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Outcome Assessment of the Digital Agriculture Ecosystem in Ethiopia

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Abstract

Ethiopia is making gradual but notable progress toward the digital transformation of its agricultural sector, driven by investments in connectivity, digital infrastructure, and cross-institutional coordination. Recent policy milestones have established an enabling foundation for scale, including the Digital Ethiopia 2025 and Digital Ethiopia 2030, personal data protection regulation and governance frameworks, and national roadmaps that will steer investment and implementation over the next decade—particularly the Digital Agriculture Extension and Advisory Services (DAEAS) roadmap and the Digital Agriculture Roadmap (DAR). However, persistent structural constraints such as limited rural internet coverage, low smartphone penetration, and unreliable electricity continue to shape the pace and equity of adoption. This paper synthesizes Ethiopia's digital agriculture ecosystem with a focus on technology, data and analytical capacity, and policy environment. In the technology landscape, work is ongoing to develop decision-support applications alongside digital channels for delivering advisory services. Evidence from multiple pilot initiatives suggests these tools can expand outreach cost-effectively and improve the timeliness and relevance of agronomic guidance. The success of various pilot projects, along with valuable lessons from earlier efforts, strong government commitment, and supportive policies, has driven further investment in Ethiopia's digital ecosystem. Nonetheless, substantial gaps remain in data availability and quality that limits the production of high-quality and context-specific advisory content. In addition, the reach and intensity of extension services needed to translate digital innovation into sustained productivity gains, income and livelihoods is not yet at the level desired. While Ethiopia's digital agriculture agenda is well-positioned for accelerated scale, its impact will depend on resolving foundational constraints in last-mile connectivity, power reliability, and the institutions and pipelines required for trustworthy data and localized advisory at national scale.

Introduction

Recognizing the central importance of agriculture to the economy and livelihoods, the government of Ethiopia has made major investments to strengthen and professionalize its extension system, including the deployment of more than 60,000 extension agents. While this has expanded outreach and supported the promotion and uptake of improved technologies (Bachewe et al., 2018; Yitayew et al., 2021), notable gaps remain. The publicly dominated extension system is constrained by multiple structural challenges, most notably limited farmer–agent engagement. On average, farmers receive only about one contact per year, a frequency that is insufficient to deliver sustained support or drive meaningful change (Mogus et. al., 2009; Berhane et al., 2018). The overall impact of extension services has also been constrained by inadequate service quality (Belay, 2002), a predominantly top-down delivery model, and generic and non-tailored advisory support (Mogus et al., 2009; Gebremedhin and Hoekstra, 2006). Most importantly, farmers' access to extension services remains inadequate to enhance their knowledge and whether this outreach has effectively contributed to productivity growth (Spielman et al., 2011; Krishnan and Patnam, 2014).

The rapid expansion of telecom infrastructure, alongside advances in big data and analytical tools, has strengthened Ethiopia's enabling environment for designing, deploying, and scaling digital solutions. Ethiopia, with 86.6 million mobile subscriptions and an estimated 81.3 percent of households owning a mobile phone, is the largest telecommunications market in East Africa, representing roughly 27.5 percent of the region's 315 million subscriptions, followed by Tanzania and Kenya. However, many of these devices remain basic or feature phones, and smartphones account for only about 43 percent of unique mobile connections, limiting the reach of data-intensive services. Ethio Telecom has expanded 4G and fiber-optic networks, boosting rural connectivity and scaling its Telebirr mobile money service. The entry of Safaricom Ethiopia has increased competition and introduced new products such as M-PESA, further supporting digital and financial inclusion. Yet affordability remains a major barrier: feature phones and smartphones cost an estimated 35 percent and 97 percent of average monthly household income in Ethiopia, compared to 15 percent and 34.4 percent in Kenya. Furthermore, internet penetration is still modest—around 27 percent of the population, or approximately 4.67 million households, report home internet access. Finally, reliable electricity remains a binding constraint for digital adoption and use at scale; grid coverage now reaches nearly 60 percent of towns and villages (GSMA, 2024).

Although access to digital devices is expanding, digital skills and literacy have not kept pace. Ethiopia is ranked 112th of 149 countries on the World Economic Forum's digital skills index[1], pointing to a major capability gap that can limit effective uptake of digital services. At the same time, device ownership is unevenly distributed, with persistent disparities by gender and location. Evidence from rural Ethiopia shows that married men are about five times more likely to own a phone than their wives, and women are substantially less likely to be the only phone owner in the household; importantly, women's phone ownership is also associated with greater participation in agricultural decision-making (James et al., 2023). These inequalities favor men and urban residents, underscoring persistent digital divides.

