Developing and piloting location-specific fertilizer recommendation for Wheat in Ethiopia

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Contents

Executive Summary

This report covers the progress of developing and piloting location-specific fertilizer and agroclimate advisory service for Wheat in Ethiopia. The report highlights the major activities implemented during the 2022 cropping season including (1) review of organic fertilizer recommendations for wheat; (2) generation of location-specific fertilizer rate (LSFR) for piloting; (3) developing kebele map for LSFR recommendation; (4) video preparation for demo training; (5) trainings organized on piloting LSFR advisory and map reading; (6) LSFR advisory reach and adoption; (7) Alliance and partners pilot trial field visits during the main wheat season; (8) field days organized ; and (9) certificate of appreciation awarded to Alliance and its partners. The main purpose of the report is to narrative the processes associated with the development of agroadvisory and its piloting in the highlands of Ethiopia.

Review of organic fertilizer recommendations for wheat

In sub-Saharan Africa including Ethiopia, fertilizer price is challenging smallholder crop growers. Not only price is becoming expensive but also its timely availability is challenging for many smallholder farmers. Complementing inorganic fertilizer with organic inputs is thus essential to support crop growth and development. In addition, sustainable crop production with reduced impact on soil health can be achieved by growing crops using organic fertilizer or integrating inorganic with organic fertilizers. In line with this, the government of Ethiopia especially the Ministry of Agriculture (MoA) is exploring options with different partners on promoting the availability and use of organic inputs such as manure, compost, vermicompost and the likes.

While finalizing the implementation of location-specific fertilizer recommendation in Ethiopia under the partnership of the Alliance of Biodiversity and CAIT and Digital green, it was noted that fertilizer price has skyrocketed (up to three times during the 2022 crop season) and its availability in many areas was constrained though the government tried to rectify the situation through many forms of subsidy. The team thus decided to fast track on developing organic and organic-inorganic combination input advisories to complement the available inorganic fertilizers.

Alternative agronomic solution for wheat production can be essential to boost crop production (Bonilla et al., 2020; Howard et al., 2003). Such options are also considered environmentally friendly and sustainable (Vanlauwe et al., 2011). In order to complement inorganic and organic fertilizers it is essential to have understanding of what proportions of one input can be supplied with what proportion of the other. To achieve this, the Alliance conducted literature review of past research conducted on organic fertilizer and integrated use of inorganic with organic fertilizer on wheat in Ethiopia. The main purpose of the review was to: (1) identify organic fertilizer types and rates used across the country, (2) assess the amount of inorganic and organic input combinations used and the corresponding crop yields, and (3) to know the nutrient contents of the different organic fertilizers used by smallholder farmers for crop production in the country.

Based on the literature review, we observed that vermicompost, compost, farmyard manure, and bioslurry are the major organic fertilizer used for wheat production in Ethiopia. The review results indicated that using inorganic fertilizer with organic inputs resulted in significantly higher wheat yield compared to applying either inorganic or organic fertilizer alone (Chala and Obsa, 2019). Based on the review, it is observed that application of inorganic fertilizer at early crop stage is necessary to overcome nutrient shortage associated with slow release of nutrients from the organic sources. It is also wise to note that most of the literature reported using organic fertilizer

alone resulted in lower wheat yields because of slow nutrient release at early crop growth which has impact on head size, grain number, and biomass harvested at physiological maturity (Mintesinot, 2022; Chala and Obsa, 2019; Assefa, 2017). Studies revealed that half of the recommended nutrient rates can be supplied by applying organic fertilizer and the remaining half could be applied from the inorganic sources (Mintesinot, 2022; Chala and Gurmu, 2018). The review studies showed that the amount of nutrients recommended for wheat production can be supplied by combining organic and inorganic fertilizer sources and the amount to be applied depends on the elemental N, P, K, and S content of the organic fertilizer types (Table. 1). Therefore, possible combinations of inorganic and organic fertilizer sources and rates were calculated based on location-specific nutrient rates generated for Ethiopia.

Table 1. Average elemental nutrient contents of different sources of organic fertilizer in Ethiopia.

