



REGIONAL HUB FACT SHEET SERIES • No. 01 • OCTOBER 2026

Digital soil mapping and soil information systems: From soil data to better decisions

Regional Hub for Fertilizer and Soil Health for West Africa and the Sahel

1

About the Regional Hub

The Regional Hub for Fertilizer and Soil Health for West Africa and the Sahel (Regional Hub) is a regional technical support unit, established in June 2024 in response to the priority actions outlined in the Fertilizers and Soil-Health Roadmap for West Africa and the Sahel (World Bank, 2023). The roadmap emerged from the Lome Roundtable, attended by Heads of State from the region and facilitated by ECOWAS and the World Bank. The Regional Hub was formally endorsed as an ECOWAS sub-program at the Africa Fertilizer and Soil Health Summit held in Nairobi in May 2024.

The Regional Hub provides technical assistance for fertilizer and soil health investments across 17 countries in West Africa and the Sahel (Figure 1). Its mandate is delivered through 20 functions organized into six thematic areas (Figure 2): soil information; knowledge management and sharing; agronomy; capacity development; policy support; and advocacy and awareness creation.

The Regional Hub is hosted at the IITA campus in Ibadan, Nigeria. It operates under the governance of ECOWAS and is managed by a consortium of technical partners, including International Institute of Tropical Agriculture (IITA), The African Plant Nutrition Institute (APNI), International Fertilizer Development Center (IFDC), University of Mohammed 6 Polytechnic (UM6P), and International Soil Reference and Information Centre (ISRIC), with financial support from the World Bank and OCP Africa.

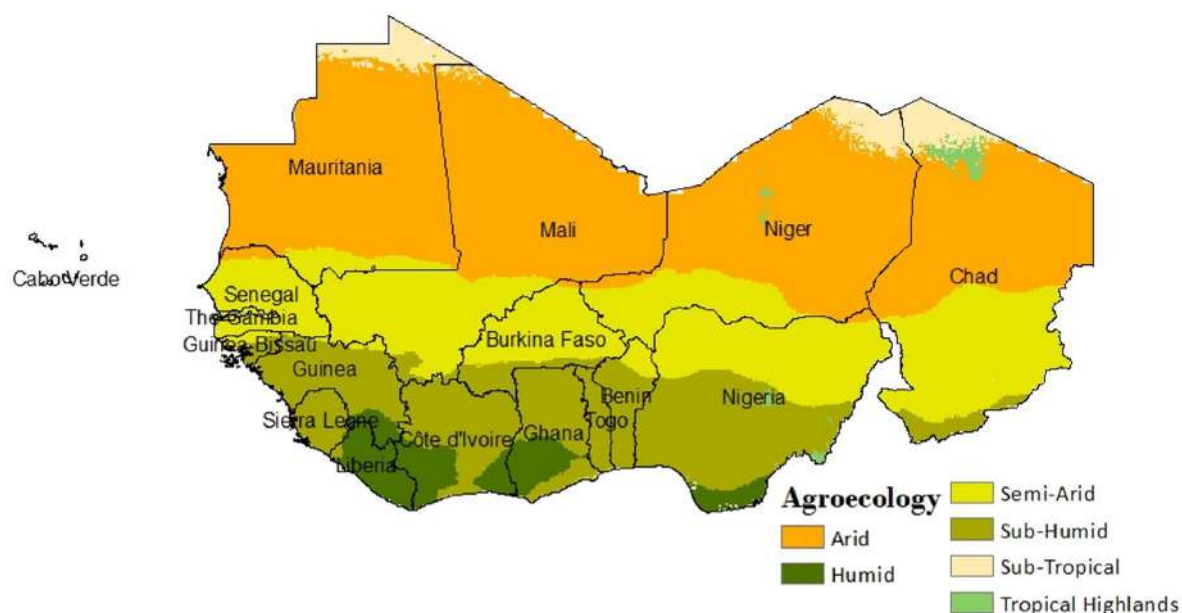


Figure 1. The 17 countries within the mandate of Regional Hub for Fertilizer and Soil Health for West and the Sahel



