

Digital Green



Site-Specific Fertilizer Recommendations for Wheat in Ethiopia: an assessment report on advisory dissemination and feedback collection



Digital Green Ethiopia and Alliance of Bioversity and CIAT

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Acronyms

DA	Development Agent
DAAS	Digital Agricultural Advisory Services
FGD	Focus Group Discussions
FTC	Farmer Training Center
KIIs	Key Informant Interviews
SSFR	Site-Specific Fertilizer Recommendations
NGO	Non-governmental Organizations
NRM	Natural Resource Management
SHG	Self Help Group
SMS	Subject Matter Specialist
VBE	Video-based Extension

1. Introduction

1.1 Background

The use of fertilizers in crop production is among the main innovations brought by the Green Revolution in the 1960s. In Ethiopia, though fertilizer use in crop production during the last four decades led to significant yield gains, yield remains below its potential across much of the country. One of the main reasons for low yield response to fertilizer application has been the use of 'blanket' recommendations whereby no tailoring of fertilizer amount and frequency is done based on spatial soil fertility and climate variation. As a result, the amount of recommended blanket fertilizer rate couldn't fit the real nutrient needs of the crop, being either sub- or supra-optimal. There is thus an increasing need for site-specific fertilizer recommendations which considers site characteristics such as climate variables (temperature, rainfall, and solar radiation); soil factors (soil organic carbon, moisture, pH, texture, cation exchange capacity; and level of macro- and micronutrients); and topographic position indices (Abera et. al, 2022). As part of this exercise, the Alliance of Bioversity International and CIAT (in collaboration with the CGIAR EiA Initiative and the Supporting Soil Health Initiatives project (supported by GIZ) has developed—using machine learning techniques—season-smart and site-specific recommendations of inorganic and organic fertilizers to increase farmers return from investment in fertilizer in wheat production systems (<https://nextgenagroadvisory.com/about>). The advisory is generated using a machine-learning model to capture the relationship between soil nutrients and wheat yield. Digital Green, who has developed agile dissemination tools, is collaborating with the Alliance of Bioversity and CIAT to provide contextualized organic and inorganic fertilizer advisory for wheat growing farmers using different channels. As of the 2023 summer season, the advisory has been disseminated for over 50,000 farmers across 16 districts in the Amhara, Oromia and southern regions.

The advisory was developed by the Alliance (under EiA and SSHI projects) through integrating large crop response to fertilizer datasets from multiple sources and corresponding covariates. Before the pilot initiative at the community level, the advisory was tested on 300 farmer plots in four selected wheat potential woredas (Goba, Lemo, Siyadebir, and Basona) in the 2021 cropping season. The validation result has shown a grain yield advantage of up to 25% due to the use of the site-specific advisory compared to blanket recommendation (Tamene et al., 2023; Liben et al 2022).

During the 2022 cropping season, the advisory has been piloted in five wheat belt woredas (Goba, Basona, Siyadebir, Lemo, and Mareko) reaching 11,000 farmers with more than 3,000 adopting the recommended practice despite the shortage of fertilizer during the season. Maps, videos, telegram bot, and extension workers were used to disseminate the advisory to farmers. Extension agents were trained on the concept of site-specific fertilizer recommendations, interpreting maps, and generating advisories using Telegram bot.

During the 2023 cropping season, the SSFR was expanded to 16 woredas assisted by the Telegram Bot, assisting extension agents to generate site-specific recommendations for their specific locations. A combination of Telegram, Map, and Video was used to reach out to

farmers. Specifically, there were eight woredas where advisory was given to farmers by DAs via a combination of video-based extension (VBE), Telegram, and a SSFR map; four where farmers only received VBE and the map; and four where only Telegram-based advisory was given (i.e., the DAs did not use video or the physical SSFR map).

One of the dissemination channels used by Digital Green to reach extension workers and farmers was Telegram Bot. Telegram bot is an interactive bot designed to provide agricultural advisories to extension agents by leveraging DA profile data collected by the Ministry of Agriculture (MOA) and Digital Green. District extension experts and development agents (DA) in each *Kebele* were trained by the DG experts through video-based extension disseminated on how to interact and use the Telegram Bot to advise farmers on site-specific fertilizer recommendation.

