Scaling Site-Specific Fertilizer Advisories in Ethiopia: Innovation Use and Practice

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CGIAR SUSTAINABLE FARMING

Scaling LAFA/HaFAS in 2025: Building Evidence, Governance, and Delivery Pathways for National-Scale Site-Specific Fertilizer Advisories in Ethiopia: Innovation Use Practice

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INTRODUCTION

The shift in naming from "NextGen" to "LAFA/HaFAS" is not simply a rebranding. It reflects a structural evolution in how Ethiopia organizes and delivers digital agricultural advisory tools. Localized Agronomy and Fertilizer Advisory (LAFA) is the core advisory engine that generates site-specific recommendations. LAFA operates within the broader Harmonized Digital Fertilizer and Agronomic Solutions (HaFAS) framework, which provides the platform and institutional approach for organizing, governing, and scaling harmonized fertilizer and agronomic advice in Ethiopia. While NextGen refers to an earlier generation of data-driven fertilizer recommendation approaches and tools that demonstrated the feasibility and value of site-specific nutrient advice. As the ecosystem expanded, Ethiopia faced a predictable challenge: multiple tools and actors risked producing inconsistent recommendations and fragmented delivery pathways. In response, the Ministry of Agriculture (MoA) and partners initiated a national harmonization process, including a DST harmonization meeting in September 2023 and subsequent platform launch processes, to align tools, standards, and institutional roles. Within this harmonization trajectory, LAFA emerged as the core advisory package, explicitly integrating previously separate tools (LANDWise and NextGen) into a single harmonized solution designed for scale and multi-channel delivery. HaFAS then provides the overarching framework that makes LAFA scalable in practice: it supports coordination rules, data flows, validation protocols, delivery partnerships, and system strengthening so that Ethiopia's advisory ecosystem functions as one coherent national system rather than a collection of disconnected pilots.

This transition also changes how partner contributions are organized. Under "NextGen," contributions were often framed around tool development and proof-of-concept piloting. Under "LAFA/HaFAS," partner contributions are framed around a national delivery system: research institutions validate and refine; MoA provides governance, hosting, and extension integration; digital and private partners convert advisories into services and adoption mechanisms; and donor-supported programs such as SSHI-III strengthen feedback loops and institutional learning through FRE–CFM structures.

LAFA/HaFAS Piloting in 2025 by Ethiopia's National Agricultural Research System

Within Ethiopia's transition to digital, site-specific agricultural advisory services and the broader LAFA/HaFAS institutionalization agenda, the National Agricultural Research System (NARS) provides the scientific and operational backbone that helps digital advisories earn trust at national scale. The Ethiopian Institute of Agricultural Research (EIAR) and the Regional Agricultural Research Institutes (RARIs) play a central role in institutionalizing the process by leading piloting efforts that test how digital recommendations perform under farmer-managed conditions across diverse agro-ecologies and management contexts. Their contributions include developing and applying field protocols, selecting representative sites and farmers, coordinating decentralized implementation, ensuring data quality and consistent field oversight, and strengthening national capacity in data systems, analytics, and model operations needed for long-term sustainability. Through these functions, EIAR and RARIs anchor NARS as the institutional mechanism that translates advanced agronomic models into trusted, localized recommendations while generating practical feedback for continuous improvement and smoother integration into national extension programs.

In 2025, EIAR—working with RARIs, NARS partners, and development collaborators—advanced piloting of a harmonized fertilizer Decision Support Tool (DST) that underpins the LAFA/HaFAS platform for site-specific fertilizer recommendations in Ethiopia's major cereal systems. The DST integrates nationally curated agronomic datasets with machine learning approaches to generate crop-specific nitrogen (N) and phosphorus (P) recommendations. The 2025 piloting focus was to assess real-world performance and delivery readiness at scale: how recommendations translate into farmer decisions, how they perform across varying soil and management conditions, what operational bottlenecks emerge during implementation, and what system adjustments are required to support consistent advisory quality in routine extension workflows.

