Soil Mapping for resilient agri-food systems in Central America and sub-Saharan Africa (SoilFER)

- Is an integrated, data-driven framework consisting of two projects funded by **the US Department of Stat**e and the **Japanese government (MoFA),** involving seven countries (Five in Africa – Zambia, Ghana, Kenya, Mozambique and Tunisia).

- It is a comprehensive framework aimed at increasing the resilience of agri-food systems by providing data-driven answers to:

  - Where to plant

  - What to plant

  - Which management system to adopt

  - How to apply

National Components

1

DATA

- Soil Sampling Campaign
- Harmonization and Collection of Legacy Data
- Soil Analysis (Soil labs)
- National Soil Analytical Databases
- National Spectral Libraries
- National Soil Information Systems (NSIS)
- Laboratory Information Management Systems (LIMS)

2

INFORMATION + KNOWLEDGE

- National Nutrient and Nutrient Budget Maps
- National Soil Property Maps
- Crop Suitability Maps
- Fully Integrated National Soil Information System (NSIS)
- Soil Monitoring System for select
- Decision Support Tools (DST) and System (DSS) – fertilizer, crop, management

3

ACTION

- Fertilizer Decision Support for farmers and governments
- Decision Support for Crop Suitability including *Opportunity Crops**
- Capacity Development and Outreach Programme
- Socioeconomic, financial and cost-benefit analysis for Fertilizers and SSM

GLOBAL SOIL PARTNERSHIP

Fertilizer management, Major and opportunity crops, Sustainable Soil Management

Validation of fertilizer recommendations

Field trials

Decision support tools

National Soil Information System

Laboratory Information Management System (LIMS)

Soil data management

Fertilizer testing, Wet and dry chemistry

Soil Laboratories

Soil sampling ...

Field data collection tool

Connecting and fostering collaboration between
three core stakeholders

National governments are provided with robust, rigorous, and responsive framework for integrated soil nutrient management at local, subnational, and national scales.

National high resolution digital soil maps (soil nutrient, nutrient budget, soil property maps, soil threats, crop suitability map) and Integrated National Soil Information Systems

Capacity Development Programme for governmental staff (soil data management, digital soil mapping, soil organic carbon sequestration modelling, training sessions on using NSIS & FERSIS applications)

National governments

Farmers are empowered with web-based applications, high-resolution nutrient maps and enhanced capacity on sustainable soil management.

Global Soil Doctors Programme a farmer-to-farmer training initiative

One tool for all farming needs (fertilizer recommendations, fertilizer prescription maps, real-time vegetation index, access to field data, crop suitability, weather conditions)

Communication, awareness raising and advice services on sustainable soil management practices

Farmers

Laboratories are strengthened by the implementation of Laboratory Information Management Systems, the modernization of their facilities, and staff capacities development through training.

Laboratory Information Management System (Central sample and analysis management and stock management; chemicals & supplies)

Modernization of national laboratories & capacity development (training on wet & dry chemistry, safety, procurement, QA/QC, provision of equipment for soil

Laboratories

Laboratory task

FROM LAB ANALYSIS

★ SOC
★ Total Carbon (TC)
★ Inorganic Carbon (IC)
★ Soil Colour
★ N
★ P
★ K
★ Texture (sand, silt, and clay)
★ pH
★ EC
★ Exchangeable cations and CEC *(soil + clay)*
★ Carbonate content
★ Gypsum content
★ Extractable Micronutrients
★ Microbial Biomass
★ Total Sulphur
★ Boron

FROM SOIL OBSERVATIONS

★ Soil depth
★ Rockiness
★ Drainage class
★ Soil erosion
★ Surface cracks
★ Soil colour (Not Munsell chart)

FAO90/**WRB soil classification** from Soil profile description

+

INDIRECT MEASUREMENTS

★ USDA Textural Classes
★ C/N ratio
★ Total Exchangeable Bases (TEB)
★ Base Saturation (BS)
★ Exchangeable Na percent (ESP)
★ Rootable depth
★ Drainage classification
★ Bulk Density
★ Multispectral properties (Mehlich extractable macro and micronutrients)