Figure 2. The 20 functions of the Regional Hub for Fertilizer and Soil Health for West and the Sahel organized across six thematic areas

2

Why it matters

Soil information across West Africa and the Sahel has traditionally been fragmented, inconsistent in quality and coverage, and often outdated. These limitations hinder evidence-based land-use planning, precision agronomy, fertilizer-policy development and climate adaptation. Concern about this information gap has grown over the past decades,

particularly because soil degradation and low fertilizer-use efficiency remain major constraints to agricultural productivity, food production and food security. They contribute to nutrient depletion, limited crop responses and greater vulnerability to climate-related and market shocks.

Addressing this challenge at scale is increasingly feasible because soil-analysis technologies are evolving. Emerging dry-chemistry approaches, including infrared and other spectral-scanning techniques combined with machine learning, can estimate soil properties such as organic carbon, texture and nutrient content more rapidly and at lower cost. The continued development and strengthening of Digital Soil Mapping (DSM) and Soil Information System (SIS) respond to priorities identified in the [2024 Nairobi Declaration on Africa Fertilizer and Soil Health](#), which calls for digital tools to support soil-health monitoring, as well as the [2025 Kampala CAADP Declaration](#), which recognizes stronger agricultural data systems as a continental priority for effective and informed decision making.

3

What is it?

Digital Soil Mapping (DSM) and integrated Soil Information system (SIS) combine field observations, laboratory analyses, remote sensing, environmental data and statistical modelling to produce accessible, reliable and location-specific soil information.

DSM shows how soil properties — such as texture, pH, organic carbon and nutrients — vary across regions, countries, landscapes, and farms. Integrated SIS bring these maps together with soil profiles, laboratory results, field observations and other relevant environmental and agricultural data. They provide both spatially explicit maps and point-based information, including estimates of uncertainty.

Together, these tools enable governments, researchers, development partners, farmers, agribusinesses and investors to better understand soil conditions, prioritize interventions, improve land-use planning, target investments and allocate resources, including fertilizer and organic inputs, more effectively.

4

What do we do?

As one of its 20 core functions highlighted in Section 1, Regional Hub promotes the development and application of DSM and integrated SIS across the region. Working with technical, financial and national partners, the Regional Hub seeks to expand soil-data coverage, strengthen data quality, and convert soil information into practical tools for improved decision-making, fertilizer management and soil-health planning.

Countries and target watersheds are selected through a transparent, demand-driven process based on three criteria:

- **Data availability:** the existence of legacy soil records, agronomic datasets and geospatial information required for reliable DSM and SIS development.
- **Institutional readiness:** government commitment, engaged ministries, capable national research institutions and formal requests for technical assistance.
- **Scaling potential:** the presence of active or planned programs, such as fertilizer and soil health management schemes, resilience initiatives and CGIAR-supported projects, that can rapidly apply and expand DSM outputs.

The DSM initiative assesses 18 key soil properties related to fertility, salinity, acidity and physical condition. These include pH, electrical conductivity, total nitrogen, available phosphorus, exchangeable potassium, calcium, magnesium, sodium and acidity; extractable zinc, iron, manganese, aluminum, sulphur and boron; and the proportions of sand, silt and clay.

These properties help identify soil constraints and guide site-specific fertilizer and soil-management recommendations. Nutrient concentrations indicate the resources available for crop growth, while pH, salinity, sodicity, acidity and aluminum reveal potential chemical limitations. Soil texture affects water retention, drainage, aeration, nutrient storage, erosion risk and root development. Collectively, the indicators support evidence-based land management and the assessment of soil-related ecosystem services, including nutrient cycling, water regulation, erosion control, soil-structure maintenance and soil biodiversity conservation.