Despite these challenges, the expansion of public and private telecom infrastructure, together with advances in data and analytics, has strengthened Ethiopia's enabling environment for designing and scaling digital solutions within agriculture. A mobile based extension service by ATI that delivers agronomic and livestock advise has about 7 million registered users. Similarly, about 2 million farmers have received

[1] UNCDF, 2024. Digital and Financial Literacy in Ethiopia: UNCDF and Ministry of Innovation and Technology Convene Key Stakeholders to Deliberate on an Upcoming Nationwide Survey. - UN Capital Development Fund (UNCDF)

customized crop and livestock advice through phone and video-based extension service by DG and PxD. The growing use of digital solutions in agriculture has raised expectations that longstanding farming challenges, such as improving inclusivity, improved productivity, increasing incomes, accelerating broader food systems transformation, and sustainability. Much of this promise rests on their ability to modernize extension and advisory services that deliver more timely, personalized support on a larger scale and at lower cost. In collaboration with development partners, the government of Ethiopia has been actively promoting digital solutions and tools in the agricultural sector.

Over the past decade, Ethiopia has strengthened its digital ecosystem through major policy and investment efforts. The Digital Ethiopia 2025 strategy launched in 2020 identifies agriculture as a one of the four priority sectors for digital transformation, alongside manufacturing, tourism, and IT-enabled services. Building on this, the Ministry of Agriculture (MoA), Ethiopian Agricultural Transformation Institute (ATI), and partners developed the eight-year Digital Agricultural Extension and Advisory Services (DAEAS) Roadmap and launched the broader Digital Agriculture Roadmap (DAR) to drive innovation, experimentation, and scaling of digital solutions across the full agricultural value chain.

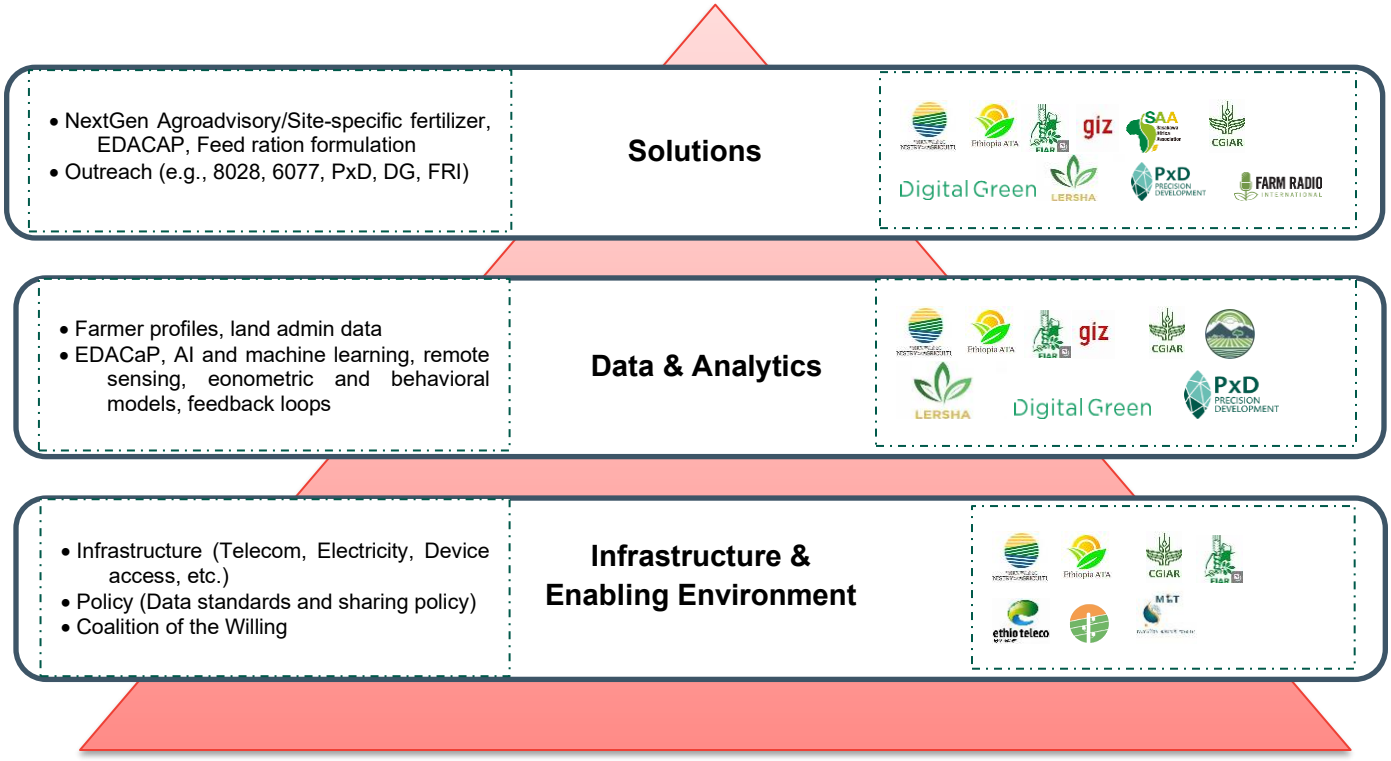
Despite these efforts and growing enthusiasm, many digital agriculture initiatives in Ethiopia have struggled to demonstrate effectiveness at scale, often remaining confined to pilot stages. The evidence base is also thin: few empirical studies rigorously assess agricultural, social, and economic impacts, and much of the literature examines isolated interventions rather than offering a systems-level view of the ecosystem and outcomes across multiple digital initiatives in agriculture and extension. This gap underscores the need for a structured, comprehensive outcome assessment of priority interventions, coupled with actionable recommendations to help government and development partners guide future actions.