	Nutrient contents						
Inorganic fertilizers	**N (%)**	**P (%)**	**S (%)**	**B (%)**	**Zn (%)**		
1.UREA	46	0	0	0	0		
2. NPS	19	38	7	0	0		
3. NPSB	18.9	37.7	6.95	0.1	0		
4. NPSBZn	16.9	33.8	7.3	0.7	2.2		
Organic fertilizer type	**N (%)**	**N in kg per tone**	**P (%)**	**P in kg per tone**	**K (%)**	**K in kg per tone**	**Sources**
1. Farmyard manure	0.65	6.5	0.4	4	0.5	5	Assefa (2017); Girma and Zeleke (2019); Chekolle(2017); Abbas et al.(2012); Wassie et al.(2010); Getachew et al. (2014
2. Compost	0.8	8	0.45	4.5	0.55	5.5	Admasu and Tadesse (2018); Girma and Gebreyes (2018); Nigus et al. (2014); Tekalign et al. (2001)
3. Bioslurry	1.2	12	0.55	5.5	0.65	6.5	Devarenjan et al (2019)
4. Vermicompost	1	10	0.5	5	0.6	6	Admasu and Tadesse (2018); Robe (2021); Girma and Gebreyes (2018); Tekalignet al. (2001); Getachew et al. (2012)

Location-specific fertilizer rate (LSFR) for piloting

Machine learning based predictive model was used to generate site specific fertilizer rate (LSFR) for wheat in Ethiopia. The machine algorithm generated LSFR were validated on 300 farmer fields in 2021. Results from last year validation study showed that LSFR significantly improved wheat grain and straw yields, increased nutrient and water use efficiency, and farmers profit per investment in fertilizer. Considering the successful validation work and interest of locals and farmers, the Alliance of Bioversity and CIAT reached an agreement with its partners (Digital Green, Zonal and District Bureau of Agriculture, Ministry of Agriculture and EIAR) to piloting the LSFR advisory in regions where wheat is important crop. The pilot trials were conducted at Basona Worena and Siyadebir districts in Amhara, Lemo and Mareko districts in SNNP and at Goba district in Oromia regions (Figure 1). These sites were identified in agreement with Digital Green and considering the interests of the local partners to pilot the advisory.

