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# Lessons from the Digital Agricultural Advisory Services (DAAS) Project in Ethiopia

## Dairy Use Case

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### Introduction

Agricultural extension services are a cornerstone of rural development and a vital instrument for policymakers to directly shape economic, social, and environmental outcomes in rural areas. These services aim to enhance farm productivity by promoting the adoption of agricultural technologies, inputs, and management practices. Through outreach, training, knowledge sharing, and learning, extension activities help bridge the gap between research and practice, potentially supporting more resilient and productive farming systems (Davis 2008; Jack 2013).

Conventional extension programs are often based on a training-and-visit model in which a lead or model farmer plays a key role in sharing and promoting new information. These programs have contributed to gains in agricultural productivity, but they also face limitations. Top-heavy organizational structures with many supervisory and field-level staff tend to incur high operational costs and limit efficiency in service delivery. These financial and logistical burdens hinder the system's ability to collect and use data effectively, adapt to farmers' evolving needs, or ensure a consistent level of service quality. Furthermore, the model is largely supply-driven, emphasizing priority crops and standardized technologies without sufficiently accounting for farmers' diverse needs and specific demands, or linking them to broader market opportunities.

Innovations in information and communication technologies (ICTs) have enabled new channels for delivering extension services, particularly in low- and middle-income countries. Mobile tools can enhance access to timely information, improve coordination across input and output markets, strengthen communication within farming communities, and streamline the delivery of public services (Aker and Mbiti 2010). Videos, voice recordings, chatbots, and other media can be used to provide engaging, consistent, and context-specific messages to extension recipients (Abate et al. 2023). When used either

independently or alongside conventional extension services, ICT-enabled approaches have the potential to improve knowledge transfer and agricultural outcomes.

Collectively, ICT-based approaches to extension aim to create more responsive, farmer-centered systems that foster stronger connections to value chains (for example, Nakasone et al. 2014; Aker et al. 2016; Spielman et al. 2021). This brief presents findings from field trials that employed ICT-powered or -driven extension in Ethiopia's dairy sector under the Digital Agricultural Advisory Services (DAAS) project. The results are taken from the midline report of a process and impact evaluation implemented by the American Institute for Research (AIR).

## Opportunities for digital agricultural extension

The DAAS project leverages digital innovations to strengthen Ethiopia's extension system, delivering tailored advice to smallholder producers. DAAS uses a range of digital delivery methods to reach farmers with actionable information. Since it began in 2019, the project has reached more than 2 million farmers, including nearly 600,000 women, to provide different combinations of ICT-based services. This brief highlights the dairy-focused component of a project that used video-mediated extension services and mobile phone–based interactive voice response systems to provide farmers with interventions. An evaluation of this project was conducted by AIR and supported by the Bill & Melinda Gates Foundation and the United Kingdom's Foreign, Commonwealth, and Development Office. The findings presented here are from the midline report of this evaluation.

## Extension in Ethiopia

Ethiopia's largely public extension system boasts the highest ratio of extension agents to farmers in Africa, reflecting the country's strong institutional commitment to rural advisory services (Berhane et al. 2018). However, the extension infrastructure faces several challenges. Development agents, who serve as frontline extension workers, are often overburdened by a wide variety of daily and seasonal tasks, and farmer training centers are frequently underfunded and poorly equipped. Furthermore, linkages between research institutions and extension services remain weak, limiting the flow of up-to-date, evidence-based technologies and practices to the field. Critically, extension services often do not adequately reach women, who represent an estimated 29 to 45 percent of Ethiopia's agricultural labor force (Buehren et al. 2019), underscoring the need for more inclusive approaches.

## The Ethiopian dairy sector

Ethiopia's dairy sector remains underdeveloped, with milk production largely reliant on traditional systems dominated by indigenous cattle breeds, which are known for their high resilience but are far less productive than other breeds. As of 2020, local breeds made up approximately 97.8 percent of the national herd, while hybrid and exotic breeds accounted for just 1.9 percent and 0.32 percent, respectively (CSA 2020). As a result, the average daily milk yield per cow is only about 1.48 liters. The mixed crop-livestock farming system found across the Ethiopian highlands provides potentially favorable conditions for more productive crossbred dairy cattle.