This paper provides an overview of Ethiopia's digital agriculture landscape by mapping key actors and their roles, reviewing the policy and enabling environment, and examining the observed impacts of key interventions. It also consolidates evidence on technological developments, policy progress, and investment results to describe how the ecosystem is evolving.

Key Actors of Ethiopia's Digital Agricultural Ecosystem

Ethiopia's digital agriculture ecosystem is characterized by a diverse network of stakeholders that includes public institutions, private firms, international development agencies, research organizations, and non-governmental organizations (NGOs). These stakeholders contribute across the value chain by generating and localizing content and data, designing and deploying policy and regulatory framework, and building digital tools, deploying services, and supporting scale. This ecosystem represents a clear shift from the historically publicly dominated extension system. Public institutions largely shape the enabling environment through policy direction, infrastructure expansion, and the production of nationally aligned content. The private sector, including telecom operators, agri-tech startups, and service providers, drives product innovation and service delivery. NGOs play an increasingly catalytic role by bridging last-mile implementation gaps, strengthening outreach and user training, and supporting localized deployment in underserved rural areas. Key actors include MoA, ATI, the Ethiopian Institute of Agricultural Research (EIAR), and the Ethiopian Commodity Exchange, alongside partners such as the Alliance of Bioversity International and CIAT, CIMMYT, ILRI, IFPRI, GIZ, Precision Development (PxD), Digital Green (DG), Farm Radio International (FRI), Sasakawa Africa Association, Hello Tractor and Green Agro Solution PLC (GAC)/Lersha.

Figure 1: Key solutions and actors in the Ethiopian digital agriculture landscape (not exhaustive)



Source: Adapted from DAEAS, 2022

The MoA functions as the central coordinating and regulatory authority for digital agriculture initiatives in Ethiopia. In collaboration with development partners, the MoA has also contributed to foundational investments in the digital agriculture sector. A prominent example is the National Rural Land Administration Information System (NRLAIS), a nationwide rural cadaster system that supports systematic land registration and certification, including mass registration, and digitizes key land transactions such as inheritance, gifting, and leasing. EIAR, in collaboration with CGIAR and other partners, has developed the Ethiopian Digital AgroClimate Advisory Platform (EDACaP). EDACaP is a web-based decision-support and learning platform that provides interactive agro-climatic information and advisory content, helping farmers and stakeholders improve crop management decisions and reduce production risks associated with climate variability and change.

ATI is advancing multiple digital initiatives to address key agricultural value-chain constraints. Its flagship 8028 Farmers Hotline (launched in 2014) delivers nationwide agronomy and livestock advice and has roughly 7 million registered users and made 67 million calls[2]. The 6077 hotline, another digital initiative that aims to deliver price information for farmers, buyers, and policymakers on key agricultural commodities in hundreds of the country's major markets, is part of the National Market Information System. Beyond hotlines, ATI has introduced a Digital Market Linkage Platform to connect farmers directly with buyers and improve access to timely price information as well as an Input Voucher System (IVS) to streamline input distribution and ease credit constraints by linking farmers to suppliers and financing mechanisms. ATI has additionally generated digital soil fertility maps in the country by collecting over 100,000 soil

[2] 8028.et

samples. These maps are being used to guide fertilizer blending decisions and determine appropriate fertilizer and liming needs.

