CGIAR SUSTAINABLE FARMING

Capacitating Extension Workers and Trainers for Soil Health: ICRISAT's Contribution to the Soil Values Project

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Training report

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Executive summary

Under the Soil Values Programme, ICRISAT implemented a set of strategic actions aimed at strengthening soil fertility, soil health, and climate resilience through evidence-based tools and capacity development of extension workers and community trainers. Activities were implemented across three priority watersheds in Mali: Upper Bani (Sikasso), Upper Niger Basin (Ségou), and Middle Bani (San–Tominian).

The interventions focused on three complementary pillars:(i) the development of a zonal catalogue of improved crop varieties, forage species, and woody species adapted to local agroecological conditions; (ii) capacity strengthening of public extension agents, NGOs, and community trainers on climate information services and Climate-Smart Agriculture (CSA); and (iii) training of farmer-trainers on Sustainable Land Management practices, particularly Soil and Water Conservation / Soil Defense and Restoration (SWC/SLM).

In total, 405 participants, including 21% women, drawn from regional agricultural services, NGOs, farmer organizations, and extension systems, were trained. Pre- and post-training evaluations demonstrate a substantial increase in technical knowledge, with average correct responses rising from 49% before training to 91% after training, confirming the effectiveness of the participatory and practice-oriented training approach. The strongest gains were recorded in Climate-Smart Agriculture and climate information use, highlighting improved capacity to translate climate data into actionable agricultural decisions.

Despite operational constraints related to logistics and the national context, the activities successfully laid a strong foundation for scaling soil health innovations through local extension systems. Key recommendations include the establishment of demonstration plots, the consolidation of a localized climate information dissemination network, and continued mentoring of trained extension workers and farmer-trainers to maximize field-level impact.

> *When climate When climate information, soil health practices, and extension capacity converge, knowledge is transformed into resilient action at farm level".*

1. Introduction

As part of the implementation of the Soil Values Programme, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) conducted a series of coordinated technical missions aimed at strengthening sustainable soil management through the development of decision-support tools and targeted capacity building. These interventions focused on the development of a zonal varietal catalogue and the identification and training of farmer-trainers on Soil and Water Conservation / Soil Defense and Restoration (SWC/SDR) practices, climate information services, and Climate-Smart Agriculture (CSA).

The development of the varietal catalogue relied on a mixed-methods approach, combining a semi-structured survey administered to key stakeholders involved in the seed value chain (including public institutions, NGOs, and seed producers) with an extensive desk review of scientific and technical documentation. This approach enabled the systematic compilation of agronomic, agroecological, and adaptive characteristics of improved crop varieties, forage species, and woody species relevant to the targeted watersheds.

In parallel, capacity building activities targeting agricultural extension agents, NGO staff, and farmer-trainers were implemented between 3 and 24 October 2025. Training modules addressed two core thematic areas:
(i) climate information services and Climate-Smart Agriculture technologies, with emphasis on the interpretation and application of climate forecasts for agricultural decision-making; and
(ii) SWC/SDR practices for the rehabilitation of degraded lands, including erosion control, soil fertility restoration, and landscape-level interventions.

These activities form part of the broader collaborative framework between ICRISAT and the Soil Values Program, which seeks to promote sustainable soil fertility management, improve soil health, and enhance agricultural productivity in smallholder farming systems.

The intervention aligns with the broader policy commitment of the Government of the Netherlands to strengthen food security and promote sustainable soil management in accordance with the Sustainable Development Goals (SDGs). Within this framework, the Dutch Ministry of Foreign Affairs (DGIS) has articulated a policy approach that explicitly integrates soil fertility improvement through a holistic perspective encompassing agroecological, socio-economic, and institutional dimensions. Consequently, a consortium comprising the International Fertilizer Development Center (IFDC), the Netherlands Development Organization (SNV), and Wageningen University & Research (WUR) was awarded DGIS funding to implement the Soil Values Programme.

Within this consortium, ICRISAT and IFDC formalized a partnership agreement to leverage their complementary expertise and support program implementation through three core activities included in the 2025 annual work plan:

(i) the development of a structured, illustrated, and technically validated catalogue of improved crop varieties and forage species adapted to watershed-specific agroecological zones;
(ii) Training of Trainers (ToT) for farmer-trainers, input suppliers, and extension agents on climate information services and CSA technologies; and
(iii) targeted training of farmer-trainers on SWC/SDR practices.