The limited presence of hybrid and exotic breeds points to significant potential for genetic improvement through reproductive technologies such as artificial insemination. Historically, the use of artificial insemination in Ethiopia has been promoted by public programs, but private actors also offer artificial insemination services (Yitayih et al. 2017). The reach and effectiveness of artificial insemination services in

Ethiopia are hindered by limited institutional support at both the federal and regional levels, along with challenges related to infrastructure, management capacity, and funding (Mengistu 2019; Yitayih et al. 2017). Additionally, several factors influence the success of AI, including seasonality (for example, insemination success rates are lower during the dry season), accuracy of estrus (heat) detection, timing of the artificial insemination procedure, semen quality, and pregnancy diagnosis (Mengistu 2019). These challenges add to others associated with dairy farming in Ethiopia, such as the limited availability and high cost of quality feed and the limited availability of veterinary services (Gebreselassie 2019).

## The DAAS dairy case

The DAAS dairy intervention provides farmers with information about reproductive services and calf and cow management using an interactive voice-based messaging system. The intervention is currently being implemented in selected *woredas* in Amhara, Oromia, and the Southern Nations, Nationalities, and People's Region (SNNPR) by Precision Development (PxD),[1] in partnership with Ethiopia's Ministry of Agriculture, the Ethiopian Agricultural Transformation Institute (ATI), Digital Green, and the International Food Policy Research Institute (IFPRI). The intervention aims to increase the adoption of better dairy practices and, in turn, milk productivity on smallholder farms.

The voice-based advisory messages focused on two general topics: (1) AI and (2) calf and cow management, including practices to reduce calf and cow mortality during pregnancy and after birth. The messaging to dairy farmers and artificial insemination technicians included (1) advice intended to encourage farmers to gradually transition toward keeping crossbred cow; (2) guidance for farmers planning to use artificial insemination to avoid unplanned pregnancies and detect estrus cycles; (3) care recommendations for pregnant cows, such as feeding and regular monitoring; (4) advisory support for labor and delivery; (5) calf management focused on feeding practices; and (6) calf health management, particularly for diarrhea prevention and treatment. These targeted messages aimed to address specific stages of dairy farming to improve overall productivity and animal well-being. These messages were disseminated through the ATI's 8028 voice-based messaging system, which provides farmers with a wide range of extension information in addition to DAAS' livestock content.

In parallel, PxD worked on strengthening the inbound hotline by conducting a series of A/B tests to refine the user interface, improve functionality, and promote farmer engagement. These experiments focused on identifying sections of the inbound call menu with high attrition and testing alternative designs to reduce it. Eight of the primary experiments are described in Table 1. Adjustments that effectively improved user engagement were fully integrated into the core intervention.[2]

**Table 1.** A/B testing of the voice-based messaging system implemented by PxD

| Experiment title | Experiment description |
|---|---|
| **Experiment 1: Remove registration** | After selecting a language, new users in the treatment group are immediately directed to the content menu instead of being prompted to register |
| **Experiment 2: Replay menu if no selection is made** | Menu options replay after 10 seconds if the user does not make a selection |
| **Experiment 3: Add pauses between language options** | New users in the treatment group experience a 10-second pause between language options |

| | |
|---|---|
| **Experiment 4: Offer the option to complete profiles during later calls** | During their first call, new users are asked if they would like to complete profile questions during later calls (after the 5th call or after accessing at least 3 content items) |
| **Experiment 5: Explain how to use voice messages for new users** | During their first call, new users in the treatment group receive a tutorial on how to use the system |
| **Experiment 6: Change menu options seasonally** | The main menu options are reordered to present relevant seasonal options first |
| **Experiment 7: Rename menu options** | Menus are renamed to be more descriptive |
| **Experiment 8: Introduce livestock content** | Livestock and other content options are added to the main menu |

**Source:** Walter et al. 2020

## Evaluation approach

The evaluation used a mixed methods approach to combine a process evaluation with an experimental impact evaluation at the farmer level. The evaluation assessed how effectively the DAAS program addresses select challenges faced by public extension systems in Ethiopia and provides information to implementers on tailoring their activities to realize the program's full potential.