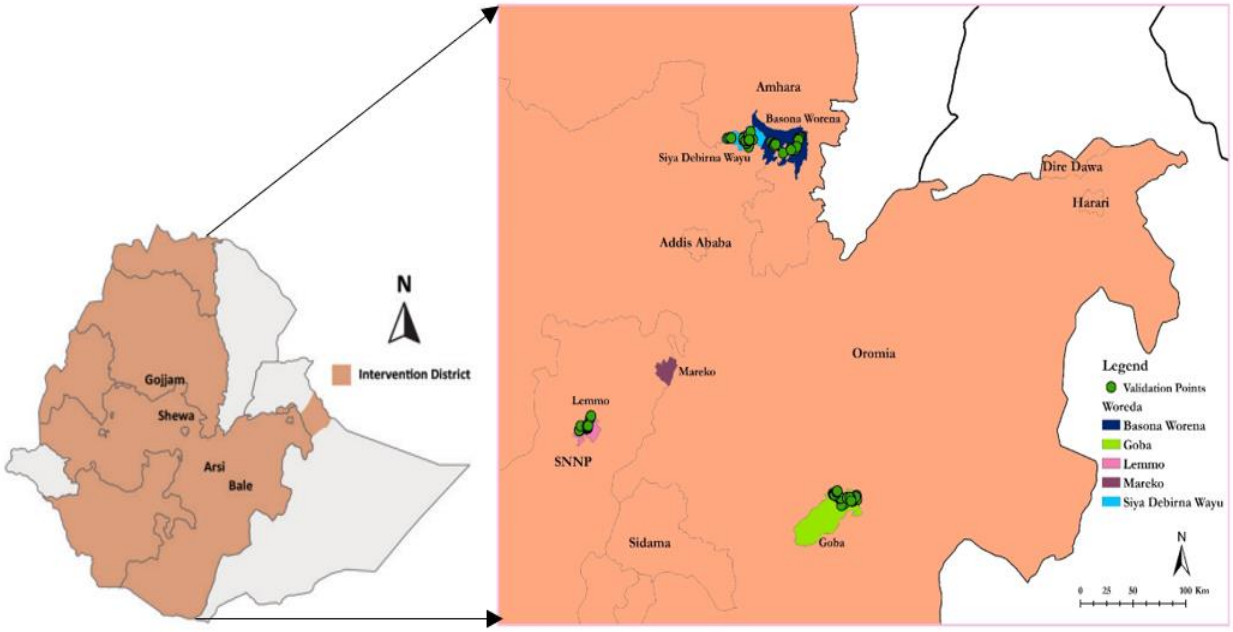

Figure 1. Location of specific fertilizer advisory validation and piloting sites and districts in Amhara, Oromia and SNNP regions in Ethiopia. The first map shows that wheat growing area in Ethiopia while the inset map is a zoom out to the four districts for the piloting.

The LSFR advisories were generated based on inorganic fertilizer sources recommended for the districts and using the organic source nutrient contents and recommendations obtained through literature review as presented above. With regards to inorganic fertilizer recommendation,

fertilizer types and rates for wheat crop were generated for each 250 m by 250 m plot across the wheat farming areas using machine learning algorithm and extracted for the piloting farmers in the three regions three regions. Next, the recommended combination of organic and inorganic fertilizer rates were calculated for advisory to complement cases where there is either (a) inorganic fertilizer shortage and/or is expensive and difficult to get; (b) where farmers have the access and ability to supply organic inputs for their farmers. Based on the above, a location-specific organic and inorganic fertilizer rates were generated for 119 kebeles in five woredas in the three regions of Ethiopia (Table 2).

Once the contents were generated, the next step was to disseminate the advisories for extension and farmers. This was done in collaboration with Digital Green who have agile dissemination channels (video, IVR, sms), experts on the ground and wide experience in disseminating advisories to farmers. In addition, the piloting has been implemented in collaboration with Zonal and District Bureau of Agriculture, and local farmers. The Zonal and District Bureau of Agriculture were very instrumental in this exercise to create awareness and mobilize extension workers and farmers. They also directly supported the piloting exercise through supervising and monitoring on the ground.

Developing Kebele map for LSFR recommendation

The LSFR developed in this project is for each location with a size of 250 m by 250 m. This means anyone who has location of plots can extract information from the tool and apply the recommended recommendation. The advisory can also be accessed through application programming interface (API) by other partners and disseminated using their available channels. However, during preparations for piloting, it was noted that Digital Green does not have location of specific plots of the various farmers where piloting was planned. There was thus a need to find a way of linking the fertilizer recommendation to farmers' fields/plots to facilitate the communication between supply and demand but also make sure the right advisory and communicated to the appropriate farmer and his/her plots. To achieve this, the EiA and Digital Green team discussed on alternatives and came up to develop a 'clustering method' whereby plots/farms that receive similar recommendation were clustered together and the types and rates of fertilizer to be applied determined. Once the 'clusters' were determined, they were then overlaid over Kebele and Google earth map to facilitate communication with extension workers and farmers. Displaying the recommendation clusters and Kebele boundaries on Google Earth was instrumental to use reference features such as schools, health center facility, main roads, minor roads and other local 'landmarks' to enable associating recommendations with specific farmers' plots/fields. This was also an important step to guide development agents who help farmers to know and apply the advisory for their fields (Figure 2). In this case, one map was

generated for each kebele and based on number of kebeles in each district 33, 14, 16, 32, and 24 maps were generated for Basona Worena, Siyadebir, Goba, Lemo and Mareko woredas, respectively. This was an essential and, in the process, an 'emergency' solution but which ultimately worked very well.