The operational framework for the 2025 piloting initiative was shaped during a national planning workshop held in May 2025 in collaboration with the International Center for Tropical Agriculture (CIAT). The workshop clarified institutional responsibilities, established field implementation standards, and agreed on an evidence-informed approach to site selection and sequencing. Piloting was prioritized in zones and for crop contexts where DST recommendations had shown promising results, enabling broader demonstration and structured learning under farmer-managed conditions. This design positioned the 2025 program not only as an agronomic assessment, but also as a deliberate test of operational feasibility, how to deliver, supervise, capture data, and learn at scale.

Field implementation was conducted across Ethiopia's main cereal-producing regions, including Amhara, Oromia, Central Ethiopia, South Ethiopia, Southwest Ethiopia, and Sidama. In total, 1,430 geo-referenced on-farm piloting trials were established in 2025 (Fig 1). The focus crops were wheat, tef, sorghum, and maize, reflecting their national importance and the availability of DST calibration data to support credible, crop-specific recommendations. Across sites, the piloting approach combined structured agronomic measurement with implementation

learning by capturing soil and biophysical characteristics, farmer management practices and input use, crop response under different fertilizer treatments, farmer socioeconomic profiles, and stakeholder perceptions from both farmers and district-level agricultural experts. This design ensured that agronomic performance evidence was generated alongside practical insight into adoption barriers, advisory communication needs, and the realities of decentralized delivery.

A defining feature of the 2025 piloting program was the systematic use of field evidence to strengthen LAFA/HaFAS as an institutional learning system rather than a static advisory product. Incoming piloting data were cleaned and assessed through exploratory data analysis and agronomic interpretation, then used to inform model adjustments and recommendation parameter refinement. Regular consultation with soil scientists and agronomists supported interpretation of results, helped explain outliers and edge cases where outputs did not align with field realities, and guided refinement of key parameters, such as nutrient use efficiency assumptions, crop-specific N:P ratio thresholds, and practical upper and lower bounds for nutrient recommendations, so that improvements reflected both empirical evidence and expert judgment.

Strengthening Ethiopia's national data infrastructure and operational backbone underpinned both technical progress and long-term sustainability. The national soil and agronomic database expanded from 56,464 records in 2024 to over 90,000 in 2025, with more than 50,000 records cleaned, structured, and integrated into the modeling pipeline after exploratory analysis. This expanded empirical foundation strengthens model calibration and improves the robustness of recommendation behavior across crops and regions. National ownership also advanced through infrastructure migration: model scripts and databases that had been hosted on Amazon Web Services (AWS) were migrated to a domestic cloud server at the Ministry of Agriculture (MoA). This transition strengthens sovereignty over advisory operations, reduces reliance on external hosting and technical support, improves continuity, and positions LAFA/HaFAS more firmly as national infrastructure rather than project infrastructure.