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Uniformity in Analytical methodologies

| Analytical Parameter	Methodology
SOC	Walkley Black and
TC	Dumas dry combustion
Nitrogen	Dry combustion method
Phosphorus	Oxalate extractable, Olsen and Mehlich III
Exchangeable cat And CEC	Ammonium Acetate (pH 7)
PSD	Pipette Method

GLOSOLAN Harmonised SOPs

Analytical Parameter	Methodology
pH	H_2O (1:2.5)
EC	H_2O (1:5)
Carbonates	Volumetric calcimeter method
Extractable micronutrients	DTPA, Mehlich III and HNO_3
Total S	Dry combustion
Boron	Hot water
Microbial biomass	Chloroform fumigation

Analytical methodologies are to be comprehensively validated by the Reference laboratories before adoption and use

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Focus areas for laboratories
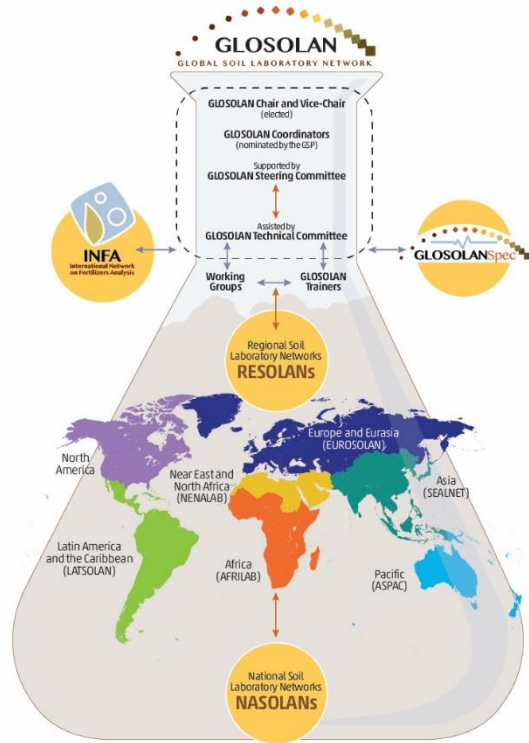
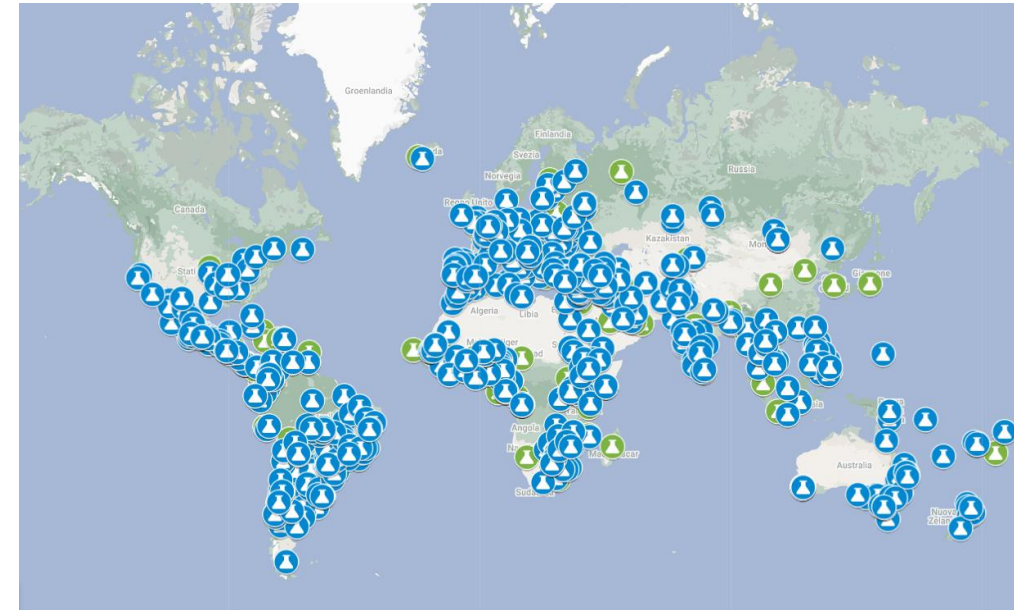1. National Soil Laboratories Networks (NASOLAN´s)

2. Capacity Building

3. Laboratory Information Management System(LIMS)

6th Meeting of the **Regional Soil Laboratory Network for Africa** (AFRILAB) | 23 October 2024

GLOBAL SOIL PARTNERSHIP

Baseline assessments

Evaluation of laboratories

based on specific criteria,

including

- technical capabilities,

- QA/QC

- Laboratory health and

  safety

- infrastructure quality,

- sustainability practices.