Over three weeks, participants from each watershed attended two-day training sessions structured around thematic modules aligned with local agroecological challenges. A participatory and experiential learning approach was systematically applied, facilitating peer-to-peer exchange, knowledge co-construction, and critical discussion. Practical field exercises including rain gauge installation and Farmer Managed Natural Regeneration (FMNR) enabled participants to operationalize theoretical concepts. Training sessions were further reinforced through the use of audiovisual materials illustrating field-level implementation of the promoted technologies.

Based on participatory planning and stakeholder consultation, five (05) training sessions were conducted: one in Sikasso, two in Ségou, and two in San, in close collaboration with focal points from the Regional Directorates of Agriculture (DRA), with support from partner NGOs, technical resource persons, and local authorities.

This document presents the current status of implementation of ICRISAT-led activities within the Soil Values Programme across three priority watersheds: Upper Bani (Sikasso), Upper Niger Basin (Ségou), and Middle Bani (San–Tominian).

2. Catalogue Development

2.1. Inventory and literature review

For the development of the varietal catalogue, it was essential to establish close collaboration with all relevant stakeholders. This approach aimed to ensure a shared understanding of the catalogue's objectives, strengthen inter-institutional coordination, and promote a harmonized articulation of needs.

2.2. Semi-structured survey

Following stakeholder consultations, varietal information was systematically collected, and several institutions provided technical datasheets to support the bibliographic synthesis of the varietal catalogue under development. In the Sikasso region, in addition to the initially identified partners, the assessment team engaged with key institutional and private-sector stakeholders, including the Regional Directorate of Agriculture (DRA) of Sikasso, sectoral agricultural services, the Lowland Rice Programme, seed companies (SOPROSA, SMA Agro, F4G), and farmer cooperatives (COPROSE, farmer organizations of Sikasso). These stakeholders participated in a semi-structured survey designed to document varietal availability, adoption, and performance.

Survey results indicate that maize, sorghum, pearl millet, rice, cowpea, and groundnut constitute the principal priority crops in the Sikasso region. Although woody species are widely present within local farming systems, they remain insufficiently documented and are not yet integrated into a formal varietal catalogue.

In the Middle Bani watershed (San), a semi-structured survey was conducted with a broad range of key actors, including the Regional Directorate of Agriculture, agricultural technical services, non-governmental organizations, the Office du Moyen Bani (OMB), cooperatives, the Water and Forestry Service, and agro-dealers. The objective was to characterize dominant agricultural commodities and identify priority crops at the watershed scale. The results indicate that pearl millet is the dominant crop, followed by sorghum, irrigated rice, rainfed rice, cowpea, and groundnut. These crops play a central role in local production systems, contributing both to household food security and to market-oriented production.

The presence of woody species (tree and shrub components) was also consistently reported across the Middle Bani basin. However, their ecological and economic contributions remain poorly quantified due to limited availability of statistical data in the San region. This highlights the need for strengthened data collection and characterization of woody species to better capture their role in agroforestry systems, soil health improvement, and climate resilience.

Stakeholder interactions further revealed that improved crop varieties are generally well adopted by farmers in the San region. Nevertheless, access to these varieties remains constrained by the lack of advance demand planning and limited availability of foundation and pre-basic seed for seed multiplication. Despite these limitations, several improved varieties across crop species are highly valued by producers and consistently ranked among the most demanded in the region.

In the Upper Bani basin (Ségou), varietal information was collected from the Regional Seed Services of Ségou, the AOPP, the Office du Niger, the Office du Riz de Ségou, seed cooperatives, the Water and Forestry Directorate, and agro-dealers. Stakeholders unanimously emphasized the importance of enhancing varietal dissemination to improve productivity and resilience. This process was supported through the provision of technical documents, including improved varietal profiles, reference catalogues, and locally conducted studies. The findings indicate that rice represents the highest regional priority crop, followed by sorghum, maize, pearl millet, cowpea, and groundnut.

3. Training of farmer-trainers and technical staff from public services and NGOs

3.1. Training objectives

The overall objective of the training was to strengthen the technical and methodological capacities of extension agents and farmer-trainers through the provision of theoretical and practical knowledge on climate information services, Climate-Smart Agriculture (CSA), and Soil and Water Conservation / Soil Defense and Restoration (SWC/SDR) practices, with the aim of improving decision-making and enhancing the rehabilitation of degraded lands.