5a

What progress have we made? — Advancing Digital Soil Maps (DSM)

Over the past 18 months, we have enhanced the baseline SoilGrids map for West Africa and the Sahel, originally developed by ISRIC through the Africa Soil Information Service (AfSIS) project (Hengl et al., 2015; Poggio et al., 2021). The baseline maps were developed from legacy soil data collected across Africa from 1960–2012, including 12,000+ soil profiles and 94,000+ soil layers (Figure 3). The enhancement is being implemented in two phases:

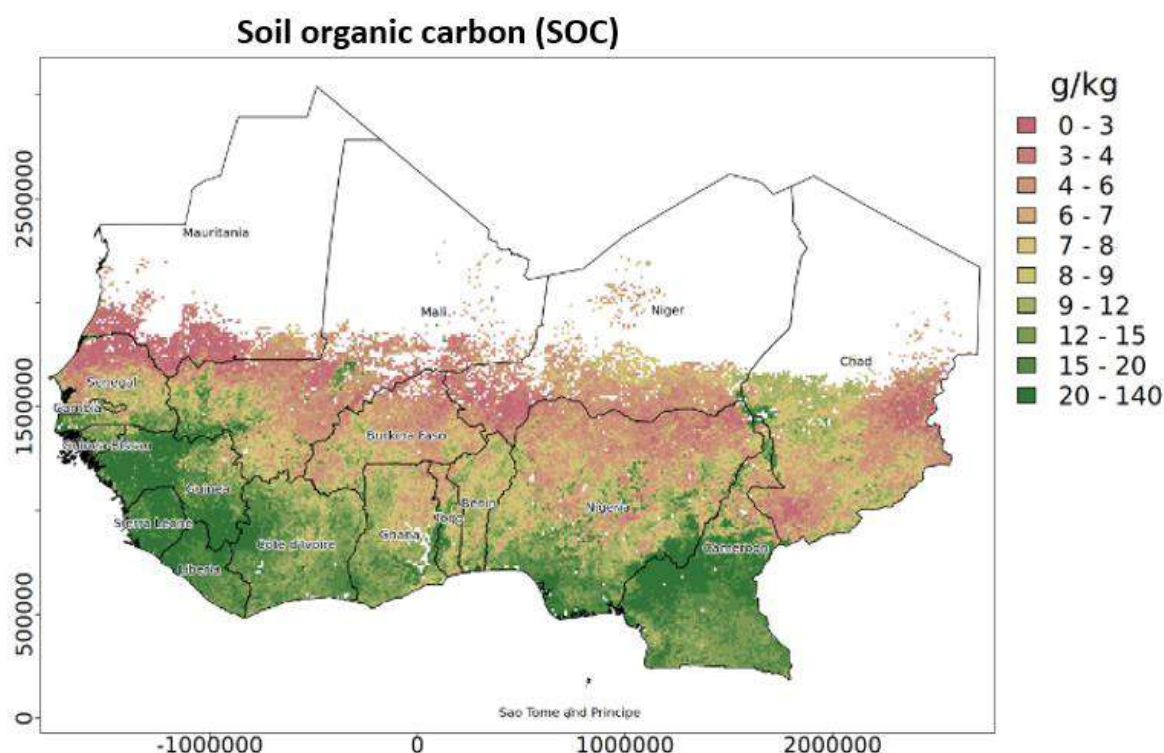


Figure 3. Example of the baseline regional soil organic carbon map for West Africa and the Sahel (Reddish areas indicate drier conditions and generally lower carbon content, while greenish areas represent wetter conditions and higher carbon content)

PHASE 1

Integration of legacy data

More than 38,000 legacy soil-sampling records from West Africa and the Sahel, not previously incorporated into the baseline SoilGrids maps—were integrated to produce more accurate, reliable and detailed digital soil maps (DSMs). The enhanced maps cover approximately 11.6 million hectares and represent 18 soil properties (Figure 4). This expanded evidence base improves the quality of soil predictions required for farm- and field-specific decision-making on fertilizer application, soil-health management and land use.

Locations were prioritized according to data availability, expected impact, institutional engagement and opportunities for scaling.