This assessment was conducted to understand the DA usage and engagement with the Telegram Bot, draw lessons from the experience of development agents, farmers, and woreda experts, understand the challenges and its potential for contribution to the extension system as a new channel.

1.2 Objectives of the Assessment

The specific objectives of the assessment include:

- Evaluating DAs experience in using the Telegram Bot;
- Understanding DA interaction with farmers; and
- Understanding acceptance and adoption decisions by farmers and the challenges in adopting SFSR.

2. Methodology

2.1 Data Collection Methods

Focus Group Discussions (FGDs), Key Informant Interviews (KIIs), as well as Direct Observation were used as methods to collect information for this assessment. In Addition to those qualitative tools, Telegram and COCO backend data analytics was used to review and asses the progresses of the initiative.

2.2 Sample selection

From a total of 16 woredas implementing SSFR, four woredas were selected for this assessment; two woredas from Telegram only, Ilu and Siliti while the other two were from Telegram+Video namely Basona Worena and Goba. A total of eight Kebeles (two per woreda) and 16 DAs (two DAs per Kebele) who started interactions with the bot were selected for the DA interviews. Development groups who received fertilizer recommendation advisory through the DAs were selected for the focus group discussion (FGD). A total of 17 FGDs were conducted with selected farmer development groups (11 Mixed Groups-involving 159 farmers (5%F) & 6 Female Only Groups-involving 69 female farmers). Including interviews with the woreda focal persons, we conducted 18 KIIs, five of which were with female DAs. In

addition to DAs who started interaction with the bot, an additional 8 DAs who have been trained but who did not start any interaction with the bot were also phone interviewed to better understand reasons for not interacting with the bot.

3. Key Findings

3.1 Perception of Farmers on SSFR

Farmers who participated in the FGD stated the site-specific inorganic fertilizer recommendation they recently received from DAs is quite different from their previous advisory. At first, the participants mentioned they had doubts about the SSFR related to its potential benefits compared to the recent rise in fertilizer price in the country. The conventional experience is that farmers apply equal amounts of DAP and UREA though there is high nitrogen deficiency in most farmers fields.

Farmers have now come to understand the importance and benefit of using specific rates for specific locations. Farmers from all woredas do believe that if they use the recommended fertilizer, they will obtain a better grain yield as well as biomass for livestock feeding.

Although the sample groups from Basona Woreda said the information they receive about the SSFR is timely and helpful, the development groups in other woredas said the information on site-specific fertilizer recommendation was received late. Though, it was disseminated by the DAs during the months of June and July, farmers' demand for inorganic fertilizer was collected in the month of April. Thus, the demand and quantity requested by the farmers did not consider the new recommendation rate. Farmers have consensus on the positive results of SSFR on productivity compared to the blanket recommendation as they witnessed this from those who applied last year.

Majority of the farmers who received the advisory are willing to adopt the new recommendation (SSFR) depending on the availability of the fertilizers. However, farmers are not expecting to get fertilizer due to severe shortages in fertilizer supplies. In woredas like Were Ilu and Basona, only 50kg/farmer of Urea fertilizer were distributed to farmers, giving priorities for cluster farmers and farmers who plant in the early cropping season. The blanket recommendation is 100 kg NPS/ha and 150 kg urea/ha (for reference, the SSFR for one sample kebele was 310 kg urea/ha and 200 kg NPS/ha, and 290 kg urea/ha and 200 kg NPS/ha in another kebele).

In Silti woreda farmers say they have conducted their own experiments showing as they apply more fertilizer, their crops' yield increases. They say this is proof of what they have been trying to understand for several years. Farmers mentioned they always desired to know the optimum rate of fertilizer application.

Farmers from Were Ilu woreda were more concerned about the supply shortages they are experiencing than the price of fertilizer. Some farmers from the other woredas expressed their concern as in some cases the SSFR might double the cost of fertilizer for farmers. In addition to soaring prices of inorganic fertilizer, the farmers in some kebeles do not have a distribution

center in their Kebele and have no credit access to buy fertilizer. Nevertheless, some farmers' commitment to insist on using the SSFR in the midst of a very high price of fertilizer is encouraging.