The impact evaluation used a longitudinal, farmer-level randomized controlled trial to investigate the program's causal intermediate impacts on knowledge, practices, and longer-term outcomes (Table 2). The evaluation team first stratified dairy farmers by *kebele* and then, within each kebele, randomly assigned some farmers to receive outbound voice messages with information on dairy practices. The remaining farmers in each kebele were assigned to the control group. The process evaluation investigated the program's fidelity of implementation, alignment with the theory of change, and ability to translate content into targeted messages.

Between December 2021 and March 2022, the evaluation team administered a baseline in-person survey to 2,496 farmers, half of whom were randomly assigned to the treatment group. At midline, two years after implementation, the team targeted the same farmers using in-person and phone-based surveys. Local enumerators were restricted by significant security concerns in certain kebeles within the Bako Tibe and Kuyu woredas of Oromia regional state. As a result, phone surveys were conducted to reach 584 farmers. The remaining 1,912 farmers were reached through in-person surveys.

The intervention did not achieve full compliance: not all farmers in the treatment group engaged with the outbound calls, while some in the control group accessed the program activities. Given this, the evaluation team reverted to an instrumental variables approach that used random assignment as an instrument to estimate a local average treatment effect. Intuitively, these estimates the intervention impacts for the subgroup of individuals who comply with their assigned treatment status.

## **Table 2.** Intermediate and final outcomes of interest for the dairy evaluation

| **Intermediate outcomes** |
|---|
| ***Agricultural practices*** |
| Knowledge of recommended practices, with a focus on artificial insemination, feeding, and practices to reduce illness, such as diarrhea |
| Adoption of recommended practices |
| ***Inputs*** |
| Feed cattle concentrate feeds/mineral supplements |
| Use of bull services |
| Use of artificial insemination |
| Number of milking cows owned (disaggregated by exotic and cross breeds) |
| **Final outcomes** |
| Milk production and productivity |

**Source:** Author's composition based on DAAS Program Evaluation Dairy Sector Midline Report.

To complement the quantitative analysis, a qualitative analysis provided the basis for in-depth analysis and insight into the DAAS program, including its potential and existing influence on Ethiopia's Agricultural Advisory System. The final sample included 28 participants from all intervention regions: Digelu Tijo in Oromia, Lemo in Central Ethiopia, and Sodo Zuria in SNNPR. At midline in 2023/24, the data collection team conducted semi-structured key informant interviews at the regional and woreda levels and held focus group discussions with farmers in the selected woredas. Table 3 summarizes the research design and sample, including the research method, number of participants, and areas of focus for each type of informant.

## **Table 3.** Qualitative design and sample

| Research method | Number of participants | Gender | Region | Woreda |
|---|---|---|---|---|
| **1 KII with a regional official**[3] | 1 | Male | Central/Southern Ethiopia | Durame |
| **5 KIIs with artificial insemination technicians**[4] | 2 | 1 Male, 1 Female | Oromia | Digelu Tijo |
| | 2 | 2 Male | SNNPR | Sodo Zuria |
| | 1 | 1 Male | Central Ethiopia | Lemo |
| **6 KIIs with DAs** | 3 | 2 Male, 1 Female | Oromia | Digelu Tijo |

| | | | | |
|---|---|---|---|---|
| | 1 | 1 Male | SNNPR | Sodo Zuria |
| | 2 | 1 Male, 1 Female | Central Ethiopia | Lemo |
| **16 FGDs with farmers** | 6 groups | 3 Male, 3 Female | Oromia | Digelu Tijo |
| | 5 groups | 2 Male, 3 Female | SNNPR | Sodo Zuria |
| | 5 groups | 3 Male, 2 Female | Central Ethiopia | Lemo |
| **Total: 12 KIIs and 16 FGDs** | | | | |

**Source**: Author's composition based on DAAS Program Evaluation Dairy Sector Midline Report.

**Note**: DA = development agent; FGD = focus group discussion; KII = key informant interview; SNNPR = Southern Nations, Nationalities, and People's Region.

## Insights into farmer engagement with outbound voice messages

The analysis of the administrative data for treatment farmers shows that between December 2021 and May 2023, the project used the 8028 farmers' hotline to make a total of 32,312 calls to dairy farmers in the study sample. In this period, the system communicated the six messages described earlier. The administrative data show that the distribution of calls was uneven over time, with 2 percent of calls occurring in 2021, 73 percent in 2022, and 25 percent in 2023. On average, a phone number in the sample received 14.2 outbound calls, with a minimum of 10 and a maximum of 29. Given that an individual household may have multiple phone numbers, the aggregated data show that the average household received 25 calls, with a minimum of 1 and a maximum of 49 over 18 months. In addition to this analysis period, the program reached more than 1 million farmers in five years.