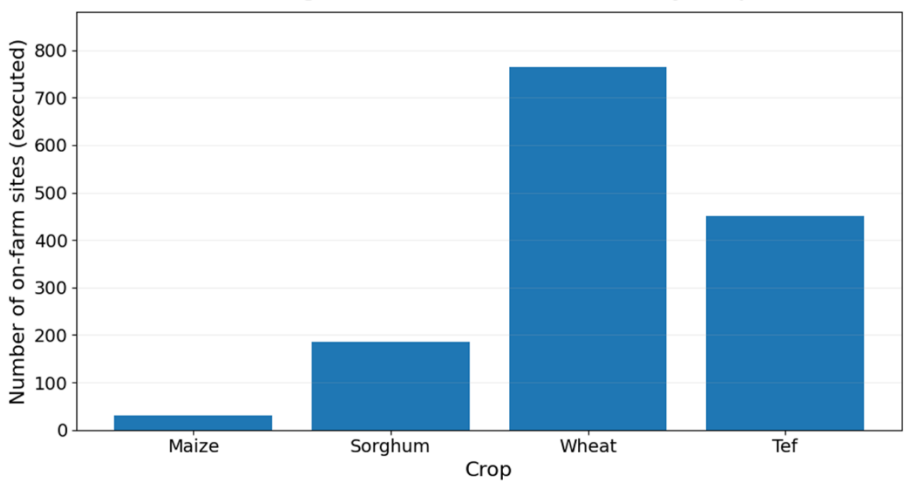

Fig. 1 2025 Piloting implementation by crops. Grouped bars compare the number of on-farm sites executed for piloting across maize, sorghum, wheat, and tef across different agro-ecologies in Ethiopia

Project coordination in 2025 was led by EIAR, with implementation responsibilities distributed across RARIs for conducting piloting the innovation at on-farm fields (Fig 2 and 3). Piloting was implemented on a substantial scale despite logistical complexity and decentralization, achieving a 65.1% completion rate, with 1,430 out of 2,195 planned piloting activities established. Crop-level implementation patterns highlight the portfolio emphasis: wheat recorded the highest number of piloting sites, followed by tef, sorghum, and maize. These patterns suggest that piloting was most advanced in wheat and tef systems, enabling deeper operational learning on delivery pathways, data flows, and advisory uptake dynamics in the crops and areas where scale potential was strongest.

Fig. 2 A wheat field managed using a DST-based digital fertilizer advisory, contrasted with surrounding fields (Hagere Selam woreda, Sidama Region). ***Photo courtesy of Dr. Birru Yitaferu.***

Fig. 3 Fields treated using DST-based digital fertilizer advisory: (a) tef in Sekota, Amhara Region; (b) maize performance in Welega, Oromia Region; and (c) sorghum in Sekota, Amhara Region. ***Photos courtesy of Dr. Birru Yitaferu***

Digital Green's Role in Implementing LAFA/HaFAS

Scientific validation is necessary but insufficient for impact unless advisories reach users in time and in usable formats. Within LAFA/HaFAS, Digital Green's comparative advantage is digital last-mile delivery: converting agronomic recommendations into interactive advisory services and feedback loops that farmers and extension agents can use in real decision moments. FarmerChat is positioned as a conversational, AI-enabled interface designed to make agricultural information accessible through local-language support and multimodal interaction, with substantial user reach across multiple countries including Ethiopia. In this sense, Digital Green functions as a demand-side and delivery pathway partner, helping ensure LAFA recommendations are discoverable, understandable, and actionable for farmers and extension workers, while also demonstrating how AI-enabled extension can be strengthened through validated knowledge bases and institutional partnerships, including collaboration with Ministries of Agriculture and integration of curated agricultural content into digital advisory systems.

Within the Ethiopia "Digital Green–Ethiopia" use case, Digital Green serves as the primary demand-side partner for deploying and scaling a site-specific fertilizer advisory system that responds to farmers' localized agronomic conditions. The program is motivated by persistent productivity constraints in Ethiopia's wheat-based production systems, now extending to other cereal-based systems, where the widespread use of generalized, "blanket" fertilizer recommendations has failed to account for variability in soil fertility, crop type, and agro-ecological context. To address this, the initiative is centered on a Decision Support Tool (DST) capable of generating plot- or farm-level fertilizer guidance, which Digital Green translates into farmer-friendly formats delivered through dissemination and feedback channels.

From 2023 to 2024, Digital Green disseminated advisory content to farmers and extension agents using agile, context-sensitive communication channels, including interactive voice response (IVR), SMS, video-based messaging, in-person training, and other capacity-building efforts. These channels were also designed to incorporate farmer feedback. Through this initial phase, the initiative reached over 60,000 farmers. Building on this foundation, Digital Green's 2025 strategy focused on expanding access and usability by enabling direct integration between the national DST platform and FarmerChat.