When it comes to organic fertilizers, farmers from Were Ilu and Siliti woredas did not receive site-specific organic fertilizer recommendations from the DAs due to farmers not producing and using organic fertilizer. On the other hand, farmers from Goba and Basona woredas knew that the SSFR provide them alternative rates of organic and inorganic fertilizer, however, farmers (both male & female groups) prefer to use inorganic fertilizer due to its ease of application compared to organic fertilizer which they expressed as labor intensive, requires bulky input and involves additional transportation costs. Some farmers also believe organic fertilizer could cause flu and other health problems. In non-video locations the knowledge gap is higher.

Relativity, organic fertilizer usage was better compared to other woredas in Were Ilu, in which few farmers were supported by a local NGO with training and financial support for raw materials. Farmers from Basona Woreda also applied organic fertilizers on their farm. However, they are not using proper steps, using an excess or deficit of materials during the preparation. It seems that lack of inorganic fertilizers encourages farmers to be curious about and interested in organic fertilizers and many farmers are open to adopting organic fertilizers if they understand how to prepare it. Since site-specific organic fertilizer recommendations are generated by Alliance for wheat production in Ethiopia, these can be disseminated using the Telegram Bot to enhance crop productivity and soil health in the country.

3.2 DA perception and Telegram usage

Most of the DAs interviewed are satisfied with the information they receive from the Telegram bot and stated that it is user friendly. However, there were few DAs who lacked confidence in using the Telegram bot due to limited experience with smartphone and Telegram usage (no discernable gender difference). The DAs interviewed all agree on the relevance of Telegram bot in providing specific advisory in a simplified and convenient manner through which advisory can be generated at a village and an individual level.

The training provided on Telegram usage and SSFR was sufficient in terms of equipping DAs to interact with the Telegram bot and disseminate the SSFR advisory for farmers. The DAs were able to list the topics which were addressed during the training including introduction and key concepts on SSFR, topography, map reading, videos, advisories, best practices, and how to interact and report with the Telegram bot. Although all of them believe the training they were provided with was enough to use the Telegram bot, they insist on having a follow-up training for better understanding. In addition, they said that the allocated duration of the training was not sufficient, since all the DAs do not have equal knowledge and skills in interacting with new technologies (no discernable differences by gender). They also suggest training all DAs in a kebele.

Most DAs used information from the bot during the video dissemination session telling the farmers specific advisories based on their location in a kebele. Development agents also used the Telegram bot to advise farmers during door-to-door visits. In Telegram only woredas, DAs reach farmers in three ways: at farmer training centers (FTCs) (where they can reach 120-150 farmers at a time), in their village (through the development groups), and at farmers house. In Telegram-only woredas, DAs also reach development group leaders, and those leaders will in turn reach farmers. The women only groups in Were Ilu woreda did not receive the advisories at all. In this woreda, women only group priorities are given to reach women on health, nutrition, harvesting, and compost. Only women in mixed groups were reached on the LSFR advisory.

DAs were using the digital map with the help of distinguishing features such as health post, school etc. to identify the location and corresponding recommendation. Reading and interpreting the map is easier when the DA knows the kebele location very well. New DAs were challenged to locate farmers in which case other DAs within the kebele supported them in identifying the location and interpreting the map. Some of the distinguishing objects in the map were also mis located which created some misunderstanding for the DAs.

All the sample DAs from the Telegram Only woredas (Were Ilu and Siliti) were not using the short video on SSFR which was shared through the Telegram bot. Many DAs didn't even notice that a link is available on the bot, and they were not properly informed during the training on the importance and use of the video.

Regarding the reporting system, farmers' reach data was not reported on time through the Telegram bot. The major reason was that due to the current inorganic fertilizer shortage, DAs are worried that they could be made responsible for the lower adoption, and out of fear of being asked about additional information on the hectare of land planted with the new recommendation which is very minimal due to fertilizer shortage. Other DAs also say that the reason for late reporting is farmers' changing willingness to adopt decisions. A few DAs also have challenges in understanding cumulative numbers reported in the bot including reach and adoption data.

