplied by LDSF	Template can be provided to translate into the local language.
☐ permits/introduction letters	-	-	-
Field equipment			
☐ 30 meter measuring tapes	2-3	Secure locally	-
☐ 5 meter stiff carpenter tape	2	Secure locally	-
☐ circumference tapes	3	Secure locally	Also called 'tailor tapes'
☐ clinometer (Suunto Clinometer)	1-2	-	For slope measurements and tree height measurements
☐ first aid kit	1	-	-
☐ range pole (1.5 meter each)	1	Secure locally	If not available, can be thin plastic PVC pipes to measure the shrub/tree height to ~ 4m
Infiltration			
☐ metal infiltration ring	2	Produce locally	-
☐ hammer	2	Secure locally	-
☐ stop watch or timer on phone	2	Secure locally	-
☐ ruler (30 cm)	2	Secure locally	-
☐ jerry cans of water (20L)	2	Secure locally	-
☐ umbrella	2	Secure locally	-
☐ block of wood	2	Source on site	-
☐ 20 L bucket	2	Secure locally	-
Soil sampling			
☐ combo auger (open)	2	Loan from LDSF	-
☐ coarse sand auger (closed)	1	Loan from LDSF	-
☐ cumulative soil mass sampling plate	1	Produce locally	-
☐ hand shovel	1	Secure locally	For mixing soil samples.
☐ red buckets (10L)	5	Secure locally	The exact color does not matter, just make sure you have 5 buckets of one color and 5 buckets of a different color.
☐ blue buckets (10L)	5	Secure locally	
☐ Large gunnia sacks (e.g., grain bags)	20	Secure locally	These will be used to transport and store soil samples until they reach the laboratory. Any strong, large bags will work.
☐ Soil sample bags (9*14 inch) or brown paper bags size 7	~1600	Secure locally	These are for the soil samples. All samples will be double-bagged.
☐ paper label tags	~800	Secure locally	These are paper labels to place inside soil sample bag in case marker on outside of bag rubs off.

Appendix 2 LDSF field form (plot and sub-plot)

PLOT (1,000 m²)

Site:	**Date (ddmmyy):**	**Latitude (DD):**	**Longitude (DD):**
Cluster:	**Elevation (m):**	**Pos error (m):**	**Country:**
Plot:	**Name:**		

Slope Up °: **Slope Down °:**

Major landform: ☐ Level ☐ Sloping ☐ Steep ☐ Composite

Position on topographic sequence: ☐ Upland ☐ Ridge/crest ☐ Midslope ☐ Footslope ☐ Bottomland

Landform designation:

☐ Medium gradient mountain	☐ Dissected plain	☐ Major depression
☐ Medium gradient hill	☐ High gradient mountain	☐ Narrow plateau
☐ Medium gradient escarpment	☐ High gradient hill	☐ Plain
☐ Ridges	☐ High gradient escarpment	☐ Low gradient mountain
☐ Mountainous highland	☐ Valley	☐ Low gradient hill

Plot bare > 10 months? ☐ Yes ☐ No

Plot regularly flooded? ☐ Yes ☐ No

Plot cultivated? ☐ Yes ☐ No

Dominant Land Use: ☐ annual crop ☐ perennial crop ☐ annual agroforestry ☐ perennial agroforestry ☐ fallow ☐ woodlot ☐ pasture rangeland

** Note that cultivated plots can include annual or perennial crops and even planted woodlots*

Vegetation types:

Trees	☐ Yes	☐ No
Shrubs	☐ Yes	☐ No
Graminoids	☐ Yes	☐ No
Forbs	☐ Yes	☐ No
Other	☐ Yes	☐ No

Woody leaf types:

Broadleaf:	☐ Yes	☐ No
Needle leaf:	☐ Yes	☐ No
Evergreen:	☐ Yes	☐ No
Deciduous:	☐ Yes	☐ No

Vegetation structure:**

Other description:

*** Forest, Woodland, Bushland, Thicket, Shrubland, Grassland, Wooded grassland, Cropland, Mangrove, Freshwater aquatic, Halophytic, Other*

Herbaceous height (m): ☐ 0.8-3.0 (m) ☐ 0.3-3.0 (m) ☐ 0.3-.0.8 (m) ☐ 0.03-0.3 (m)

Herbaceous annual: ☐ Yes ☐ No

Same landuse since 1990: ☐ Yes ☐ No

Land ownership: ☐ Private ☐ Communal ☐ Government ☐ Don't know

Primary current use:

Food/Beverage	☐ Yes	☐ No
Timber/fuelwoood	☐ Yes	☐ No
Foragee	☐ Yes	☐ No
Other	☐ Yes	☐ No

Soil/water conservation measures:
Number of measures in plot:

☐ None ☐ Vegetative

☐ Structural ☐ Other

0	**1**	**2**	**3**	**Impact on habitat:**
☐	☐	☐	☐	Impact of tree cutting
☐	☐	☐	☐	Impact of agriculture
☐	☐	☐	☐	Impact of grazing/browsing
☐	☐	☐	☐	Impact of fire
☐	☐	☐	☐	Impact of urban activities
☐	☐	☐	☐	Impact of industry
☐	☐	☐	☐	Impact of erosion
☐	☐	☐	☐	Impact of alien vegetation
☐	☐	☐	☐	Impact of firewood collection
☐	☐	☐	☐	Other

Vegetation strata description:

Land cover/use history description:

SUB-PLOT (100 m²)

SUB-PLOT (100 m²)	1	2	3	4
Rock/stone, Gravel cover (%)	☐ <5 ☐ 5-40 ☐ >40	☐ <5 ☐ 5-40 ☐ >40	☐ <5 ☐ 5-40 ☐ >40	☐ <5 ☐ 5-40 ☐ >40
Visible erosion	☐ None ☐ Sheet ☐ Rill ☐ Gully	☐ None ☐ Sheet ☐ Rill ☐ Gully	☐ None ☐ Sheet ☐ Rill ☐ Gully	☐ None ☐ Sheet ☐ Rill ☐ Gully
Woody cover rating (%)	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65
Herbaceous cover rating (%)	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65	☐ Absent ☐ 15-40 ☐ <4 ☐ 40-65 ☐ 4-15 ☐ >65
Auger depth restriction (cm) (If no restriction, write 50cm)				

Notes – indicate if a Cumulative Soil Mass sample was taken (CM = depth) or if infiltration was conducted:

TREE AND SHRUB MEASUREMENTS - SUB-PLOT (100M^2)

Site: **Date:**

Cluster: **Plot:**

Density and Distance Measurements of Trees and Shrubs								
Subplot	**1**		**2**		**3**		**4**	
Description	**Shrubs** Suplot 1	**Trees** Subplot 1	**Shrubs** Suplot 2	**Trees** Subplot 2	**Shrubs** Suplot 3	**Trees** Subplot 3	**Shrubs** Suplot 4	**Trees** Subplot 4
Plant density								
Point-plant distance	m	m	m	m	m	m	m	m
Plant-plant distance	m	m	m	m	m	m	m	m

Tree and Shrub Measurement in each Subplot									
Subplot		**1**		**2**		**3**		**4**	
Description		**Shrubs** Suplot 1	**Trees** Subplot 1	**Shrubs** Suplot 2	**Trees** Subplot 2	**Shrubs** Suplot 3	**Trees** Subplot 3	**Shrubs** Suplot 4	**Trees** Subplot 4
1	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
2	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
3	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
4	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
5	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
6	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
7	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
8	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
9	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
10	Height	m	m	m	m	m	m	m	m
	Length	m	cm	m	cm	m	cm	m	cm
	Width	m	circumfrence	m	circumfrence	m	circumfrence	m	circumfrence
	Species								
11									
12									
13									
14									

Appendix 3 LDSF infiltration form

SITE:		PLOT:	
CLUSTER:		DATE:	

Start minute	End minute	Start level (cm)	End level (cm)
00:00:00	00:05:00		
00:05:00	00:10:00		
00:10:00	00:15:00		
00:15:00	00:20:00		
00:20:00	00:25:00		
00:25:00	00:30:00		
00:30:00	00:40:00		
00:40:00	00:50:00		
00:50:00	01:00:00		
01:00:00	01:10:00		
01:10:00	01:20:00		
01:20:00	01:30:00		
01:30:00	01:50:00		
01:50:00	02:10:00		
02:10:00	02:30:00		

Let the stopwatch run continuously. Record the end level & refill to the start level at the indicated time intervals.