CGIAR is a key contributor to Ethiopia's digital agriculture transition by offering scientific benchmarking; high-quality agronomic and livestock content, data and analytical capacity; and piloting digital solutions. With deep expertise in agriculture and natural resource management, CGIAR centers are well positioned to support Ethiopia's transformation agenda by generating evidence-based advisories and research outputs that can be delivered through the national extension system and digital channels. A notable example is the CGIAR-led Coalition of the Willing (CoW), which promoted data access and sharing to enable the development, validation, and rollout of location- and context-specific recommendations, including fertilizer guidance and climate-smart agronomic advisories. For outreach,[3] CGIAR centers collaborate with government extension efforts, including those by the MoA and ATI, as well as non-governmental and private sector actors who leverage digital solutions like DG, PxD, and Lersha.

Non-governmental actors play a substantial role in scaling advisory delivery in Ethiopia through diverse channels. DG uses a facilitated video-based extension model, where extension agents screen locally relevant videos and guide group discussions. This approach has reached about 3.3 million farmers, 31 percent of whom are women. PxD is another key actor that uses a mobile phone-based digital advisory, PADDY, to disseminate customized and localized contents that reached over 2 million farmers. FRI leverages radio to share agricultural knowledge at scale and reports a reach of roughly 12 million potential listeners. Lersha, a private sector actor, provides customized agro-climate advisory and related services, reaching over 200,000 smallholders through a network of 4,175 Lersha agents.

Impacts of Digital Agriculture Solutions

Building Skills and Fostering Knowledge

Evidence from Ethiopia suggests that agent-facilitated video extension can complement and strengthen conventional in-person approaches. Abate et al. (2023) find that video-mediated training expands coverage, simultaneously enabling a larger share of farmers to be trained relative to face-to-face extension alone and improving farmers' knowledge of recommended practices by about three percentage points, with benefits to both household heads and spouses. Similarly, Hörner et al. (2022) show that combining standard in-person extension with video content increases knowledge of integrated soil fertility management practices by roughly seven percentage points compared to in-person delivery alone and is particularly effective for communicating more complex topics such as compost preparation.

Debsu et al. (2016) report that mobile phones have become instrumental in Ethiopia by facilitating access to timely and critical information on grazing conditions, weather forecasts, and livestock market prices. Complementing this, Haile et al. (2019) show that mobile phone ownership can reduce information asymmetry among smallholders: ownership is associated with a roughly 30 percent decline in the conditional mean of price prediction errors. They also find that remoteness amplifies the value of information—each additional kilometer from the nearest grain market corresponds to an estimated 10 percent reduction in expected prediction error, underscoring the benefits of digital access for farmers in more distant locations.

When deliberately designed for inclusion, digital technologies can help shift traditional gender roles by strengthening women's access to information and their influence over agricultural decisions. Abate et al.

[3] An example of these is the collaboration of CIMMYT, CIAT, and the AICCRA project with GAC to provide climate agro-advisory, input aggregation, bundled credit, and insurance services for smallholder farmers.

(2023) show that engaging husbands and wives together in video-based training improves women's understanding of recommended practices. Likewise, Tenager (2022) describes strategies of PxD to reach women through direct phone access or by encouraging couples to listen together on loudspeaker, with reported benefits for women's decision-making and wellbeing. Reinforcing these findings, Friedson-Ridenour et al. (2025) report qualitative evidence from Ethiopia that joint participation in agent-facilitated video extension is associated with greater collaborative decision-making, driven by improved spousal communication, reduced knowledge gaps, and shared awareness of both the benefits and trade-offs of adopting new agricultural technologies.

Although digital tools are sometimes thought to displace farmer-to-farmer learning, the emerging evidence points in the opposite direction. Studies suggest that external information delivered through mobile services can catalyze local knowledge sharing and, in some settings, strengthen peer effects rather than weaken them (Duflo et al., 2008). This is especially relevant in Ethiopia's pastoral areas, where mobility is high, infrastructure is underdeveloped, and social networks are central to information exchange, making it important to design digital channels that complement customary communication practices (Debsu et al., 2016). Consistent with this, Fernando (2021) finds no reduction in social interaction when farmers acquire access to digital extension; instead, participants become more likely to share recommendations on agricultural inputs with peers, who subsequently place greater importance on engaging with them. Evidence from other comparable contexts suggests that delivering agricultural extension content through digital channels can substantially enhance farmers' knowledge (Tambo et. al., 2019; Dione et al., 2021; Van Campenhout et al., 2021; Fernando, 2021; Cole and Fernando, 2021).

Reducing Transaction Costs

Evidence from Ethiopia suggests that mobile phones have strengthened market communication, particularly for traders and brokers. Minten et al. (2014) find that phones are widely used to share and negotiate price information, and that market information flows and phone-mediated transactions have increased markedly compared to the era of fixed-line telephony. In addition, almost all traders and brokers report using mobile phones to transmit prices. Nevertheless, due to the absence of standardized grading and quality assessment systems, buyers continue to prefer in-person inspection of agricultural products before completing deals.