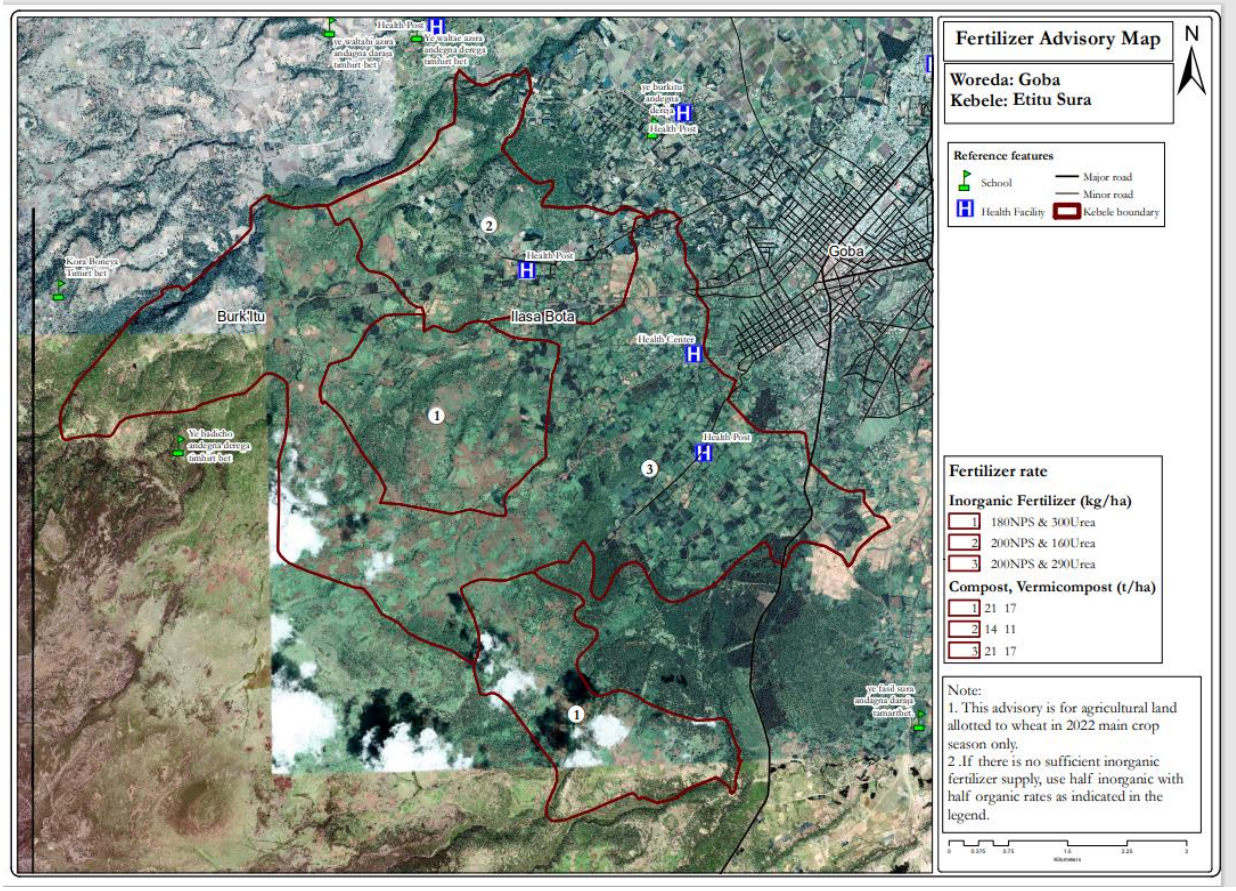

Figure 2. Map prepared to guide development agents in reaching the newly released location specific fertilizer advisory to respective farmer fields in each kebele.

Video preparation for demo training

One of the key tools that Digital Green uses to disseminate advisories to farmers is video. Video is used not only to inform advisors and good agronomic practices, but it is also a means to demonstrate practices using best use cases/examples. In this project, Digital Green has organized two video sessions: (a) the Digital Green team developed videos related to the fertilizer recommendation, and (b) the EiA team also developed videos to explain the processes followed to create the advisories and what it can serve smallholder farmers. The Digital Green video covered issues related to the advisory implementation procedures, land preparation, location-specific fertilizer recommendation types and rate, wheat management on field, and on how to

use the map in order to provide the right fertilizer for the respective plots. The videos were prepared in Amharic and Afan Oromo languages to make them understandable for the farmers. The videos were also used to train development agents and the development agents in turn used the videos to train and expose trial hosting farmers in implementing advisory. This was a crucial step to create awareness and capacitate extension workers and farmers on the proper implementation of the advisories.