Most farmers found voice-based messages clear, relevant, and easy to understand. During focus group discussions, even those unfamiliar with the hotline were able to summarize key points from sample messages. Farmers widely agreed that voice-based content was useful for informing their decisions on cattle feeding, reproduction, health, and AI. Many shared the messages with spouses, children, and neighbors, increasing the impact of the information.

Despite the perceived value, actual engagement with outbound calls was mixed. Only 25 percent of farmers reported always listening to the messages, 19 percent said they listened often, and 53 percent listened only occasionally. Even among those who did engage, many did not fully listen to the entire message. However, since the same information was often shared by multiple messages, it is possible that farmers engaged less once they began receiving the same messages. Most who engaged found the content easy to follow and reported high sound quality.

Farmers noted that voice-based messages often repeated advice already provided by DAs and artificial insemination technicians—especially about crossbreeding, milk production, and estrus detection—but they still preferred voice calls due to their accessibility, with illiterate farmers especially preferring voice calls. DAs and technicians also supported the use of voice messages and suggested complementing them with text messages to overcome network issues and reinforce key messages.

A/B tests conducted on the inbound calling system provided additional insights that will be useful for the implementation and improvement of digital extension. The 8028 menu structure is relatively complicated, and given farmers' generally low levels of digital literacy, it was difficult for them to navigate. This, in turn, reduced the number of farmers who could successfully access the content. In addition, much of the information collected through self-registration proved to be inaccurate, limiting its usefulness for content customization. Given these limitations, the implementers initiated an experiment to postpone the registration process, streamline access, and improve data quality. Removing or postponing user registration (experiment 1) increased the share of users accessing content by 11 percentage points and improved user engagement with content options. As part of this experiment, the researchers also noted that registration information was often inaccurate, further supporting the decision to remove this section. Users tended not to add profile information in later calls (experiment 4).

Adding the livestock content (experiment 8) led to a significant shift in the selection of menu options. Before the livestock content was introduced, 52 percent of users selected the rainfed option, 28 percent chose irrigation, and 19 percent opted to reset their profiles. After the introduction of the livestock content, however, the share of users choosing rainfed fell to 39 percent, irrigation declined to 25 percent, and profile reset dropped to 12 percent. The livestock option attracted substantial engagement, drawing 24 percent of users.

In the original design of the system, calls would automatically end if a user did not make a selection after the menu options were provided. As a result, there was a steep decline in the number of users who progressed from one stage of the menu to the next, and ultimately, far fewer who reached the actual content. To address this challenge, the second experiment involved automatically replaying the menu options rather than terminating the call. This small but important adjustment reduced the risk of premature call termination, improved usability, and led to a 1 percent increase in users who accessed content.

Farmers demonstrated a strong tendency to select the first menu option, particularly when they experienced difficulty in understanding the different options. As a result, nearly 60 percent of users consistently selected Menu 1, which in practice meant that most listened to content on preparing for planting, regardless of whether it was the appropriate season. To address this misalignment, PxD designed an experiment that rotated the menu options (experiment 6) to feature seasonally relevant content first. The results showed that farmers more often accessed content aligned with the current season.

## Program impacts on farmer behavior and milk production

The intervention did not lead to an increase in overall adoption of artificial insemination services across the full sample or any subgroups. This suggests that providing information alone—without addressing other barriers—is not sufficient to shift adoption behavior.

Farmers cited several key reasons for not using artificial insemination services, including concerns about low success rates, past negative experiences, technician unavailability, and logistical challenges such as delayed insemination or workload. The intervention did not significantly affect these perceptions or reduce reported barriers.

However, the program did have some targeted impacts among the farmers who adopted AI. It significantly increased the use of public artificial insemination technicians and modestly improved perceived accessibility. In addition, it led to higher rates of successful pregnancy among cows that received artificial insemination: rates increased by 6 percentage points among farmers who participated in the in-person survey and 12 points among farmers with only local cattle. Awareness of estrus detection, a key

factor for artificial insemination success, also improved, suggesting the intervention may have helped deepen understanding among certain groups, which in turn enhanced the effectiveness of service delivery for these groups. In other words, although adoption levels did not shift, the intervention demonstrated the potential to increase the rate of successful pregnancies among those who use artificial insemination, an outcome with meaningful implications for productivity.