At the farm level, mobile phone access can reduce information friction. As mentioned above, phone ownership is associated with a roughly 30 percent reduction in price prediction errors by farmers, with even greater benefits to remote farmers whose prediction errors are lowered a further 10 percent for each additional kilometer they are from a grain market (Haile et al., 2019). Nevertheless, greater mobile phone access among smallholder farmers has not always led to significant improvements in market arbitrage or price gains. Tadesse and Bahiigwa (2016) show more muted effects on marketing behavior and farm gate prices, suggesting that gains depend on how phones are used in practice and on market conditions, particularly with the availability and reliability of price information and the structure of local markets.

Adoption of Inputs and Improved Practices

Empirical studies from Ethiopia indicate that access and use of digital solutions can translate into measurable behavioral change. Abate et al. (2023) report a six–percentage point increase in farmers' adoption of recommended technologies when they receive the agent-mediated video extension. Hörner et al. (2022) similarly show that adding video to conventional extension boosts uptake of more knowledge-

intensive integrated soil fertility management practices such as composting, line seeding, and lime application. However, the study noted that interventions could not demonstrate significant effects for blended fertilizers and improved seed, likely because these inputs were already widely promoted through the conventional extension system and had high baseline adoption. Consistent with these patterns, a broader body of evidence from sub-Saharan Africa and comparable settings suggests that digital delivery mechanisms can support the adoption of improved agricultural practices (Van Campenhout et al., 2021; Silvestri et al., 2020; Areal et al., 2020; Voss et al., 2021; Kansiime et al., 2019; Baul et al., 2024; Li et al., 2022; Xie et al., 2024).

Enhancing Cost-effectiveness in Agricultural Extension

Digital agriculture tools offer a scalable and efficient pathway to extend advisory services to smallholder farmers, often at far lower unit cost than exclusively face-to-face models. In Ethiopia, Abate et al. (2023) estimate that an agent-mediated video approach costs roughly US$16–30 per additional adoption under experimental conditions. However, the cost could fall to $3–6 per adoption when implemented at full scale across wider geographies. Moreover, complementary findings by Haile et al. (2019) show that farmers in Ethiopia's lowlands are willing to pay for information services and, depending on their income level, allocate an estimated 7–20 percent of income for reliable price information.

Evidence also shows that performance gains can come from small, data-driven refinements that might not require costly redesign. By analyzing a series of experiments by PxD to improve the 8028 Farmers Hotline, Walter et al. (2020) conclude that low-cost tweaks informed by user data can meaningfully improve digital advisory performance. Similar findings from other comparable settings indicate that digital delivery can reduce extension costs and that, as coverage expands, average cost per user declines strengthening the long-run financial sustainability of these services (Baul et al., 2024; Silvestri et al., 2020; Gandhi et al., 2009; Kansiime et al., 2019; Fernando, 2021; Cole and Fernando, 2021).

Resource Use Efficiency, Productivity, and Farmer Incomes

Recent work in Ethiopia demonstrates the potential of data-intensive, machine-learning enabled agronomic decision support to improve input efficiency and farm performance. Using large-scale data integration to generate machine learning-based site-specific fertilizer recommendations (SSFR), Liben et al. (2024) developed localized fertilizer guidance and evaluated its effects on wheat production. Their results indicate that SSFR outperforms conventional blanket fertilizer recommendations, delivering higher wheat yields and economic returns while improving the efficiency of key resources, including nitrogen and water use.

Haile et al. (2019) find that access to timely and accurate price information via mobile phones can reduce welfare losses among smallholders by improving their ability to make informed marketing decisions. Complementary evidence reported by Tenager (2022) highlights the positive effects of interactive voice response dairy advisory services on both farming practices and the overall quality of life for participating households. Comparable findings are reported across other settings, where a growing empirical literature links digital advisory tools to gains in productivity and farm income (Arouna et al., 2021; Van Campenhout et al., 2021; Fabregas et al., 2019; Baul et al., 2024; Subramanian, 2021; Luke and Jones, 2023).

Outcomes of the Digital Extension Initiatives in Ethiopia

Building on global advances in digital innovation, a growing set of actors in Ethiopia are designing, localizing, and deploying digital tools to expand the reach and coverage of agricultural services. These technologies increasingly complement conventional extension by improving access to information, training, and advisory support, particularly for smallholder farmers and by addressing last-mile constraints that have historically limited-service delivery in remote rural areas. Digital solutions have become a crucial tool in Ethiopia in improving access to agricultural information, education, and advisory services, particularly for smallholder farmers. These solutions have bridged significant gaps in rural areas, where traditional extension systems often face limitations to meet expectations. This section examines how digital agricultural extension initiatives have contributed to technological progress, policy development, and investment outcomes in Ethiopia.