In 2025, Digital Green was granted API access to the DST platform, allowing partner platforms to extract site-specific agronomic and fertilizer advisory content and convert it into user-facing formats. This enabled delivery of multi-modal, localized advisory services through the AI-powered FarmerChat platform, where farmers and extension agents can request and receive customized fertilizer and crop management recommendations in preferred local languages, including Amharic and Oromiffa. The operational logic is explicitly inclusion-oriented: reducing language and literacy barriers through conversational design and enabling advisory access through simple user interactions.

As part of its 2025 operational plan, Digital Green initiated a pilot of the Localized Agronomy and Fertilizer Advisory (LAFA) system across eight regional states, spanning 49 zones and 192 districts. The pilot aimed to reach approximately 88,500 farmers producing wheat, maize, and tef. The delivery approach combined digital dissemination with traditional extension services, offering a blended model intended to support farmer adoption while ensuring multiple access pathways.

Early implementation, however, encountered logistical and technical barriers that delayed service deployment and limited initial reach. By the early stages of the wheat planting season, only 494 farmers and extension agents had received advisory services. These constraints persisted until August 2025, when the LAFA advisory system was successfully integrated into FarmerChat via the DST API. Following integration, farmers began accessing site-specific recommendations through a conversational interface that responds in local languages and generates fertilizer guidance based on users' geo-coordinates. As of the latest update, this feature is operational for maize and wheatFollowing integration, FarmerChat was enhanced to support site-specific advisory workflows for both practicing farmers and extension agents. Utilization increased substantially in subsequent months, indicating improved availability and growing user awareness. However, because the rollout occurred relatively late in the season, many users engaged with the tool only after key early-season agronomic decisions, such as sowing and initial fertilizer application, had already been made, likely limiting the immediate agronomic impact of advisories during the 2025 cropping cycle. This experience underscores the importance of aligning advisory deployment with the cropping calendar to maximize value for planning and timely decision-making.

To assess demand and engagement, the report uses recorded *Send_Query* events within FarmerChat as a proxy for interaction with LAFA services. Over the reporting period, 15,167 queries were submitted. Following the August 2025 integration, service use rose rapidly: queries increased from 494 in August to 1,212 in September and then surged to 4,361 in October. Uptake continued through November and December, with an estimated additional 9,100 queries, although December data may be incomplete. This sharp increase suggests a concentrated period of adoption, likely influenced by intensified outreach, increased familiarity, and improved visibility of the platform, while simultaneously reinforcing that late-season launch reduces the potential agronomic benefits of advice.

User engagement was segmented by two client roles: practicing farmers and extension workers. Practicing farmers generated 10,902 queries (about 72% of total), while extension workers submitted 4,265 queries (28%). This pattern is consistent with an adoption pathway in which extension workers help introduce and facilitate early use, followed by rising direct farmer engagement as confidence and digital familiarity increase, though the absence of referral-chain tracking means this interpretation is indicative rather than definitive.

Geographically, demand was highly concentrated. Five locations, Jimma (3,678 queries), Bale (2,381), West Hararghe (1,699), East Hararghe (1,475), and Sidama Region (1,294), accounted for approximately 69% of all recorded queries. This spatial clustering suggests adoption is shaped by local implementation dynamics such as outreach intensity, mobile network connectivity, training coverage, and the agro-ecological fit of DST recommendations. The findings point to the need for geographically tailored scaling strategies that pair advisory

availability with localized user support and demand generation, to ensure equitable and effective access to digital agro-advisory services across Ethiopia's diverse farming landscapes.

Overall, within LAFA/HaFAS scaling logic, Digital Green contributes to three strategic needs. First, it expands access by providing user-friendly interfaces for requesting location-specific advice. Second, it strengthens learning by generating anonymized demand signals and feedback patterns that can inform advisory refinement and targeted outreach. Third, it supports inclusion by reducing literacy and language barriers through conversational, local-language, and multi-modal design. These contributions make Digital Green a central operational partner because they address delivery, usability, engagement, and timeliness constraints that scientific and research institutions alone cannot solve.