3.2. Implementation Framework

A joint planning mission was conducted in the regions of Sikasso, San, and Ségou. In accordance with the Terms of Reference (ToR), an initial series of meetings was organized between the ICRISAT team, the Regional Directorates of Agriculture (DRA), and partner NGOs. These consultations led to the joint development of implementation schedules to plan coordination with technical services involved in the seed production value chain. The identification of farmer-trainers was discussed collaboratively with the DRAs and partner NGOs, and finalized lists of trainees were provided by the DRAs and selected NGOs.

Sikasso Region

Over a five-day period, the team consulted with Soil Values partners (CADJI, IFDC/AMAPROS, FITINET Consult) and the DRA, which served as the focal institution. Based on the level of institutional collaboration, it was agreed that the list of farmer-trainers would be jointly established by the DRA and partner NGOs. A total of 78 farmer-trainers were identified from the communes of Sikasso, Kaboila, and Zangaradougou.

San Region

In coordination with the DRA and agricultural technical services, the number of farmer-trainers to be supported under the ICRISAT mandate was determined. The agricultural services of San provided a consolidated list covering six communes (San, Somo, Yasso, Tominian, Sourountouna, and Sanékuy). In total, 138 farmer-trainers were selected for training.

Ségou Region

The planning mission was conducted in Ségou from 19 to 22 October 2025, with facilitation support from the National Directorate of Agriculture (DNA). The DRA provided a consolidated list of 190 farmer-trainers, distributed across eight communes within the region

3.3. Description of Training Modules

- **Climate Information and Climate-Smart Agriculture (CSA)**

In the context of climate change, climate information services constitute a critical foundation for agricultural decision-making, yet they remain poorly understood within rural communities. In the Sahel, where climatic variability is high, access to seasonal forecasts, early warning systems, and climate trend analyses is essential for effective crop planning, water management, varietal selection, and livelihood protection.

This training module aimed to enhance the capacity of farmers, extension agents, and decision-makers to understand, interpret, and operationalize climate information for agricultural planning. It strengthened local adaptive capacity by linking climate data to practical farm-level decisions. Participants were introduced to the principles of Climate-Smart Agriculture (CSA), encompassing practices and technologies designed to sustainably increase productivity, enhance the resilience of smallholder farmers, and reduce greenhouse gas emissions. Training content included CSA best practices as well as climate-resilient and promising crop varieties, which were discussed throughout the sessions.

- **Soil and Water Conservation (SWC) and Soil Defense and Restoration (SDR)**

Soil and Water Conservation (SWC) and Soil Defense and Restoration (SDR) are complementary approaches for sustainable natural resource management. SWC focuses on preventing soil and water degradation by reducing erosion, runoff, and land degradation, while SDR targets already degraded soils through interventions aimed at restoring soil fertility, structure, and water-holding capacity using biological and physical measures.

The training covered a range of SWC/SDR practices, including stone bunds, earth bunds, Farmer Managed Natural Regeneration (FMNR), composting, intensive lowland rice systems (SRI), zaï pits, and integrated production systems. The training adopted an interactive and participatory approach, combining technical presentations with field-based demonstrations. Practical sessions on FMNR implementation were conducted during each training event across the different watersheds. Each module was further reinforced through the use of instructional videos illustrating real-world application of the technologies.

3.4. Training on climate information services and climate-smart agriculture (CSA)

A total of five (05) training modules on climate change were delivered across all training sessions. The same set of modules was consistently implemented in each session (Sessions 1 to 5) to ensure harmonized knowledge transfer among participants. Following training modules were provided:

- Module 1.1: Understanding Climate Change
- Module 1.2: Climate Information and Participatory Climate Services
- Module 1.3: Climate-Smart Agriculture (CSA)
- Module 1.4: Climate-Resilient Agricultural Practices and Adapted Crop Varieties
- Module 1.5: Practical Training on the Use of Farmer Rain Gauges

Picture 2: Training facilities for Climate Smart Agriculture / Climate information in Sikasso, Ségou, and San.

3.5. Training on Soil and Water Conservation (SWC) and Soil Defense and Restoration (SDR) Practices

For the SWC/SDR component, training modules were delivered in accordance with the specific conditions of each watershed. Based on agroecological characteristics, the content and emphasis of SWC/SDR techniques varied across regions, ensuring contextual relevance and alignment with local land degradation challenges.

- Theme 2: Soil and Water Conservation (SWC) and Soil Defense and Restoration (SDR) Techniques
- Module 2.1: Stone Bunds (Cordons pierreux)
- Module 2.2: Earth Bunds (Diguettes)
- Module 2.3: Composting
- Module 2.4: Farmer Managed Natural Regeneration (FMNR / RNA)
- Module 2.5: Intensive Rice Production System for Lowlands (SRI)
- Module 2.6: Zaï Technique
- Module 2.7: Integrated Production Systems
- Module 2.8: Practical Sessions on Best Practices in FMNR and SWC/SDR Techniques

Picture 2: Training facilities for Soil and Water Conservation / Soil Defense and Restoration (SWC/SDR) practices in Sikasso, Ségou, and San.