Technology Outcomes

Data integration and analytics applications in Ethiopia's agricultural sector are emerging steadily and are increasingly used to inform decision-making, track performance, anticipate production risks, and improve the targeting of interventions. Illustrative examples include EDACaP developed by EIAR in collaboration with CGIAR which integrates multiple datasets to generate agro-climatic advisories, and the CGIAR-led CoW, which has advanced data access and sharing to enable big data analytics and the production of location- and context-specific advisory services.

CIAT developed the NextGen Agroadvisory to deliver context-specific recommendations that adjust to local biophysical conditions, including location, climate, and soil characteristics. The tool is powered by a machine learning model trained on approximately 20,000 field observations capturing crop yield responses to varying fertilizer types and application rates across diverse production environments. Model outputs were validated through participatory work with farmers and benchmarked against national recommendations. Results indicate that site-specific fertilizer recommendations (SSFRs) outperformed blanket recommendations in over 75 percent of comparisons, with mean yield gains of about 16 percent and 25 percent relative to national and local blanket recommendations, respectively. These SSFRs, together with additional agronomic guidance, are delivered through the NextGen Agroadvisory online platform.

Collaborative work between CGIAR centers and national/international universities has produced two complementary digital innovations for Ethiopia's seed system: the Ethio-Seed Hub and a Seasonal Seed Scenario Planning Tool. The Ethio-Seed Hub functions as an information-exchange and matchmaking platform, improving coordination by linking seed producers and users and providing more timely, standardized data on seed supply and demand for decision-makers in both the public and private sectors. The Seasonal Seed Scenario Planning Tool integrates seasonal climate forecasts to strengthen seed distribution planning, and CGIAR researchers have contributed to iterative refinements of the tool. Early experience highlighted an important limitation: forecast outputs available only about six months before the season were too short to inform strategic decisions such as seed production planning. This finding motivated further development toward incorporating longer-lead projections in the order of at least one year to increase the tool's operational relevance for upstream planning (Steinke et al., 2022).

To meet rising demand for advisory services that are scalable, inclusive, and timely, Ethiopia has expanded the use of digital delivery channels, including SMS and voice platforms such as ATI's 8028 Farmers Hotline and the National Market Information System's 6077 hotline. Beyond extending reach, these

systems also offer new opportunities to employ low-cost experiments and iterative design processes. ATI and PxD conducted a detailed examination of user call logs from a mobile-based agricultural advisory platform in Ethiopia to pinpoint where users most frequently disengaged during the call flow, thereby identifying specific usability bottlenecks. Guided by these engagement data, the team introduced targeted refinements that streamlined menu structures, simplified language to reduce cognitive burden, and reordered prompts to better match user behavior. These evidence-informed adjustments increased successful access to advisory content by 24 percent, illustrating how adaptive, user-centered design can measurably improve digital extension performance (Walter et al., 2019).

Several complementary channels have scaled advisory delivery to farmers in Ethiopia. DG's agent-facilitated, video-based extension model has reached large numbers of rural households. FRI's interactive radio programming supports wide-area dissemination in low-connectivity settings. The Lersha platform by GAC further extends services by combining advisory delivery with input access and linkages to complementary services. More recently, pilots have begun to incorporate advances in AI by deploying intelligent bots through platforms like FarmerChat and Telegram to deliver dynamic, context-specific extension support to farmers, further expanding the reach and responsiveness of agricultural advisories.

Policy Outcomes

Ethiopia has taken important strides toward digital transformation through the Digital Ethiopia 2025 strategy and subsequent Digital Ethiopia 2030 strategy, which provide a national framework using technology to accelerate development. In agriculture, this direction is being operationalized through a set of roadmaps intended to guide priorities and investment. In 2022, the MoA, in collaboration with ATI, CGIAR centers, development partners, and private-sector actors, co-developed a strategic framework for digitizing agricultural extension. This process strengthened sector alignment and coordination and culminated in the DAEAS Roadmap, which provides a national guide for transforming extension delivery. Anchored in the goals of inclusivity, scalability, and data-driven decision-making, the roadmap outlines a coordinated approach for leveraging digital tools to provide timely, localized, and actionable information to smallholder farmers.