Trainings on piloting LSFR advisory and map reading

Piloting a technology require technical and financial support. The Alliance and Digital Green team provided various trainings and technical backstopping for extension workers and farmers related to the fertilizer advisory and other good agronomic practices. Trainings were organized for each of the participating sites in Goba, Siyadebir, Basona Worena, Lemo and Mareko districts. The trainings included components related to the results of the fertilizer recommendation validation work conducted in the previous year and supplemented the prerecorded videos to provide clarifications and explain if questions arise. In addition, the trainings included providing background related to the LSFR, its importance, implementation procedures, and practical exercises on identifying one's farm in the recommendation maps prepared at high resolution at kebele level. Generally, the trainings had the following major focus areas:

- ✓ discuss on the need of location specific fertilizer recommendation
- ✓ explain how the advisories were developed (the processes and results)
- ✓ help DAs and experts clearly understand the content of the advisory map and how to read it in order to identify pilot trial hosting potential farmers in each advisory unit.
- ✓ discuss on the possibilities of piloting of the new fertilizer recommendations

A total of 249 development agents and experts were trained (Table 2; Figure 3, 4 & 5). The following points were some of the training participants reflections during the training:

- The participants were happy to learn that the validation of the advisory has worked very well.
- The fact that the training involved the whole value chain of the advisory development process (data-analytics-dissemination) was interesting for the participants as it gives them better background for informed engagement.
- Involving development agents on such kinds of research could raise their capacity and can also be an incentive for them
- Such detailed and location specific advisory can help to reduce farmers production cost and increase the efficiency of production

- Because of the price of fertilizer in 2022 season and that farmers may not afford for all their wheat crop, there can be a challenge to involve all farmers. Thus, organic fertilizer options such as compost and vermicompost were also recommended as an alternative.
- In some kebeles the farmers number is more than 700 and was difficult to reach in a short time before the planting season starts. There is a need to organize another training session for the development agents who were no able to attend this time around.
- The need to develop advisories for the other crops as farmers do not grow only wheat but grow other crops equally.

After the training, the farmers were able to understand the basic of the advisory and also they were able to understand which of their plot belongs to which fertilizer recommendation units and get support and follow-up from extension agents when in doubt.

Table 2. Agricultural experts and development agents who participated in the location-specific fertilizer recommendation piloting for wheat crop in Ethiopia

Region	Woreda	Male	Female	Total
Amhara	Basona Worena	52	18	70
Amhara	Siyadebir	17	8	25
Oromia	Goba	24	6	30
SNNP	Lemo	84	29	104
SNNP	Mareko	15	5	20
Total		**192**	**66**	**249**

Figure 3. Lemo District DAs and Experts training on LSFR at Hosana (Photo credit: Woldegebreal Jimore, Digital Green)

Figure 4. Training on piloting location-specific fertilizer rate given for agricultural experts and development agents at Goba district.

Figure 5. Training given for agricultural experts and development agents on reading the agroadvisory maps to identify and provide recommendation individual farmers plots.

This raised partners interest specially the Zonal and District Bureau of Agriculture to scale the new advisory beyond the Digital Green candidate Kebeles at the districts. For instance, Agriculture Office at Lemo district expanded the new advisory piloting to additional 1271 farmers and reached all the kebeles in the district with little support from Alliance side.

LSFR advisory piloting

Mobilizing farmers and awareness creation is essential to enable piloting and scaling technologies over larger areas and communities. During the 2022 season, Digital Green registered 24,073 smallholder farmers from five districts who wanted to pilot the new LSFR advisory for wheat. The plan was to reach 12,000 wheat growers in the three regions in 2022 crop season. In the same cropping season, Alliance and Digital Green were able to reach out to 11,171 farmers (89.4 % of the plan) through training and video demonstration. From this, 3387 farmers (42.4%) implemented the new advisory despite the cost (more than double) and shortage of fertilizer in the 2022 crop season (Table 3).

Table 3. Number of smallholder wheat growers with whom the LSFR advisory has been piloted during the 2022 season in Ethiopia.

Region	Woreda	Target kebeles	Kebeles with Pico	Registered farmers (Target: 12,500)	Actual Reach	Adoption
SNNP	Lemo	25	15	5926	4512	2600
SNNP	Markeo	16	6	3565	946	344
Amhara	Basona Warena	20	17	7820	1489	144
Amhara	Siyadebir	7	5	2185	2649	214
Oromia	Goba	12	9	4541	1575	85
Total	**5**	**80**	**52**	**24,037**	**11,171 (89.4%)**	**3387 (42.4%)**

On October 11, 2022, a team of scientists and experts from –Alliance, Digital Green, Zonal, Woreda agronomists and extensionists made visit to smallholder farmer fields who used the LSFR to grow wheat in the Lemo Woreda. The team observed that the wheat farms which received the advisory are showing very high performance from the vigor and color compared to the neighboring wheat plots managed under blanket fertilizer recommendations or farmers' practices (Figure 6).

