Co-developing and co-validating location-specific fertilizer and agroclimate advisory service for Wheat in Ethiopia:
the Digital Green Use Case

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Contents

Executive summary

This report addresses activities conducted during the Incubation Phase of the Excellence in Agronomy (EiA) “Digital Green Ethiopia Use Case”. The report outlines the major activities implemented from proposal development to the execution of the main activities and associated results. The focus of the Use Case was to capitalize on the datasets and resources of the coalition of the willing (CoW) led by the Alliance of Bioversity and CIAT and supported by GIZ) to develop and pilot a minimum viable product (MRV) related to the development of an agroadvisory tool incorporating fertilizer, crop planting date and wheat rust surveillance for wheat value chain in Ethiopia. EiA is generally composed of content development and associated demand partner. In this case, the Alliance and its team envisaged developing location-specific agroadvisory (content) and Digital Green would disseminate the content to extension and farmers using its agile channels. Accordingly, the Alliance team in Ethiopia supported by EiA and CoW team developed an integrated location-specific fertilizer recommendation tool that has been validated on selected farmers. in three regions and four Woredas of Ethiopia. Close to 300 farmers participated in the trails which were composed of: *national blanket recommendation*, *local optimal recommendation* (based on local research institutes, Universities, etc.), and *the data-driven location-specific recommendation* developed by the CoW-EiA collaborative project. Note that the ‘local optimal’ recommendation relates to commonly applied fertilizer type and rate based on suggestion by local experiences (applied in the four sites) but with no adequate documentation. Also note that the data-driven location-specific fertilizer recommendation refers to one developed through the collaborative effort of the CoW (supported by Alliance, GIZ-Ethiopia and EiA), in general referred to as the ‘Digital Green Use Case (DGUC). While evaluating the three trials, the Farmers’ field days and data analysis results clearly showed that the DGUC has produced significantly higher biomass and grain yield compared to the other two. Field validation results show that the location-specific advisory (DGUC) resulted in about 8-17% grain yield increase compared to the standard and local checks. Biomass yield of plots that received the DGUC advisory showed 8% (1 t ha^{-1} increase compared to the local check). This indicated location-specific fertilizer rate advisory boosted not only grain yield but also biomass yield, which is one of the most valuable products for feeding livestock in Ethiopia. In addition, thousand seed weight and plant vigor were higher with site-specific fertilizer rate compared with local fertilizer rates. This is an important achievement demonstrating the value of integrated data analytics to make date-based and knowledge-informed decision making. During the 2021/2022 season, an attempt will be made to develop and provide bundled advisories composed of onset of rains and planting date (extracted from EDACaP, Ethiopian Digital AgroClimate

advisory Platform) and a weather surveillance system developed by different partners (EIAR, Alliance and CIMMYT).

This report summarizes the details of activities associated with the DGUC undertaken in the 2020/2021 cropping season in Ethiopia. The report is organized into different sections, including: (1) background of the project, validation trial protocol development; (2) field trip to districts and kebeles for discussion and site selection; (3) training and planning workshop held on validation trial implementation, management, data collection and use of open data kit (ODK) for digital data collection; (4) field book preparation and customization of data forms on ODK; (5) fertilizer treatment set up for the target development group (DG); (6) barcoded identification card preparation for digital data collection; (7) validation trial inputs and research materials purchase and distribution; and (8) trial follow up and visit by Alliance (CIAT) and Digital Green team, and farmers' field day to evaluate the three fertilizer treatment performances based on their observation; (9) validation trial data collection and submission to ONA using ODK tool; and (10) research results from the fertilizer validation trial data.

Part I: Digital Green Use Case Proposal

‘Co-development (with Digital Green) of agronomy and climate advisory tools for the production of high yielding and high-quality wheat in the highlands of Ethiopia’ *[DigitalGreen-Ethiopia]*

Justification

Digital Green, through its DAAS/FarmStack, project is interested in developing fertilizer, climate, and location-based customized agronomic advisories to communicate and farmers via development agents facilitated community videos. This requires accurate information at the appropriate scale for specific users. The effort on ‘fertilizer recommendation’ thus far generally depended on ‘blanket’ approach without considering biophysical and socio-economic realities. As a result, crop response to fertilizer application gave mixed results undermining adoption by farmers. Recent work by the Alliance of Bioversity and CIAT and its partners supported by GIZ has started to build soils/agronomy database spanning over the last 50 years. An exemplary step was the creation of the coalition of the willing (CoW), hosted by the Ethiopian Institute of Agricultural Research. The CoW is constituted by individuals/institutions who are willing to share data and/or support the process of data access and sharing. Its membership has grown fast reaching over 100 people by the beginning of 2022. In addition to data collated from various sources, the CoW also shared their data, which is now available in a database. Using the available dataset thus far, the team developed crop response to fertilizer application for different crops. There are still more datasets to come and when those are available, detailed analysis using various machine learning techniques can be undertaken, to developed detailed location-specific fertilizer recommendation. After integrating with climate advisory service and good agronomic practices, a comprehensive advisory service can be developed to provide bundled advisory services for dissemination. For appropriate targeting, farmer profiling can be done based on socio-economic data of households (household typology), based on which customized recommendation options can be developed for different household groups. An integration of all these (fertilizer-climate-agronomic advisories) corresponding to specific household typologies will lead to the development of location- and context-specific decision support system. The whole process of developing decision support tool and dissemination mechanisms will be co-developed by Alliance, GIZ-Ethiopia, CoW, EiA 2030, and Digital Green Team. Below brief description of the Digital Green Ethiopia Use Case is provided.