Most DAs have not started reporting adoption data since farmers are not adopting as per the recommendation due to the shortage of fertilizer. The reporting in the Telegram bot is by number farmers reached disaggregated by gender and it does not include a list of farmers reached. To fill this gap, some DAs in Telegram only Woredas keep a list of farmers reached in hard copy and report to the woreda office based on the direction given by the woreda focal person. The DAs suggested the integration of other advisory contents such as agronomic practices for crop, Livestock husbandry, fattening, and agrochemicals recommendation rate in Telegram bot to address farmers with comprehensive advisory.

3.3 Woreda Expert Perception and Acceptance

In all the four woredas the Agriculture offices have assigned a focal person who will be responsible for the follow-up and support for the Telegram Bot SSFR pilot. The assigned

focal persons are closely working with Digital Green field technical coordinator for the effective implementation of the initiative. The woreda focal persons mentioned that Integrating Telegram into the extension system will play a significant role in improving the system. DAs can easily access information and deliver advisory to farmers.

The woreda offices have experience in using Telegram channels. They have Telegram groups that they use to share information with the DAs and the zone and used for following ups and reporting the kebele major activities. Digital Green field coordinators, through insights gathered from the Telegram Dashboard, also uses the woreda Telegram groups to share information of usage of the Telegram bot by the DAs (by Kebele) monthly. This helps the woredas to follow up with low performing DAs. The DAs also mentioned that this helps them to know their status when compared with other kebele DA performances.

The Woreda Agriculture offices are interested in the future of the technology and willing to promote the technology in the regular extension system. They advocate the SSFR advisory to be included as part of the regular package of the woreda. They believe the channel will help DAs easily access information to advise farmers and reduce operational cost of the woreda extension offices. Some of the recommendations from the woreda DAs and SMS include:

- The need for sensitization of the woreda leadership on the technology use.
- Integrating Telegram with Video intervention and expanding the scope to more DAs and kebeles.
- The woreda SMSs pressed the relevance of including a woreda expert review option feature to ensure reliable and quality farmer data reporting.
- Consideration of easy identification of plots adding GPS location features.
- There was a suggestion to consider other commodities like maize, barley, etc.

3.4 Women Engagement on SSFR

Except Were Ilu woreda, the other three woredas reached out to women only groups on SSFR advisory. In Were Ilu woreda, there is a Women Only Group structure with more priorities given on reaching women on health extension, nutrition, harvesting, and compost. The DAs were mentioning agriculture practices extension is more focused for the mixed group, in which the few women in the mixed group are reached on the agriculture practices. The women in the FGD from the mixed groups have a good understanding of the benefits of SSFR, and they are willing to adopt the new recommendation. Although the current fertilizer supply issue affects their adoption decision.

According to the Goba woreda Kebeles, women had information on SSFR like that received via mixed groups. The women group mentioned that the DAs used to provide information SSFR while they come to Farmer Training Centers (FTCs), on SHG meetings and traveling to their village. During the discussion they confirmed that they are participating in advisory service delivered by DAs. The women group raised the issue of unaffordable fertilizer price coupled with absence of a distribution for fertilizer centers in their kebele. Regarding the

organic fertilizer, they explained that the amount required is too much and makes it difficult to use on a large farm size.

In some of the woredas like Siliti woreda, the advisory for women was provided along with the men. However, the trained DAs designed role divisions to reach more women. They have also used local institutions like "Edir" and "Mahiber" to mobilize women.

There are women farmers in Basona Woreda said that they were pioneers in adopting the SSFR practices in their farmlands in the previous season. The advisory was provided to them in women only groups and in mixed groups where they were advised to use recommended amounts of fertilizers. When it comes to decision making, the women said decisions related to fertilizer use are well consulted and they are part of the decisions made in this regard. Both male and female farmers stated they make joint decisions regarding purchase of fertilizer inputs, selling products/outputs, adopting practices. Women play a significant role in deciding the type and amount of input to be used.

In addition to the inputs to be used, women's role is significant in deciding the number of seeds to be saved for the next season, the amount to be used for household consumption, the amount of seed to be sold for loan repayment, and to sell livestock for the household purpose.