Figure 6. On-farm comparative evaluation of pilot farms which received LSFR advisory with plots managed with local fertilizer recommendation.

The farmers who implemented the advisory in the Lemo district have stated how pleased they are with the improvement they have seen due to the advisory (Figure 7 & 8). Some of the farmers for example stated that they expect a yield increase of close to 50% from due to the use of improved location-specific fertilizer and other agronomic advisories communicated by the Alliance of Biodiversity and CIAT (ABC) and Digital Green (Figure 7 & 8). One farmer stated "*"you can tell from the stand now, how vigorous it is, and this definitely will improve my year's grain yield of 3.7-4 tons per hectare significantly*."


Figure 7. LSFR wheat field at Haysie (Left) and Omoshera-1 Kebele (right) of Lemo district

Figure 8. Farmer's wheat field that received LSFR advisory at Haysie kebele of the Lemo district

Alliance and partners organized field days at four districts

During the second and third weeks of November 2022 cropping season, the Alliance and Digital Green organized field days at Lemo, Siyadebr, Basona Worena and Goba districts to demonstrate to farmers, partners and stakeholders how the LSFR improved wheat performance. In the four district a total of 292, of which 259 are male and 32 are female farmers, participated in the field days. In addition to the farmers, 153 male and 20 female extensions workers participated in the field days (Table 4). Zonal and District Agricultural Representatives and experts have also visited many of the piloting farms in their respective areas. In each of the sites, the participants started the field visit after getting detailed explanation from the Alliance and its partners about the location specific fertilizer advisory pilot scaling (Figure 9). Then farmers who are hosting the LSFR advisory explained what they have done and what they expect as the crop stands now (Figure 10).

Table 4. Experts and farmers participated on field days organized at four districts where the LSFR was piloted.

LSFR Field Day Participants	Male	Female	Total
Farmers	153	20	173
DAs	28	7	35
Woreda experts	36	2	38
Zone experts	25	1	26
MoA experts	1	1	2
Others (DG, CIAT, … Stafs)	16	1	17
Total	**259**	**32**	**291**

Many of the host farmers highlighted that the LSFR advisory significantly boosted wheat performance when compared the plots with neighboring farmers who did not apply the recommended advisory. They explained that based on the plant height, head width and spike length they are confident of a significantly improved wheat grain yield for their families and also better straw for their livestock feed. After visiting the fields that applied advisory and compared with those without, the participants expressed their surprise on such major difference and many of them promised to pilot in their fields in the coming main cropping season (2023).

Figure 9. Field day participants visiting plots which received adviaories and entertaining questions with ABC and its partenrs (Digital Green, North Shoa Zone Agricultural Bureau, and Siyadebir Agricultural Bureau) at the Siyadebir district. (*Photo credit*: Feyera M Liben, Alliance of Bioversity and CIAT)

Figure 10. A farmer explaining to field day participants (farmers, Digital Green, Siyadebir Agricultural Bureau, North Shoa Zone Agricultural Bureau, and Alliance) about (1) the procedure he followed during advisory implementation and (2) on field performance of the wheat plots which recieved LSFR advsisory. (*photo credit*: Alliance/Mohammed Ebrahim)

The North Shewa Agricultural Office Representative who visited the fields with LSFR advisories during the field day at Siyadebir has requested the Alliance and Digital Green team to prepare themselves and plan for wider scaling in the coming 2023 main season. He also advised that the Alliance and Digital Green team should closely work with the Ministry of Agriculture (MoA) to get the new fertilizer advisory be registered as a national extension package. This is an interesting testimony that highlights the performance of the LSFR advisory to improve farmers grain and biomass gains. During the discussions, both the local farmers, extension workers, officials and research-development partners promised to strengthen their partnership and collaboration to expand the fertilizer advisory and reach much more farmers in the 2023 season.