3.6. Participants

The activity brought together more than 405 participants, including men and women from local partners of the Soil Values Project, Farmer Organizations (FOs), associations, NGOs, and public agricultural services (extension agents, technicians, and advisors). Participants were drawn from 17 communes across the three regions, representing institutions actively involved in agricultural development.

In terms of regional distribution, Sikasso registered 80 farmer-trainers, including 30 women and 50 men, corresponding to a female participation rate of 37.5%, the highest among the three regions. In Ségou, out of 181 participants, 46 were women, representing 25.41% of the total. The San region recorded 144

participants, including 31 women and 113 men, resulting in a female participation rate of 22.69%, the lowest among the regions.

Regarding institutional contributions, the Regional Directorates of Agriculture (DRA) mobilized a total of 316 participants, including 300 farmer-trainers and 16 technical staff. Technical partners Sahel Eco and FITINET Consult each mobilized 40 farmer-trainers, while NEF and ALPHALOG contributed one (1) and five (5) participants, respectively.

Overall, the geographic distribution of participants included 80 farmer-trainers from Sikasso, 181 from Ségou, and 144 from San (Table 3).

3.7. Training evaluation

3.7.1. Pre- and post-training assessment

To assess participants' understanding of the training modules, pre- and post-training assessments were conducted for each training session. Participants completed structured pre-evaluation and post-evaluation questionnaires containing questions aligned with the content of the modules delivered. The pre-training assessment was administered at the beginning of each session, while the post-training assessment was conducted at the end of the session.

3.7.2. Data analysis

Participants' responses were compiled and subjected to descriptive statistical analysis, including the calculation of response frequencies and average scores.

3.7.3. Results

Overall results indicate a substantial improvement in knowledge levels between the pre- and post-training assessments. Across all modules and regions, the average proportion of correct responses increased from approximately 49% at pre-training to 91% at post-training. This marked improvement reflects a significant enhancement in participants' technical understanding and confirms the effective assimilation of key messages delivered during the training. The fact that most thematic areas reached post-training scores close to or above 89–92% demonstrates a high level of comprehension and successful uptake of the concepts taught.

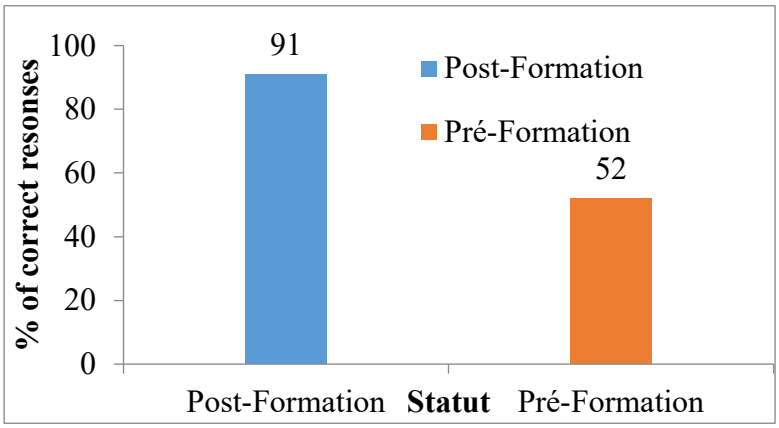

Figure 1. Comparison of pre-training and post-training assessment scores (percentage of correct responses) across all regions.

3.7.4. Domain-Specific Analysis

- Climate Information

This domain showed a substantial improvement, with the percentage of correct responses increasing from 51.8% in the pre-training assessment to 89.9% in the post-training assessment, representing a gain of nearly 38 percentage points. This improvement indicates a marked enhancement in participants' ability to interpret seasonal forecasts, use rain gauges, understand climate predictions, and apply climate indicators for agricultural decision-making.

- Climate-Smart Agriculture (CSA)

The CSA domain exhibited the largest relative improvement, with correct responses rising from 18.95% before training to 89% after training. This significant increase reflects a strong improvement in participants' understanding of climate-resilient agricultural practices, adaptation measures, and strategies for reducing climate-related risks.