Distance to closest tree (m):		Tree species:	
Distance to closest shrub (m):		Shrub species:	

Appendix 4 LDSF rangeland form

LDSF Rangeland Module 2022 v6

Site:					Plot:					Enumerator Name				
Cluster:					Date:		P = Perennial grass, A = Annual grass, F = Forb, W = Woody. Distance (Dist) in cm							

Distance on tape (m)	#	Under canopy (Y/N)	Bare Ground (Y/N)	Leaf litter (Y/N)	Dung (Y/N)	Rock (Y/N	Perennial grass (P) Annual grass (A) Forb (F) Woody (W) None (N) (P,A,F, W, N)	Nearest P spp	Dist P	Nearest A spp	Dist A	Nearest F spp	Dist F	Nearest W spp	Dist W	Comments
South to North Transect																
0 m	1															
2 m	2															
4 m	3															
6 m	4															
8 m	5															
10 m	6															
12 m	7															
14 m	8															
16 m	9															
18 m	10															
20 m	11															
22 m	12															
24 m	13															
26 m	14															
28 m	15															

If the point on the tape falls directly on a grass tuft or forb, distance is 0 cm.
If distance to nearest perennial (P), annual (A) or forb (F) is more than 100 cm, simply write >100 cm and add a comment that distance is more than 100 cm.

Appendix 5 Regreening App – Frequently Asked Questions

Data Upload & Connectivity Issues

Q: Why does uploading field data, especially photos, take so long?

A: The slow upload is due to internet speed at the enumerator's location. The app and server perform efficiently on stable internet. For faster uploads, please ensure you have access to a strong internet connection. (Note: Similar issues were reported with ODK, but these were resolved once users accessed better internet connections.)

Q: Does the server's location affect upload speeds?

A: No. The server is hosted in a professional data center with high-speed internet, and its location does not affect data transfer. We have tested this in multiple workshops (30+ participants) with no issues reported when proper internet was available.

Photos in Data Collection

Q: I can't upload more than one photo. Why?

A: The app is designed to limit the number of photos per module:
- Tree-Planting and FMNR modules: 1 photo per tree.
- Nursery module: Only 1 photo needed.
- Rangeland module: 1 photo per intervention status (e.g., per half moon).

Tip: Use medium resolution photos (1–5MB). High-res images take longer to upload. We are confirming if the app compresses images automatically.

Account & Login Issues

Q: I'm getting a message that my account doesn't exist after logging out and back in.

A: Ensure your username is entered with correct upper/lower case, as it is case sensitive. If you're unsure, use the "Reset Password" option. Enter your registered email to receive your correct username and a password reset link.

Q: I'm trying to register, but the app says my credentials are already used.

A: Your email and username must be unique. This error typically means you've already registered before. Use the "Reset Password" option with your correct email to retrieve your account.

Geospatial Data Handling

Q: Can I download shapefiles of polygons collected during surveys?

A: No, the system doesn't export shapefiles directly. However, the CSV data includes WKT (Well-Known Text) formatted polygons. You can:
- Load the CSV into QGIS via Layer > Data Source Manager > Delimited Text.
- Set Geometry Definition to recognise WKT.

Area of Interest for the plot mapping

Q: Capturing a full area of interest takes time, especially in inaccessible locations.

A: We are working on two features to address this:

1. Divide and conquer: Multiple users can capture different parts of a large plot.

2. Parallel recording: One captures the plot; others record trees/features.

Workaround: If a section is hard to access, take a point as close as safely possible and continue.

Question to consider: If an area is truly inaccessible, was it actually part of the intended intervention / restoration zone?

Server & Upload Integrity

Q: Only partial data has uploaded from our sites (e.g., 19 out of 35).

A: This is not a server issue. The most likely cause is incomplete uploads due to poor connectivity. Ensure each site has a good connection during syncing.

App Platform & Updates

Q: Does the Regreening App work on iOS?

A: Not currently. The app is only available on Android devices.

Q: The app changes frequently with updates, affecting data uploads.

A: Updates are part of ongoing improvements. The app notifies users to upload pending data before updating. Please follow the on-screen prompts carefully.

Access to Data & Support

Q: How can I access my project's data in the Data Reporting System (DRS)?

A: Access must be granted by your project data manager. Please contact them directly for permissions.

A: Post your query in the DRS Forum (https://radrs.icraf.org/forum/) (login with your app credentials)

Email: Tor Vagen (T.VAGEN@cifor-icraf.org), Muhammad (m.ahmad@cifor-icraf.org), Benard (B.Onkware@cifor-icraf.org)

Follow updates on WhatsApp-Channel and Telegram-Channel.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