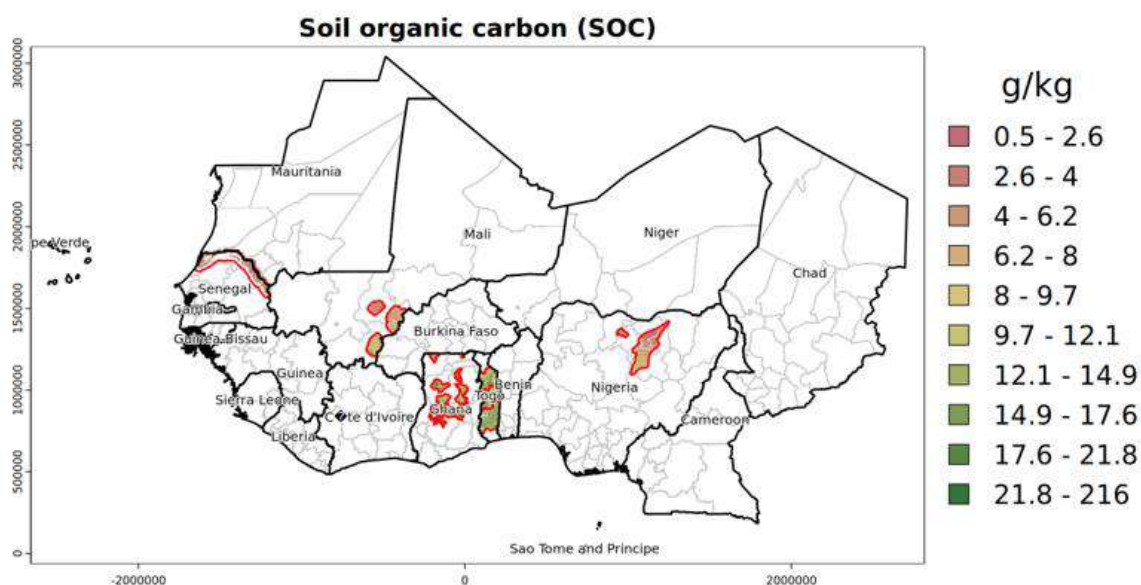


Figure 4. Example of the Phase 1 enhanced soil organic carbon map covering priority target watersheds (reddish areas indicate drier conditions and generally lower carbon content, while greenish areas represent wetter conditions and higher carbon content)

PHASE 2

Integration of new field data

New soil data from 1,024 sampling points in target watersheds in Nigeria and 524 sampling points in Mali are being incorporated to strengthen the reliability and spatial accuracy of the soil maps and ensure that they adequately represent current soil conditions. The enhanced datasets will provide a robust evidence base for developing site-specific fertilizers and soil health advisories based on Integrated Soil Fertility Management (ISFM) principles, enabling fertilizer and other soil fertility inputs to be better matched to local soil conditions and management needs. The enhanced maps cover approximately 3.9 million hectares in Nigeria and Mali involving 18 soil properties (Figure 5 and 6).

Target locations were selected using the same Phase 1 criteria, supplemented by the availability of funding for field data collection and analysis. By incorporating recent observations, these final maps provide more current and locally precise information compared to DSMs produced at phase-1 to support farm- and field-specific decisions on fertilizer application, soil-health management and land use.

However, in countries such as Sierra Leone and Liberia, where legacy soil data are limited, new national soil surveys and sampling campaigns are ongoing through partnership projects. These activities will provide evidence needed to develop more accurate and enhanced DSM products.