Another field day was held at Goba in Oromia region (Figure 11 & 12). Similar to the other district, many of the farmers who applied the advisory expressed how extremely happy they are with the status of their fields. They explained that applying the same amount of fertilizer irrespective of the heterogeneity of fields and soil fertility status was too much a generalization and appreciated the innovation the project brought to provide targeted advisory for each plot. Furthermore, the

farmers witnessed that the fertilizer advisory generally matches to their respective field conditions and the fact that different plots get different advisories based on their fertility status makes the advisory unique and innovative. Some of the farmers indicated that they may get up to three tones higher yield from their plots that received advisories compared to what they harvested last year

Figure 11. Farmers and partners (Digital Green, Bale Zone Agricultural Bureau, Goba Agricultural Bureau, and Alliance) and smallholder wheat growers visiting LSFR advisory pilot plots at Goba in Ethiopia. (*Photo credit*: Feyera M Liben, Alliance of Bioversity International and CIAT).

Figure 12. Location specific fertilizer advisory pilot hosting smallholder farmer at Goba, Oromia region, in Ethiopia. (*Photo credit*: Feyera M Liben, Alliance of Bioversity International and CIAT)

In all target districts, the performance of the LSFR plots attracted farmer's, expert's and DA's interest. Hence, Agriculture Office at the districts organized field visits with their own initiative and has reached a total **7,729** of which 7011 were male and 728 were female wheat growers in the piloting districts. Such promotion and awareness creation effort will help partners to reach most of the wheat growers in the coming few years.

Table 5. Number of farmers participated on LSFR pilot plot exchange visits initiated and organized by Bureau of agriculture at the four districts

No	District	Number of kebeles	Farmers		
			Male	Female	Total
1	Lemo	33	4312	139	4441
2	Siyadebr	5	808	111	919
3	Basona Worena	12	1735	443	2178
4	Mareko	6	156	35	191
	Total	**56**	**7011**	**728**	**7729**

CEOs of Extension and Crop Directorates of the MoA visit advisory piloting sites

A field visit was organized at the Goshebado Kebele of the Basona Worena district in North Shewa, Amhara region with the Crop Development and Extension Executive Chief Officers at the Ministry of Agriculture (MoA), Zonal and District Agricultural Representatives, development agents, and farmers (Figure 13 & 14). The visit was organized by the Alliance of Bioversity and CIAT and Digital Green. The main purpose of the visit was to have an idea of the performance of the advisory in relation to farmers practices and discuss on the way forward for wider piloting. During the visit, the Chief Executive Officers had conversation with farmers, and extension workers related to their experiences on the LSFR advisory and their opinions about its performances related to fields which did not receive advisory. Based on these discussion and feedbacks received the CEOs appreciated the performance of the wheat pilots which received LSFR. The CEOs were very impressed with the performance of the advisory and recommended for technical meetings to discuss and agree on the way the LSFR can be piloted and/or scaled widely in the coming years. The CEOs also recommended the Alliance team to generate location specific fertilizer recommendation for the other major crops of the country such as maize, barley, teff as well as for malt barley and durum wheat, which have very high demand for commercial purposes in many part of the country. In addition to the performance of the advisory, the CEOs were impressed on how the advisory was disseminated to specific plots through the development of recommendation maps draped over google earth to support implementation.

Figure 13. Crop development CEO of MoA explained about agronomic benefits of location specific fertilizer advisory to farmers during the field day at Basona Worena (*photo credit*: Mohammed Ebrahim, Alliance of Bioversity International). This is an example of comparing a less performing wheat plot which did not receive the new advisory to plot with received LSFR.

Figure 14. Crop development and extension CEOs of the MoA discussing with Alliance, Digital Green, North Shoa Zonal Agricultural Bureau, development agents and other partners after the field day at Basona Worena. (*Photo credit*: Alliance/Mohammed Ebrahim).

During the meeting, the North Shewa zone agriculture extension coordinator stressed the need to support agriculture with science and knowledge to boost its productivity and explained to participants how happy and encouraged he is with the LSFR and its great potential. He also noted that despite farmers apply lower fertilizer than recommended in many instances, there are also cases of over application of fertilizer by wheat growers such as at Jiru and Siyadebir districts and advised the field day participant farmers to follow advisories generated by the Alliance for fertilizer optimization and to reduce the risk of soil health associated with over application of fertilizer than required.