- Improved Varieties

Baseline knowledge in this domain was relatively higher (57.4%), indicating some prior familiarity among participants. Post-training results reached 91.8%, corresponding to an increase of more than 34 percentage points. This demonstrates improved mastery of the characteristics, benefits, and appropriate use of climate-adapted crop varieties.

- Soil and Water Conservation / Soil Defense and Restoration (SWC/SDR)

Knowledge gains in this domain were positive but comparatively more moderate. The pre-training score (67%) increased to 91% after training. The smaller relative gain is likely attributable to the more technical and practice-oriented nature of SWC/SDR interventions, which may require longer-term field application for full assimilation.

- Climate Change

Understanding of climate change concepts increased markedly, with correct responses rising from 38% in the pre-training assessment to 89.4% post-training, representing a gain of more than 51 percentage points. This reflects a significantly improved understanding of the causes of climate change, its impacts on agriculture, and the importance of adopting appropriate adaptation strategies.

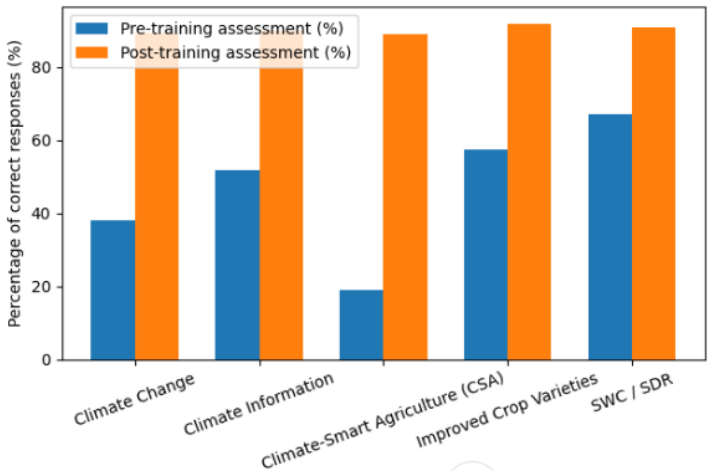

Figure 2: Pre- and Post-training assessment results by thematic domain

The final ranking of thematic domains for knowledge gains (Figure 5) is as follows:

- Climate-Smart Agriculture (CSA): +70 percentage points (from 18.9% to 89%)
- Climate Change: +51 percentage points (from 38% to 89.4%)

- Climate Information: +38 percentage points (from 51.8% to 89.9%)
- Improved Crop Varieties: +34 percentage points (from 57.4% to 91.8%)
- Soil and Water Conservation / Soil Defense and Restoration (SWC/SDR): +24 percentage points (from 67% to 91%)

4. Conclusion and Recommendations

The training activities resulted in a substantial improvement in participants' knowledge across all evaluated domains. The most pronounced gains were observed in Climate-Smart Agriculture (CSA) and climate change understanding, two critical areas for strengthening the resilience of agricultural systems to climate-related risks. Improved mastery of climate information services further demonstrates enhanced capacity among participants to use weather forecasts and climate data for more effective agricultural planning. The consistently high post-training assessment scores confirm the quality and effectiveness of the training in strengthening participants' technical competencies.

Recommendations

- Enhancing knowledge application through demonstration plots:

  To capitalize on the training outcomes, it is recommended to establish demonstration plots during the upcoming agricultural season to facilitate the practical application of acquired knowledge by farmer-trainers and producers. These plots will serve to: illustrate the good agricultural practices promoted during the training; facilitate learning through observation and hands-on experience; strengthen farmer adoption through visible and shared results within communities.

- Strengthening the application of climate information services:

  It is strongly recommended to establish a localized and expanded dissemination network to ensure the regular, reliable, and accessible delivery of climate information (daily and seasonal forecasts) to farmers. This network should: build on trained community facilitators, local technical services, partner NGOs, and community radio stations; integrate appropriate digital tools (SMS messaging, interactive platforms, WhatsApp) to ensure wide outreach; further strengthen stakeholders' capacity to interpret and use climate information for agricultural decision-making, including varietal selection, planting dates, and climate adaptation strategies.

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Photos

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Soil Values, Climate Smart Agriculture, Capacity building, Mali, Watershed

Partners

IFDC, ALPHALOG, AMAPROS, ASEMA, NEF, MA

About CGIAR Sustainable Farming Science Program

The CGIAR Sustainable Farming Science Program will address key challenges in agrifood systems by fostering efficient production of nutritious foods and safeguarding the environment to create fair employment opportunities, as we simultaneously tackle climate change, soil degradation, pests, diseases, and desertification.