Piloting LAFA/HaFAS through LERSHA (Green Agro Solution PLC) in 2025

Farmer adoption of site-specific fertilizer recommendations is often constrained not by lack of information, but by affordability, liquidity, and risk exposure, especially under climate uncertainty and volatile fertilizer prices. Within the LAFA/HaFAS scaling agenda, LERSHA's delivery model responds to these binding constraints by bundling agronomic advisories with enabling financial services, converting recommendations into financed input packages and risk-managed adoption pathways. This approach reflects a broader, responsible scaling logic that recognizes heterogeneity in farmer risk preferences and capacity to invest, and that advisory systems become far more adoptable when paired with services that reduce downside risk and transaction costs.

To address Ethiopia's interconnected constraints, limited access to locally relevant advice, difficulties financing fertilizers and other inputs, and vulnerability to seasonal and climate-related risks, the Alliance of Bioversity International and CIAT adopted a human-centered approach that integrates tailored advisory services with input credit and agricultural insurance. At the core of this strategy is LERSHA, a farmer-facing platform developed by Green Agro Solution PLC. First piloted in the 2023 cropping season, LERSHA integrates agro-climate and site-specific fertilizer advisory services with customized financial solutions, including microfinance and insurance, to improve farmers' financial security, facilitate timely access to essential inputs (particularly fertilizers), mitigate risks associated with climate variability and crop failure, and promote the adoption of sustainable, location-specific practices.

One of LERSHA's operational strengths is its ability to reach farmers through multiple delivery channels, combining digital and human support to ensure usability even in remote settings. Delivery channels include personalized SMS, mobile apps, voice messages, and call centers, designed to provide customized support and streamline applications for credit and insurance. Complementing these digital services, LERSHA leverages trained village-level agents and call-center assistance to provide on-the-ground support, aggregate demand, and enable efficient delivery of bundled agricultural services.

In partnership with the Alliance, LERSHA expanded its operational capacity in 2025 through agent training and hands-on support to farmers in applying seasonally tailored site-specific fertilizer recommendations (SSFRs). This collaboration enabled integration of customized advisory content from the NextGen decision-support tool (DST) web platform, now aligned under LAFA/HaFAS, through API access. In addition, the initiative developed and distributed digital and printed recommendation-domain maps at the kebele level to strengthen local relevance and uptake of field-level practices. A key innovation of the model is the deliberate bundling of agronomic advice with credit and insurance, reducing farmer risk while fostering stronger collaboration with local financial institutions and building on prior experience with loans linked to area-yield index insurance.

Building on earlier implementation, LERSHA scaled its 2025 approach by fully integrating input loans (including fertilizer financing) and agricultural insurance into a single bundled service, while maintaining delivery of localized agronomic and fertilizer advisories. The model

aimed to: (i) increase productivity through precise, location-specific recommendations; (ii) translate recommendations into actionable inputs for appropriate loan sizing; and (iii) broaden access to input financing, while also driving adoption of digital advisory platforms through scalable dissemination strategies. Implementation followed a structured sequence: farmer identification and data collection, advisory generation, and dissemination through LERSHA's multi-channel communication model.

In 2025, LERSHA identified and profiled more than 32,000 smallholder farmers through its platform. Following a credit scoring process, 8,069 farmers were selected and supported with input financing, enabling timely purchase of fertilizers and other key inputs such as improved seeds and agrochemicals, aligned with site-specific recommendations. Among farmers supported with bundled advisory and financial services, 1,291 were women and 6,778 were men (Fig. 4a). The bundled package was deployed across 16 woredas in three regions: 11 woredas in Oromia, 4 in Sidama, and 1 in Central Ethiopia. Reach by region is visualized in Fig. 4b, with Oromia representing the largest share, followed by Central Ethiopia and Sidama.