Alliance and Partners awarded certificate of appreciation

Appreciating the efforts of the Alliance, Digital Green and its partners in enhancing crop yield through the application of targeted and location-specific advisory in their district, the Bureau of Agriculture at Siyadebir district offered a certificate of recognition. This was offered during a ceremony organized to acknowledge and appreciate the support provided by the Alliance and Digital Green and other partners (Figure 15). During the certificate award, the Bureau head highlighted his delight with the performances of the advisory both during validation and piloting

and stressed that such collaboration should be strengthened to reach more farmers and cover more crops. This is profoundly encouraging for the Alliance and its partners and will be an incentive to do more in order to support the stallholder farmers in the country.

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Certificate of appreciation

ለ Alliance of Bioversity and CIAT

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To Alliance of Bioversity and CIAT

Your institution has been working on location- and context-specific fertilizer recommendations though advanced analytics and participatory research to increase wheat productivity and production at Siyadebrna Wayu district. We appreciate your contribution in providing us advisory maps to guide the implementation of location and context fertilizer advisory, supporting field day and training capacity building. Thus, on behalf of Siyadebrna Wayu Agricultural office, we present this certificate to your institution with great gratitude.

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Figure 15. Certificate of recognition awarded to Alliance of Bioversity International and CIAT by Bureau of Agriculture at Siyadebir district.

The Alliance – Digital Green Partnership deemed exemplary to scale

Excellence in Agronomy (EiA) is designed to efficiently link a functioning 'demand – supply' partnership such there is direct symbiotic relationship between the two actors. Demand partner in this case is a government, non-government, and/or development organization that seeks to get validated agricultural technology that can be disseminated for farmers to support enhance their agricultural productivity and improve livelihoods. The demand partner should have a well-developed and agile dissemination channel and feedback mechanism to reach farmers and collect information about their opinions related to the technology and/or the means of dissemination. On the other hand, supply partner is one that generates scientifically proven and operationally tested content (can be in the form of data/information, recommendation, advisory, decision support tool, etc.) that can support improving farmers (users) livelihoods. While the supply side generally focuses on generating quality content the demand side is about delivering

the content to the right users using appropriate means/channels. In both cases the government extension system and/or any privity sector entity can serve mediating the linkage between content and users.

Based on the above modality, one of the EiA Use Cases is organized such that the Alliance of Bioversity and CIAT generates data-driven, knowledge-based agroadvisory services (recommendations) targeting smallholder wheat farmers for Digital Green to deliver to the farmers using agile dissemination channels and with the support of development agents. The partnership model is ideal because it capitalizes on the strengths and experiences of both institutions on the respective tasks. Started with repeated conversations and discussions between team members and management of the two institutions, the partnership has become one of the best functioning in terms of participatory development of activities, very good understanding among the team, focusing on mutual support, and eagerness and commitment to support the stallholder farmers as much as possible.

The great understanding and close collaboration of the two organizations has led to successful implementation of the agroadvisory validation covering 300 farmers across three regions of four districts. Managing three treatments of 300 farmers is huge achievement. Selecting sites, selecting farmers, soliciting and distributing inputs, providing trainings, setting up and managing the trains during the seasons (from planting to harvesting and data coaction) requires seamless understanding and positive collaboration. This collaboration also continued during the piloting stage where over 10,000 farmers were exposed to the advisory and close to 4000 are implementing. Here also the coordination and collaboration were massive and very successful across the whole chain of activities – select sites, identify farmers and create awareness, train farmers and support the farmers to implement the advisory. In addition, the two parties managed field days and associated visits of the sites by relevant partners.

Because of this successful experience and lesson, the partnership between the Alliance, Digital Green, and district extension system has been recommended as a use case for developing a functional research-extension-farmers linkage mechanisms at national scale. The partnership and its achievements were discussed during various sessions and an agreement is reached to pilot the content/advisory and partnership model in three districts focusing on three value-chains: wheat, acid soil management and liming. The model will be implemented in the 2023 season and lessons will be used to develop a platform that can support coordinating and harmonizing research and development efforts in the agriculture sector, which helps to avoid duplication of efforts and promote innovations through close collaboration and co-development of technologies.

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