In February 2025, Ethiopia introduced the DAR, marking a significant step in the country's effort to modernize agriculture through digital innovation. Led by the MoA and ATI, the roadmap was developed through a multi-stakeholder process in which CGIAR centers, NGOs, development partners, and private-sector actors contributed via technical and advisory committees and supported the identification and prioritization of next-generation use cases. The DAR serves as a strategic blueprint to coordinate and align national digital agriculture efforts, guide both public and private investments, and establish the necessary policy, institutional, and technological foundations for scaling digital solutions across the country. By enabling wider adoption of digital tools across value chains, the roadmap aims to boost smallholder productivity, resilience, and incomes while improving efficiency and transparency in agricultural systems. Overall, the DAR represents a timely opportunity to accelerate Ethiopia's digital agriculture transition and move from pilots to sustainable scale.

CIAT, in collaboration with GIZ-Ethiopia, helped to establish the CoW as a multi-institutional platform that brought agricultural experts and organizations together to advance stronger data governance and the responsible use of digital agricultural data in Ethiopia. In a short timeframe, the coalition delivered key outputs, including a centralized agricultural data repository to improve cross-institutional data access, integration, and analytics. Alongside the repository, CoW developed guidelines and protocols to promote

data standardization, interoperability, and ethical data-sharing practices among participating stakeholders. Collectively, these advances provide a foundation for more coordinated, evidence-informed decision-making and support the emergence of a more inclusive, digitally enabled agricultural ecosystem in Ethiopia.

Emerging digital agriculture initiatives in Ethiopia, including the farmer registry system, have underscored the critical need for a national data sharing framework and data protection legislation. In response to growing risks associated with the collection and use of personal information, Ethiopia has recently enacted a personal data protection proclamation intended to reduce misuse of personal data and strengthen consent-based handling of sensitive information. At the sector level, the MoA has also developed and ratified an internal guideline governing the sharing of soil and agronomy data. While this represents an important institutional step, its scope remains narrow and does not yet address broader cross-sector requirements such as interoperability, standardized data-sharing agreements, governance roles, accountability mechanisms, and enforcement across the wider digital agriculture ecosystem. Taken together, these developments point to the need for a comprehensive, nationally harmonized agricultural data governance framework that aligns data protection obligations with practical data-sharing rules to enable safe, ethical, and effective use of data for innovation and service delivery.

Investment Outcomes

Accumulating evidence from pilot interventions together with lessons from earlier implementation cycles has increased confidence in the feasibility of digital agriculture in Ethiopia. This momentum has been reinforced by sustained government commitment and a progressively enabling policy environment, which together have catalyzed additional investment in the country's digital ecosystem.

In the extension and advisory domain, the development of the DAEAS Roadmap has helped mobilize substantial external financing, including support from the World Bank and the Bill & Melinda Gates Foundation (BMGF), and helped to operationalize priority initiatives and use cases. More recently, the formulation and launch of DAR by the MoA has further stimulated donor and partner interest, accelerating commitments to implement a portfolio of digital use cases. The MoA has also established a Project Management Unit (PMU) to provide coordination and implementation support for the DAR. Key areas of investment under the DAR include farmer profiling, digital extension, timely interventions, digital kiosks, access to credit and insurance, input track-and-trace solutions, and market linkages between farmers and buyers. Across these workstreams, CGIAR centers have contributed technical leadership by participating in working groups and by providing analytical and design backstopping to refine use cases and support implementation readiness.

The expanding portfolio of digital agriculture initiatives in Ethiopia has underscored the importance of establishing reliable unique identifiers for farmers and their farm plots as an essential prerequisite for delivering targeted digital extension, advisory, and related services. In response, development partners have increased investments in farmer registry and profiling efforts. As an early step, with the support from BMGF, the MoA and DG piloted a farmer registry, accompanied by an IFPRI process evaluation to inform subsequent design and scale decisions. The DAEAS Roadmap built on these experiences and elevated farmer profiling as a priority, and in coordination with Ethiopia's national digital ID system (Fayda), ATI has initiated a project to advance this agenda.

In recent years, Ethiopia has adopted a more ambitious approach to rural land administration that extends beyond conventional registration. The MoA has invested in the National Rural Land Administration Information System (NRLAIS) to modernize and safeguard cadastral data management (Getie and Birhanu,

2023). NRLAIS represents a strategic upgrade for the sector, providing core functionalities to manage rural land datasets and support land administration services. As a cornerstone of the national digital agenda for standardizing and harmonizing rural land administration, it is expected to improve interoperability and enable more tailored services for farmers.