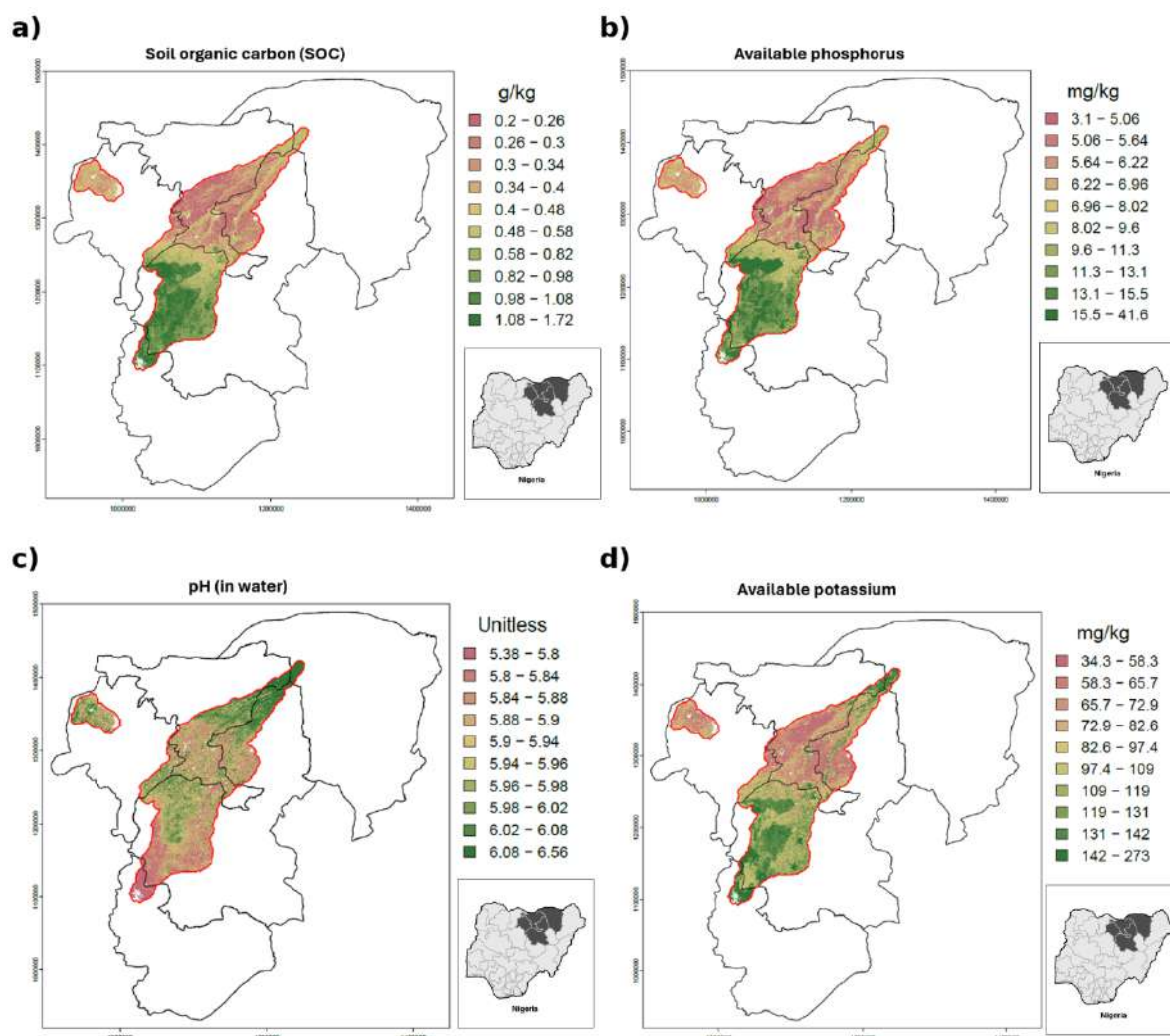


Figure 5. Examples of enhanced Phase 2 digital soil maps covering target watersheds in northern Nigeria: (a) soil organic carbon, (b) available phosphorus (P), (c) soil pH and (d) exchangeable potassium (K). Soil organic carbon helps retain water and nutrients; available P supports root growth; pH influences nutrient availability and microbial activity; and exchangeable K supports water regulation, plant strength and stress tolerance.