4. Telegram Bot Engagements

A total of 453 DAs (31% F) were registered in the Telegram bot from the 142 kebeles of the 12 pilot woredas (4-Telegram only & 8-Telegram+Video) (Figure 1). From the Telegram only group a total of 116 (31%F) DAs were registered, while 337 (31%F) DAs were from Telegram+Video group. From the registered DAs, 91% (414) DAs were with smart phones and attended the Telegram Bot training which was provided by Digital Green.

4.1. DA Interaction with the bot

- 65% of the DAs (269 DAs (24% F)) interacted with the Bot at least once. The major reasons for the rest of the DAs not interacting were phone/tablet not working properly to access Telegram, Tablet failing to read SIM card, and DAs having no smartphones at all.
- 80% DA interactions were recorded in the Telegram only woredas while in the Telegram video it was 59%.
- 35% (39% F) of the DAs did not start interacting with the bot, which is higher in the Telegram+Video Group including Basona Worena, Goba, and Lemo woredas.
- On average, DAs interacted with the telegram bot for 4.81 Days (M=5.10 & F=4.51) since June 2023.

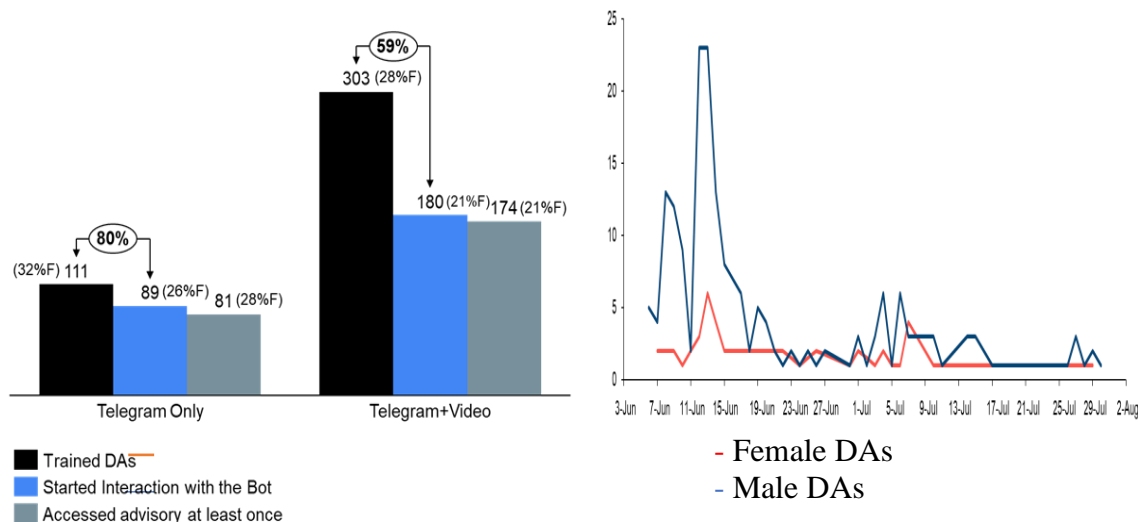


Figure 1. Telegram Bot engagements and development agent (DA) interaction with Telegram Bot with different contents.

4.2. Accessing Advisory and maps from the Bot

- 65% of the DAs (269 DAs with 22%F) accessed SSFR advisories at least once from the Telegram bot. While 44% (189 DAs with 23% F) generated advisory more than once (Figure 1).
- 82% (88%F) of the DAs downloaded the map. In Telegram only woredas, 89% of the DAs downloaded the map, while 79% of the DAs downloaded the map from Telegram+Video woreda.

4.3. Accessing video link

- Short video on the LSFR was shared for DAs through the Telegram bot. Only 24% (21%F) of the DAs who accessed the advisory were accessing the video. DAs who accessed the video from the Telegram Only group are lower (13%), when compared with the Telegram+Video woreda (29%), perhaps unsurprisingly since the Telegram+video DAs are familiar with accessing/watching videos. All the DAs from Goro woreda (Telegram Only) did not access the shared video link. It was also well observed during the assessment that the sample DAs in the Telegram Only woredas did not notice the video link in the Telegram bot.