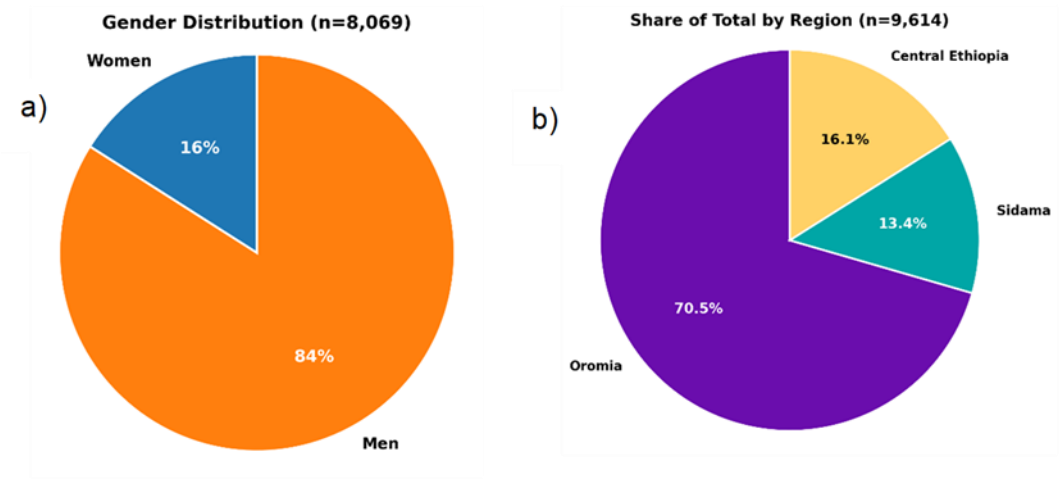

Fig. 4 Fertilizer recommendations bundled with financial solutions delivered to farmers by LERSHA through digital channels (SMS, IVR, and call-center advice), showing reach by gender (men and women) (a) and total reach by region (b) in Ethiopia.

To ensure precision, farm plot geo-location data were collected and validated with local extension officers and cooperatives. Fertilizer recommendations were then generated through integration with the NextGen tool where LAFA/HaFAS advisory content is hosted and delivered via concise SMS messages in local languages. Beyond farmer-level benefits, the 2025 LERSHA model strengthened wider agricultural system performance by improving how demand is translated into financing and supply-chain planning. By aligning localized recommendations with credit assessment and input financing, financial institutions were better able to design loan packages tailored to real agronomic needs, reducing risks of both under- and over-financing. These more accurate demand signals also supported cooperatives and unions to plan fertilizer procurement and distribution more effectively, improving operational efficiency and reducing mismatches associated with uniform input packages.

Overall, the 2025 results underscore the practical value of delivering agronomic advice, financial access, and risk protection as a single integrated service. The bundled model lowers adoption barriers by ensuring that farmers who receive SSFRs can also access timely financing, while insurance coverage reduces risk exposure and increases lender confidence. The combination of API-integrated digital tools, multi-channel delivery (SMS, voice, app, call center), and on-the-ground capacity building positions LERSHA as a scalable, market-oriented pathway within HaFAS, bridging the gap between scientifically generated recommendations and actionable farming decisions supported by financial products.

Delivering Site-Specific Fertilizer and Lime Advisories through the MoA and Regional and District Bureaus (FRE–CFM)

Ethiopia's public extension system remains the primary national vehicle for reaching millions of smallholders. For that reason, institutionalizing LAFA/HaFAS requires embedding site-specific advisories within public delivery structures, while simultaneously strengthening feedback mechanisms that keep recommendations responsive to farmer realities rather than treating dissemination as a one-way end point. Historically, Ethiopia's extension model has been predominantly linear and top-down: researchers develop technologies and recommendations, extension services disseminate them, and farmers are expected to adopt with limited customization or feedback. While this approach has delivered important gains, it has struggled to address the country's highly localized variation in soils, climate, and farmer resource constraints, contributing to low adoption rates, modest productivity impacts, and a persistent gap between research outputs and on-farm realities.