Demonstrating successful digital outreach in Ethiopia can serve as a catalyst for increased investment, as proven results reduce perceived risk and strengthen the case for scaling effective solutions. DG implemented a digital advisory project between 2014 and 2018, which was coupled with IFPRI's impact evaluation. The positive findings from IFPRI's impact evaluation strengthened the case for scale and helped mobilize a five-year initiative funded by the BMGF and the UK Foreign, Commonwealth and Development Office (FCDO) to expand digital agriculture and advisory services (DAAS). Implemented by DG and PxD, DAAS initiative delivered low-cost, scalable digital products and reached more than two million farmers, with a particular focus on wheat and dairy value chains. IFPRI has supported the initiative with monitoring and evaluation from the design stage onward. The program has since been extended by one year, with greater emphasis on institutionalizing the digital products and supporting their transition to the MoA.

The Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA) project, which aimed to advance a climate-smart future for African agriculture through science and innovation, has received grant funding from the World Bank to support the design of an integrated and decentralized national agricultural data hub. Building on the success and lessons learned from the Soil and Agronomy Data Hub, this platform is designed to serve as a centralized access point for all agriculture-related datasets, including those from the livestock sector.

Conclusions

Digital technologies are playing a growing role in Ethiopia's agricultural transformation by helping to overcome long-standing system constraints while opening new pathways for resilience and growth. By improving access to timely, accurate, and locally relevant information, these tools strengthen farmer decision-making and support better on-farm practices. They also make extension delivery more efficient by enabling one-to-many communication and lowering the cost of reaching large numbers of farmers compared to fully in-person models. Beyond advisory delivery, digital platforms can reduce information frictions that limit input use and market participation and asymmetries in knowledge between farmers and suppliers.

Progress could further strengthen when these national priorities connect with innovations from research institutions such as EIAR and global networks like CGIAR, which contribute scientific evidence, technical backstopping, digital tools, and advisory content. ATI supports digital solutions across the value chain, including farmer hotlines, market linkage platforms, input voucher systems, and soil mapping for fertilizer planning. The growing ecosystem of civil society and private sector actors drive inclusive innovation, enhance the scalability of digital tools, and ensure inclusivity using digital tools like video, mobile, radio, and agent networks. Decision-support innovations, including site-specific fertilizer recommendations and weather-informed advisories, allow farmers to use inputs more efficiently and manage climate-related risks. Overall, more tailored guidance on climate-smart practices, pest and disease management, and improved input use can contribute to higher productivity and improved rural livelihoods.

Ethiopia's decision to liberalize its telecommunications sector and allow private operators has begun to reshape the market, creating stronger competition and a more dynamic environment. The licensing of

Safaricom Ethiopia has the potential to accelerate improvements in coverage, service quality, and innovation. At the same time, rapidly advancing technologies, including artificial intelligence (AI), blockchain, and the Internet of Things (IoT), offer new pathways to strengthen digital agricultural extension. Ethiopia's digital agriculture ecosystem has advanced considerably in recent years, yet its ability to deliver transformative, system-wide impact is still limited by structural constraints. Key constraints include persistent gaps in rural connectivity, limited digital literacy, and inadequate financing to scale proven innovations. Realizing the full potential of digital agriculture will require coordinated investments in last-mile infrastructure, the design of inclusive and user-centered solutions, and deliberate measures to ensure gender equity and linguistic accessibility across services.

Digital agriculture initiatives in Ethiopia are generating tangible outcomes across technology, policy, and investment. On the technology side, tools such as EDACaP, developed by EIAR in collaboration with CGIAR, combine multiple datasets to produce localized agro-climatic advisories, while CIAT's NextGen Agroadvisory delivers context-specific recommendations informed by soil, weather, and location conditions. Complementing these platforms, the CGIAR-led CoW has strengthened data access and analytics and supported the production of tailored advisory services. Policy progress has also accelerated, reflected in the Digital Ethiopia 2025 strategy and the rollout of the DAEAS and DAR roadmaps, which signal strong government commitment to sector-wide digital transformation. Importantly, these advances have been accompanied by rising investment: evidence of impact from digital outreach helped mobilize longer-term financing. Ethiopia has mobilized substantial support from development partners, while new private-sector entrants such as Safaricom have reshaped the national telecom landscape. Together, these developments signal growing confidence in Ethiopia's digital agriculture ecosystem.

Crucially, digital technologies should not merely replicate traditional in-person agricultural extension and advisory services but complement and enhance them by offering low-cost, context-specific, and scalable solutions. When thoughtfully integrated with existing systems and developed through an inclusive and iterative approach, digital tools hold significant potential to close equity gaps, empower marginalized farmers, and contribute to a more resilient and efficient agricultural sector. As these innovations continue to scale, they are positioned to significantly accelerate the country's agricultural transformation and contribute to sustainable rural development.

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