# Common challenges amongst laboratories

Standardization of Methodologies

Soil laboratories use different methodologies for analysis, such as Bray PI and Mehlich I, emphasizing the need for harmonization to ensure consistent and comparable results across all labs

Proficiency test (PT)

Some laboratories cannot participate due to equipment shortages and lack of validated methodologies, unlike accredited ones
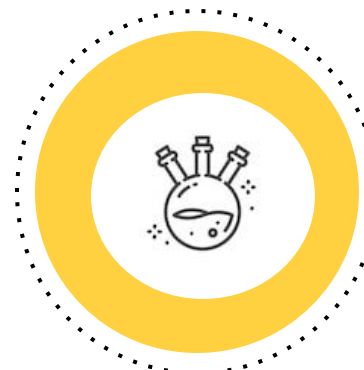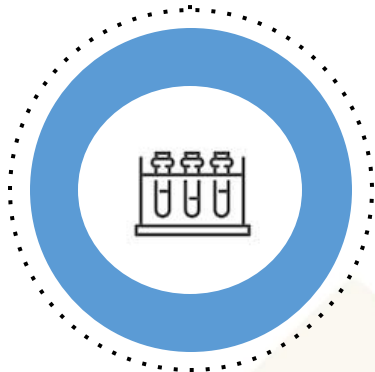
Capacity building

Laboratories need strengthening in administrative areas and accreditation training, including ISO 17025, Health and safety, and risk management.
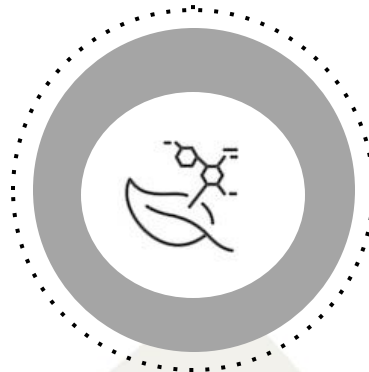
Equipment

Many laboratories face challenges in updating and maintaining their equipment due to budget constraints, while accredited labs typically follow stricter maintenance protocols

Reagents and consumable importations

Reagents importation is often delayed and burdened with complex bureaucratic procedures.

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SoilFER triple Intervention

Equipment capacitation

Human Capital development

QA/QC

Procurement plan

THE APPROACH

Comprehensive capacitation	Automation	Local context	Going green
• Wet chemistry • Physical • Biological • Proximal sensing	• Improved efficiency • User friendly	• Filling the gaps • Compatibility • Backup service • Maintenance • Calibration services	• Low energy consumption • Reduced chemical usage • Reduced waste

Intervention

Needs driven laboratory equipment list

Smart reagents and laboratory consumables

Target technologies

Sample preparation
• Efficient, safe and contamination free process
• Making use of stainless steel, fibreglass and heat resistant materials

Dissolution and digestion
• Microwave technology
• Dry combustion (CNS Elemental analysers)

Analyte quantification
• ICP MS Finish
• Automated UV/Vis and titration technology