4.4. Reporting reach and adoption

Out of the DAs who accessed the advisory, 94% of the DAs were reporting reach and willingness to adopt data through the Telegram bot (Figure 2). Accordingly, a total of 36,707 (21%F) were reached, of which 81% were from the Telegram+Video woredas, and 19% from the Telegram only woredas. When compared with the initial plan, 44% of farmers were achieved through the Telegram bot.

Regarding adoption, it was observed that farmers were facing challenges for SSFR adoption due to shortage of fertilizer. However, 3,500 (22%F) adoption data were reported through the Telegram bot.

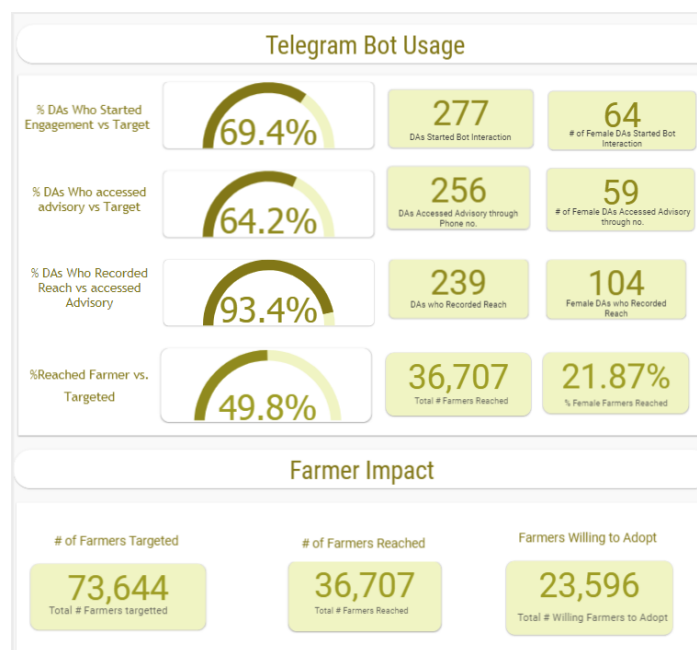


Figure 2. A dashboard being utilized for tracking the interaction of DAs with the bot with various types of interaction, reach and adoption of the advisories.

After analyzing unique number of farmers reached in 16 SSFR woredas, Table-1 demonstrates the farmers reached and adoptions recorded for the SSFR use case.

Table 1. Summary of sites-specific fertilizer recommendations unique reach and adoption

Advisory channel used	Number of farmers reached				Number of farmers adopted			
	Male	Female	F%	Total	Male	Female	F%	Total
Telegram Only	5,971	1,574	21%	7545	648	310	32%	958
Telegram + Video	26,476	8,766	25%	35,242	5541	1287	19%	6828
Video Only	5007	2406	32%	7413	475	55	10%	530
Unique Reach & Adoption	37,454	12,746	25%	50,200	6,664	1,652	20%	8,316

4.5. Feedback on the Bot

- Feedback was provided by 166 DAs (20%F) on the Inorganic and Organic fertilizer recommendations (Figure 3).
- 150 out of 157 and 48 out of 50 provided positive feedback with a “thumbs up”.

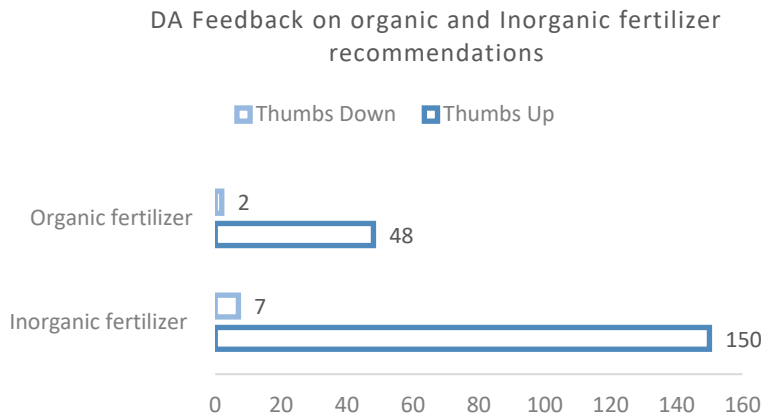


Figure 4. Development agents feedback on site-specific inorganic and organic fertilizer recommendation disseminated via Telegram Bot for smallholder wheat growers in their areas.