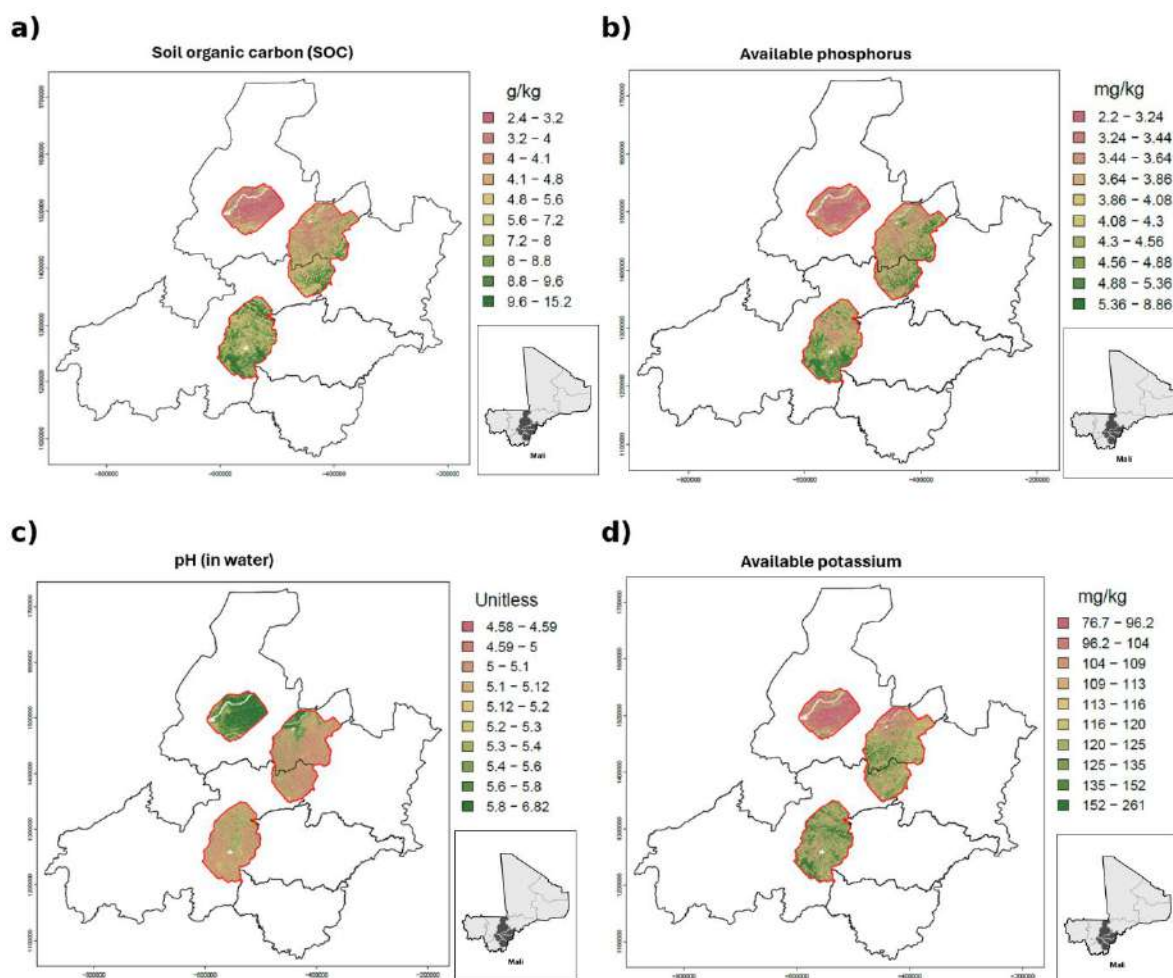


Figure 6. Examples of enhanced Phase 2 digital soil maps covering target watersheds in Mali: (a) soil organic carbon, (b) available phosphorus (P), (c) soil pH and (d) exchangeable potassium (K). Soil organic carbon helps retain water and nutrients; available P supports root growth; pH influences nutrient availability and microbial activity; and exchangeable K supports water regulation, plant strength and stress tolerance.