There were no significant changes in overall herd size, milk production, or feeding practices. However, the intervention led to a small statistically significant increase in the number of pure or exotic heifers, suggesting some adoption of improved cattle genetics. Overall, while the intervention showed limited effects on adoption and productivity, it led to modest improvements in service delivery and outcomes among farmers already using AI.

## Lessons from the DAAS dairy use case

The DAAS dairy intervention is an innovative strategy for leveraging voice-based messaging technology to improve extension services. These systems allow organizations in the agricultural ecosystem to reach many more farmers and develop refined solutions, such as translation into different languages and context-specific information. By delivering extension information to mobile phones, the program has the potential to improve women farmers' access to extension information. The intervention provides farmers with the information necessary to increase their productivity and income from dairy farming. Specifically, the messaging increased dairy farmers' access to knowledge about artificial insemination services and advantages.

The findings from the evaluation of this program highlight both the potential and limitations of using voice-based dissemination tools in agricultural extension. Most farmers who received outbound voice messages found them clear, relevant, and easy to understand. The information—focused on feeding, reproduction, health, and artificial insemination—was widely viewed as useful, with many farmers sharing it with family and neighbors. Outbound voice messages were especially valued by illiterate farmers for their accessibility and were preferred over text-based messaging by both farmers and extension agents. These results underscore the tool's promise in extending reach and improving knowledge transfer in rural contexts.

Despite this potential, actual engagement with voice messages was limited. Only a quarter of farmers reported always listening to the messages, and many of them did not listen to the content in full. Several factors may have contributed to this result, including unreliable network connectivity and limited mobile phone access—especially among women farmers, who often manage dairy cattle but lack direct access to phones. These structural barriers reduced the overall effectiveness of the intervention and suggest that digital interventions, while promising, must be delivered through equitable and reliable channels.

Importantly, the intervention did not lead to increased adoption of artificial insemination services. Although the outbound voice calls raised awareness and improved perceptions of accessibility, farmers still cited numerous barriers to adoption, including concerns about artificial insemination effectiveness, past negative experiences, technician shortages, and logistical issues such as delayed service or high workloads. These findings underscore that while information is necessary, it is not sufficient on its own to change behavior when deeper systemic constraints persist.

Nonetheless, the program did yield modest improvements in specific outcomes. It led to increased use of public artificial insemination technicians, improved pregnancy success rates among cows that received artificial insemination, and greater awareness of the importance of estrus detection. It also slightly increased the number of pure or exotic heifers, suggesting some adoption of improved genetics. These targeted effects suggest that voice-based tools can reinforce positive behaviors among farmers already engaged in certain practices.

The A/B testing of the inbound voice platform demonstrates the importance of such experiments for developing an effective system. The tests reveal that several small changes had significant impacts on user engagement and access to useful information. These changes included removing the need for users to register, adding an option to replay the menu, and changing the order in which content is presented, based on the season. Several experiments had no or adverse effects, which indicates the need to test changes before implementing them. Overall, these experiments emphasize the need to reduce the burden on respondents and tailor platforms to their specific needs.

For policymakers, these findings offer clear guidance: voice-based technology can strengthen agricultural extension by reaching more farmers, especially those traditionally excluded from in-person services. However, its impact will remain limited without addressing underlying barriers such as gendered access to technology, poor network infrastructure, and service delivery constraints. To maximize the value of digital extension, future programs should integrate voice-based tools with investments in technician availability, inclusive phone access, and tailored strategies that address the realities of rural farming communities.

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## ENDNOTES

[1] Formerly known as Precision Agricultural Development (PAD).

[2] In addition to informing design improvements, these experiments generated valuable insights into farmers' interactions with digital advisory systems. A more detailed analysis of this work is available in Walter et al. (2020).

[3] The research team planned to conduct another key informant interview with a regional official in Oromia, but members of the regional bureau were unwilling to speak with interviewers.

[4] The research team planned to conduct three key informant interviews with artificial insemination technicians in Oromia, but the team was only able to interview two artificial insemination technicians in woredas where DAAS programming occurred.

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