Proximal sensing
• Vis-NIR – DRS
• MIR – DRIFTS
• Cosmic Ray Nuetron sensors

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Human Capital development

FOCUS AREAS

Analytical methodologies

Key instruction resource

GLOSOLAN Harmonised SOPs

Target group

Lab managers
Supervisors
Lab analysts

Key Topics

Wet chemistry methods
Physical parameters
Biological parameters
Dry chemistry

H&S, QA &QC

Key instruction resource

GLOSOLAN guidelines
ISO 17025:2017 Standard
National standards and regulations

Target group

Lab managers
Supervisors
Lab analysts
Lab assistants

Key Topics

Safety in the laboratory
Laboratory QC
Validation and measurement uncertainties

Laboratory Management

Key instruction resource

GLOSOLAN Manuals
ISO 17025 Guidelines

Target group

Lab managers
Supervisors
Lab analysts

Key Topics

Laboratory procurement
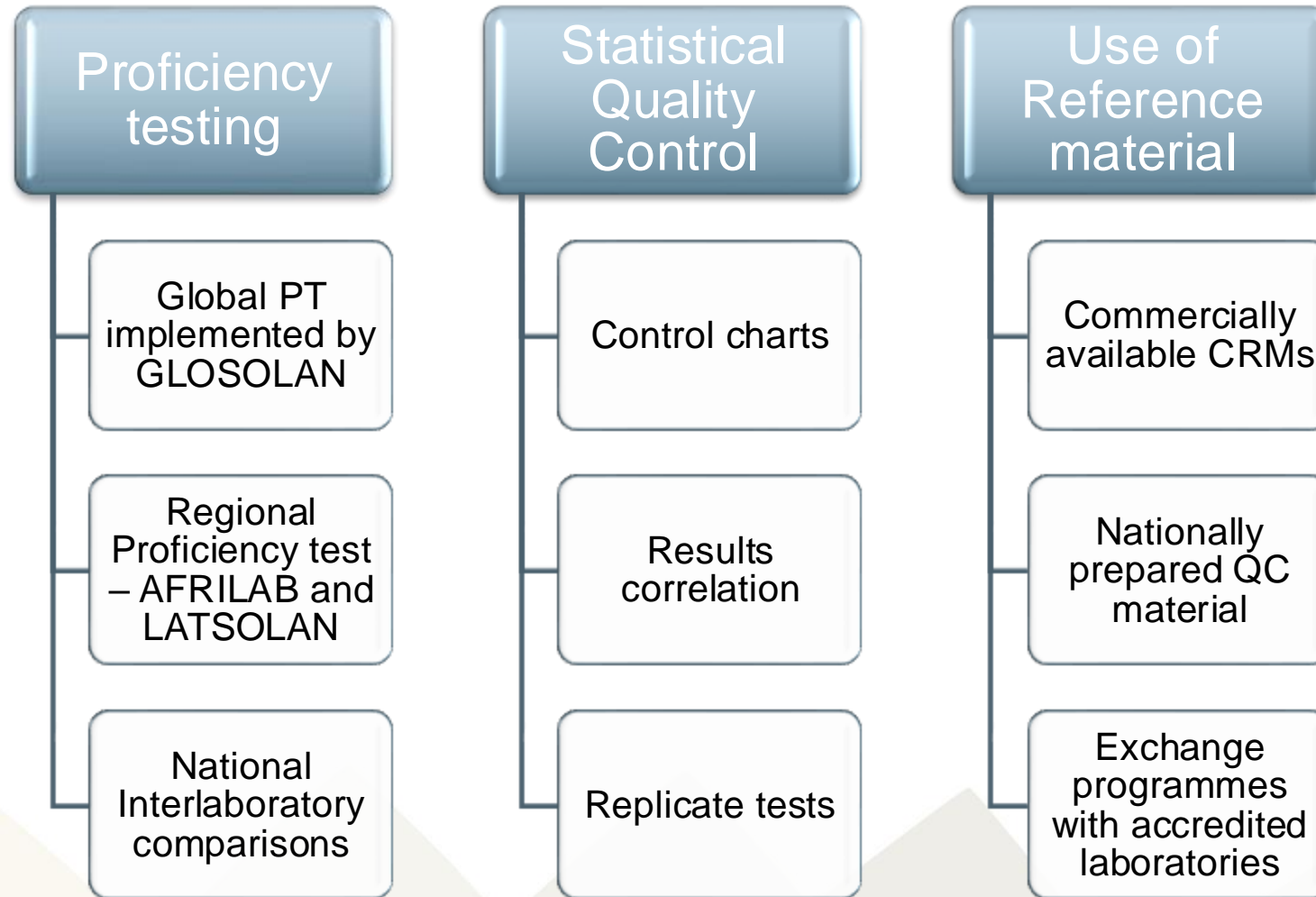Equipment maintenance
Risk management
CAPA