5b

What progress have we made? — Establishment of National Soil Information Systems (SIS)

Development of national Soil Information Systems (SIS) follows four interconnected stages: initiation, planning and design, implementation, and operation (Figure 7). Together, these stages provide a structured pathway for establishing sustainable, fit-for-purpose, and nationally owned soil information systems.

Throughout these stages, each national SIS will maintain a functional link with the central soil information database hosted by the Regional Hub. This central system, which is currently approaching the Minimum Viable Product (MVP) stage, will provide a common platform for facilitating data exchange, interoperability, and regional integration across participating countries. The linkage will allow national systems to retain ownership and control of their soil

information while enabling relevant datasets, products, and services to be shared and integrated at the regional level. This approach will support the development of a connected regional soil information ecosystem, while ensuring that national SIS remain responsive to country-specific priorities and institutional arrangements.



Figure 7. The National Soil Information System (SIS) development framework — four stages guiding each country's SIS build-up

Step 1: Initiation

The Regional Hub works with national institutions to identify priority soil-information needs, including type of data need and corresponding application features of the SIS such as data management system, fertilizer recommendations, soil-health monitoring, climate adaptation etc. This stage involves reviewing existing and available data, institutional and technical capacities, infrastructure, and available resources through technical consultations and stakeholder workshops. The process results in an agreed purpose and priority applications for the SIS, identification of lead institutions, and an initial implementation roadmap.

Step 2: Planning and Design

The Regional Hub partners jointly develop the SIS design, defining the required data, field and laboratory methods, quality standards, data storage and access arrangements, governance structures, financing mechanisms, and technical infrastructure. The design also establishes how the National SIS will connect with the Hub's Central Data Infrastructure system, ensuring interoperability and opportunities for regional data integration. The outcome is a practical, sustainable, and nationally relevant SIS design that responds to identified priorities.

Step 3: Implementation

During implementation, the Regional Hub and national institutions work together to organize existing soil information, collect new field data, conduct laboratory analyses, apply quality-control procedures, and develop soil databases, digital maps, and decision-support tools. The Regional Hub provides technical guidance, standards, modelling support, interoperability advice, and training, while national institutions lead country-level activities, validate data, oversee field and laboratory operations, and approve final outputs. Implementation is supported through joint work plans led by the Hub technical team, pilot activities, technical

assistance, and user testing. The result is an operational National SIS providing reliable soil information for agricultural and land-management decision-making.

Step 4: Operation and Sustainability

Once operational, national institutions take responsibility for maintaining and regularly updating the SIS, managing databases and maps, monitoring data quality, supporting users, and integrating soil information into national programs. The RH-FSH West Africa & Sahel continues to provide technical assistance, capacity development, quality guidance, regional coordination, and support for linking national systems to the Central Data Infrastructure. Regular data updates, system maintenance, model recalibration, quality reviews, user feedback, and sustainable financing help ensure that the SIS remains current, reliable, nationally owned, and fit for purposes. Ultimately, the system supports farm-specific decision-making, improved fertilizer and soil-health management, informed land-use planning, and climate-resilient agriculture.

Since 2025, the Regional Hub has progressed through the national SIS initiation and design phase by conducting workshops in Nigeria, Ghana, Liberia, Sierra Leone, and Togo. These engagements addressed needs assessments, enabling-environment reviews, system design, government buy-in, and partnership development. Stakeholders identified the SIS as an important decision-support tool for developing location-specific fertilizer and input recommendations along with assessing land and crop suitability, supporting land-use planning, monitoring soil health and degradation, enabling precision agriculture, and assessing climate-related risks such as erosion and landslides. The SIS is also expected to support investment planning, identification of data gaps, and inform evidence-based national soil policies and regulations, including fertilizer-quality standards. In parallel, the Regional Hub is finalizing the Minimum Viable Product (MVP) of the regional/central soil information and data infrastructure, with its initial release targeted for late 2026 to early 2027. The infrastructure will provide the foundation for organizing, accessing, sharing, and integrating soil information across participating countries, while supporting the development of regional soil information products and services.