5. Major Challenges Identified

Although the farmers are willing to adopt the SSFR recommendations and DAs are happy to use the Telegram bot to provide the advisories for farmers, there are some challenges affecting the effective implementation of LSF recommendations and use of Telegram bot advisories. The major challenges identified include:

- Severe shortage of inorganic fertilizer is one of the major bottlenecks limiting farmers from adopting SSFR. The farmers are provided with limited amount of fertilizers that affected the adoption of the SSFR and advisories;
- High price of inorganic fertilizers is also mentioned as one of the factors contributing to low adoption of LSFR particularly in Goba and Silti woredas.
- Lack of Farmer associations or farmer organizations group serving as the distribution center for inputs including inorganic fertilizers in sampled Kebeles at Goba and Were Illu woreda affected the availability and fair distribution of the fertilizers.
- Limited awareness and wrong perception of farmers regarding organic fertilizers resulted in lower usage and adoption of organic fertilizer including compost and vermicompost.
- While interpreting the advisory map on LSFR, the DAs reflected the difficulty of identifying features used in the map easily on the ground to locate farmers' plot.
- New DAs assigned to new kebeles face difficulties in reading and interpreting the map as it requires knowing the specific locations.
- Limited internet connectivity and access inhibited DAs to use Telegram bot features.
- Some DAs with smartphones did not start interacting with the Telegram bot as they did not upload the app properly.

- The woreda level SMS engagement in monitoring data quality was weak in the system because the DAs share aggregated data which is difficult to monitor and woreda staff does not have direct access to the Telegram dashboard (i.e., relies on Digital Green's field technical coordinator's monthly reports).
- Some DAs have changed their phone number registered for Telegram use which interrupted their access and use of Telegram bot; and
- Some DAs are challenged to identify distinguishing features on the Map mainly because in some areas, the map does not clearly show the distinguishing features.

6. Key Learnings

- Site-specific inorganic fertilizer recommendations which is different from the previously used blanket recommendation were widely accepted by farmers and government SMSs and DAs. Farmers were aware of the importance and benefits of using the location-based recommendation. However, the limited supply of chemical fertilizers and the increased price negatively impacted the adoption of the recommendations. Even though the fertilizer supply is limited, and the prices are higher, some farmers are still committed to apply the SSFR in manageable ratio on their plot, which is encouraging. Other farmers also could be encouraged to do the same to encourage better adoptions.
- Most of the interviewed Farmers prefer inorganic fertilizer rather than organic fertilizer. This is due to the lack of knowledge, wrong perception of organic fertilizer, and lack of input to prepare the organic fertilizers. Due to the current shortage of inorganic fertilizers, farmers are interested in producing and using organic fertilizers.
- The fact that there is no Farmers organization in the center of Kebeles would contribute more to barriers of adoption and affect the effective input supply system.
- Training on the Telegram bot was provided for one day. The training provided on Telegram usage and SSFR may not be enough to equip all the DAs equally (no discernible gender differences in their ability to use the bot were observed).
- The site-specific fertilizer recommendation advisory was late, which was disseminated by the sample kebele DAs in the month of June and July. The demand on inorganic fertilizer was collected in the month of April, in which the demand (quantity needed) by farmers did not consider the new recommendation rate. Timing for recommendations may need to be reconsidered.
- Most of the Development Agents managed to properly use the Telegram bot technology in interacting, accessing advisories, and reporting farmers' reach and adoption data. In some woredas, DAs did not notice or use the shared short video on the SSFR through the Telegram bot.
- Furthermore, some DAs did not report farmers' reached data, afraid of accountability for the lower adoption due to the current fertilizer supply shortage.

- DAs were properly using the map shared through the Telegram bot to disseminate the location-based fertilizer recommendation. In some case there were challenges in locating the farmers. Distinguishing features are key to helping the DAs properly locate the farmers.
- The Telegram bot does not have a feature in which a list of farmers can be added. It reports several female and male disaggregated data. The reporting is exposed data quality issues. The supervisors suggest access to the Telegram bot to have oversight of what is being reported which may help to reduce quality concerns.

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