Hybrid mode of instruction

1. In-person workshops – Theoretical and practical sessions done in periodic workshops

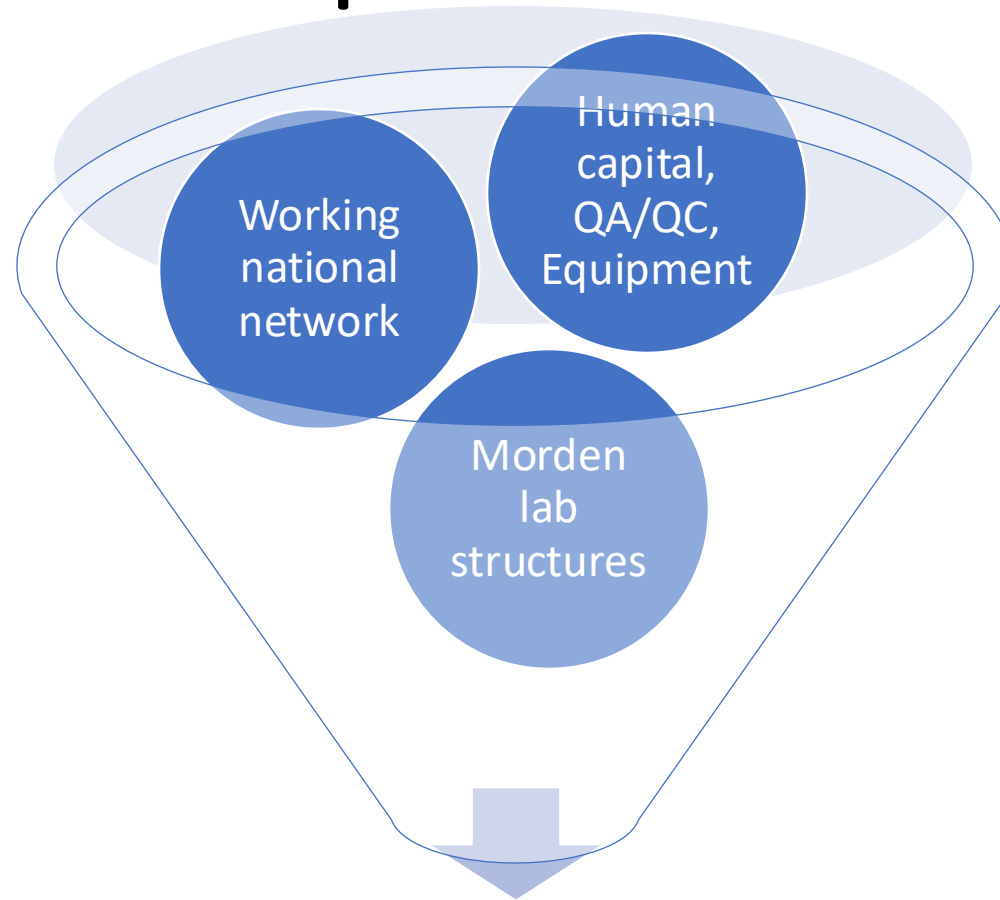2. Webinars – Structured Webinars on specific topics organised by GLOSOLAN

6th Meeting of the **Regional Soil Laboratory Network for Africa** (A

A Basket of QC activities adopted by laboratories in the implementing countries

Proficiency testing

- Global PT implemented by GLOSOLAN
- Regional Proficiency test – AFRILAB and LATSOLAN
- National Interlaboratory comparisons

Statistical Quality Control

- Control charts
- Results correlation
- Replicate tests

Use of Reference material

- Commercially available CRMs
- Nationally prepared QC material
- Exchange programmes with accredited laboratories

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Output

Working national network

Human capital, QA/QC, Equipment

Morden lab structures

Strengthened national capacity

Discussion