6

What comes next

Looking ahead, Regional Hub will focus on three complementary priorities:

- First, it will expand Digital Soil Mapping (DSM) to additional regions, while strengthening the collection and validation of field and laboratory data and translating soil information into practical applications such as land-use planning, crop suitability assessment, soil-health monitoring, input recommendations, precision agriculture, and climate-risk management.

- Second, the Hub will launch the Minimum Viable Product (MVP) of the central soil information data infrastructure, which will provide a common platform for organizing, discovering, accessing, and managing soil information generated across the region. Beyond facilitating integration and interoperability, the infrastructure will improve the availability, standardization, and reuse of soil data, support the development and dissemination of regional soil information products and services, reduce duplication in data management, and provide a foundation for more efficient analysis, modelling, and evidence-based decision-making.
- Third, the Hub will advance national SIS from the planning and design stage towards establishment and operationalization, including finalizing system architectures, establishing functional links with the Hub's central data infrastructure, integrating relevant national datasets, testing priority use cases, and strengthening institutional capacity for sustainable operation. Together, these efforts will contribute to a connected, sustainable, regional and nationally owned soil-information ecosystem that supports evidence-based decision-making at both national and regional levels.

7

Join us

Closing the soil information gap in West Africa and the Sahel is a shared responsibility. The Regional Hub invites governments, development partners and investors to support funding, data sharing and technical collaboration. Together, we can turn better soil information into better decisions for millions of farmers and other stakeholders across the region.

Suggested citation

Regional Hub for Fertilizer and Soil Health for West Africa and the Sahel (2026). *Digital soil mapping and soil information systems: From soil data to better decisions*. Regional Hub Fact Sheet No. 01. Ibadan, Nigeria: Regional Hub for Fertilizer and Soil Health for West Africa and the Sahel. <https://regionalhub-west.org/>

Contacts



Sinha Surajit
Data Scientist–
Ibadan,
Nigeria
S.Sinha@cgiar.org
Regional Hub, IITA



Shehu M. Bello
Agronomist –
Ibadan, Nigeria
M.Shehu@cgiar.org
Regional Hub, IITA

References

African Union. (2024). *Nairobi Declaration on Africa Fertilizer and Soil Health*. Africa Fertilizer and Soil Health Summit, Nairobi, Kenya, 7–9 May 2024. <https://library.faraafrica.org/storage/2024/05/The-Nairobi-Joint-Declaration-AFSH-FINAL-design.pdf>

- African Union. (2025). *Kampala CAADP Declaration on Building Resilient and Sustainable Agrifood Systems in Africa*. <https://au.int/en/documents/20250109/kampala-caadp-declaration-building-resilient-and-sustainable-agrifood-systems>
- Hengl, T., Heuvelink, G. B. M., Kempen, B., Leenaars, J. G. B., Walsh, M. G., Shepherd, K. D., Sila, A., MacMillan, R. A., Mendes de Jesus, J., Tamene, L., & Tondoh, J. E. (2015). Mapping soil properties of Africa at 250 m resolution: Random forests significantly improve current predictions. *PLoS ONE*, 10(6), e0125814. <https://doi.org/10.1371/journal.pone.0125814>
- Poggio, L., de Sousa, L. M., Batjes, N. H., Heuvelink, G. B. M., Kempen, B., Ribeiro, E., & Rossiter, D. (2021). SoilGrids 2.0: Producing soil information for the globe with quantified spatial uncertainty. *SOIL*, 7, 217–240. <https://doi.org/10.5194/soil-7-217-2021>
- World Bank. (2023). *Fertilizers and Soil-Health Roadmap for West Africa and the Sahel: Investing in the Future by Nourishing the Soil*. World Bank, Washington, DC. <https://thedocs.worldbank.org/en/doc/35380715cfe0b7564a1bb6d294594693-0360012023/original/Roadmap-English.pdf>