To address these limitations, a more inclusive and adaptive model is emerging through the Farmer–Research–Extension (FRE) linkage platform combined with a digital Client Feedback Mechanism (CFM). Implemented under the Supporting Soil Health Interventions in Ethiopia (SSHI-III) project, led by the Alliance of Bioversity International and CIAT in collaboration with the Ministry of Agriculture (MoA), regional bureaus of agriculture, GIZ–Ethiopia, and district-level actors, the FRE–CFM approach is helping transform extension from a one-way transfer of technology into a participatory, data-driven process. It operationalizes participatory extension by enabling district experts, extension agents, and farmers to test recommendations, report constraints, and generate learning that feeds back into advisory improvement.

The initiative began in three pilot districts in 2023 and expanded to ten districts by 2025. These districts, located in wheat-producing areas of Oromia, Central Ethiopia, Sidama, and South Ethiopia, were strategically selected based on both their importance to cereal-based production systems and their susceptibility to soil acidity, a key rationale for integrating lime advisories alongside fertilizer recommendations. Within these districts, the FRE–CFM platform supported delivery, adaptation, and refinement of LAFA/HaFAS-generated site-specific fertilizer and lime recommendations developed using geo-referenced soil properties, crop types, and localized climate conditions. In 2025, the FRE–CFM approach expanded from early pilots to 10 districts and delivered tailored fertilizer and lime recommendations to 484 plots during the reporting period.

Early adoption signals were encouraging, while also highlighting structural constraints that must be addressed for scaling. More than 70 farmers, over 15% of those receiving recommendations, implemented site-specific practices by the time of reporting demonstrating that uptake is feasible when advice is trusted and inputs are available. Farmer engagement was particularly strong when advisories aligned with locally accessible inputs and were delivered through trusted intermediaries such as lead farmers and extension agents, reinforcing the importance of credibility and last-mile relationships in adoption.

At the same time, farmer feedback underscored that recommended rates can be perceived as financially demanding relative to traditional practices, and that timing, input availability, and risk considerations strongly shape whether recommendations are adopted. This reveals a significant gap between advisory dissemination and actual implementation, one that cannot be closed by technical precision alone. Farmers' responses indicate that affordability remains a central barrier, pointing to the need to integrate economic feasibility more explicitly into future advisory design. Incorporating cost–benefit analysis into recommendation frameworks, and equipping extension personnel with tools to communicate the economic rationale and potential returns, will be important for building confidence and enabling informed decision-making. Moreover, because risk preferences and investment capacity vary widely across smallholders, advisory services should increasingly differentiate between farmers who are willing and able to invest for higher returns and those who prioritize lower-risk strategies with more stable outcomes.

The FRE–CFM mechanism is strategically important precisely because it treats dissemination as the beginning of an institutional learning loop. Through routine feedback capture, farmer constraints and implementation realities can be systematically documented and translated into delivery improvements and, where necessary, recommendation adjustments, strengthening both agronomic soundness and real-world feasibility over time. Within the HaFAS system, MoA and regional/district bureaus provide the institutional pathways through which LAFA becomes a public good: training extension staff, embedding advisories into routine seasonal planning, aligning recommendation domains with input supply systems, and ensuring feedback loops operate at scale rather than only in project districts. SSHI-III support is particularly catalytic because it strengthens the "connective tissue" of scaling, the practical mechanisms that connect scientific outputs to extension operations, input systems, and farmer realities, enabling inclusive and sustained agricultural transformation.

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Key Words:

site-specific fertilizer advisory, NextGen, fertilizer Decision Support Tool (DST), national harmonization, MoA governance, NARS, EIAR, RARIs, DST coordination platform

Partners

Partners include ICRISAT, the Ethiopian Institute of Agricultural Research (EIAR), Regional Agricultural Research Institutes (RARIs), the Ministry of Agriculture (MoA), Regional Bureaus of Agriculture (RBoAs), Wollega University and scaling partners such as Digital Green and LERSHA

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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.

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