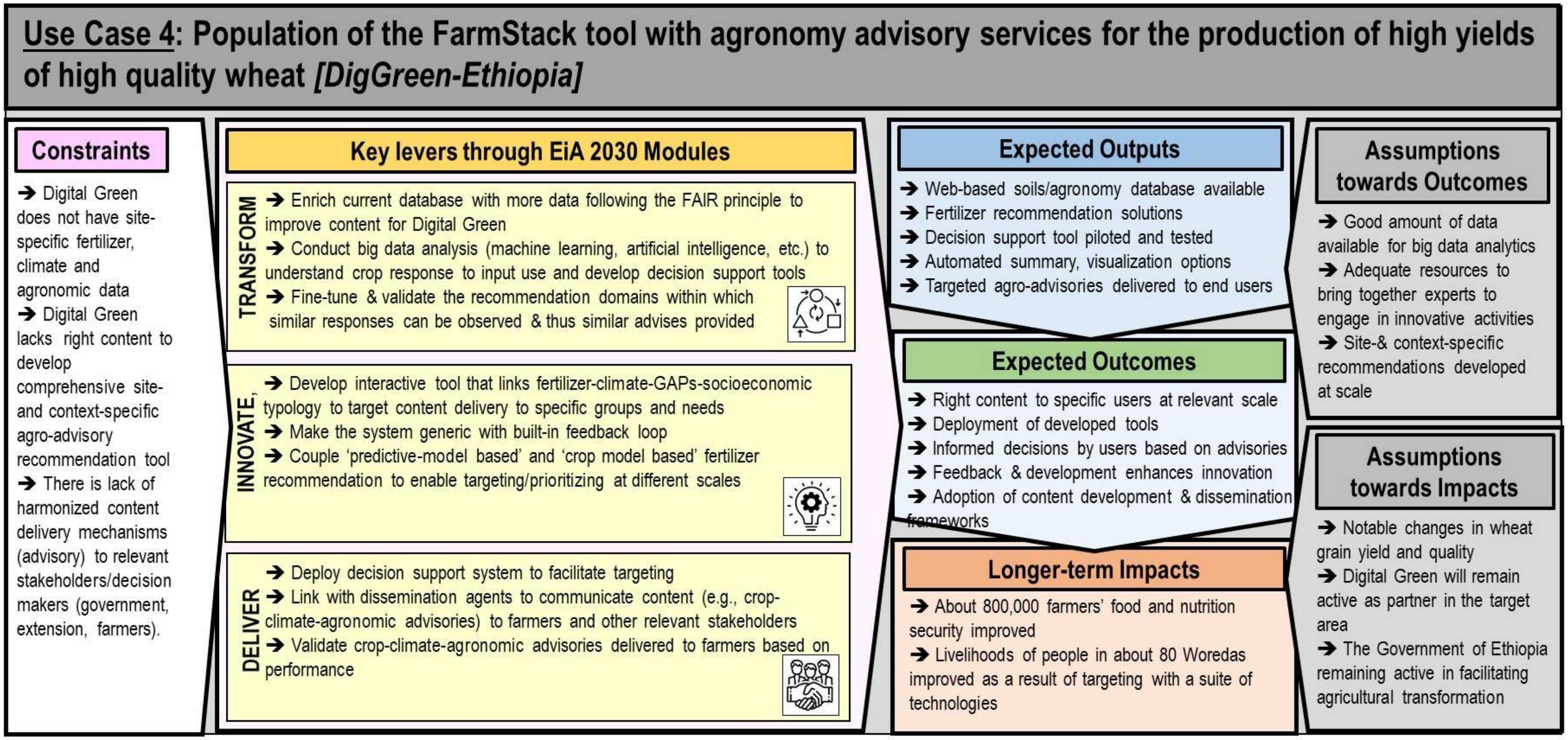
Description of the Digital Green Use Case. Note this is taken from the earlier EiA Inception Phase Ethiopia Use Case proposal

GENERAL DESCRIPTION	
Partnership	Digital Green will be the prominent partner for this use case. Digital Green and the EiA 2030 team will co-package recommendations for dissemination to farmers via extension agents. EiA 2030 team and the CoW members will be key partners to develop 'content' for advisory. The CoW has taskforce that plans and monitors activities. It also has technical team who provide advisories, trainings and technical support. In addition, the CoW has data scientists who are engaged in data analysis and capacity development. CIAT leads the CoW and EIA 2030R is the host/home of the database. EIA 2030R, Regional Agricultural Research Institutes (RARIs), Agricultural Universities, Ethiopian Agricultural Research Council Secretariat (EARCS), MoA, ICRISAT, CIMMYT, and IITA are key members and the backbone of the CoW. Experts in artificial intelligence (e.g., iCog Labs) will play prominent role to bring their skills in the area of robotics to agriculture and conservation. GIZ and EiA 2030 will provide financial and technical support to make sure that objectives are achieved.
Geography and farming systems	This project will be implemented in Ethiopia, focusing on wheat farming system in the four regions of Tigray, Amhara, South Nations, Nationalities and peoples (SNNP) and Oromia, covering about 80 Woredas (districts). The EiA 2030 team will work on a subset of these Woredas, which will be selected in due time. The exact sites will be defined together with Digital Green. In 2020, Digital Green will be flexible to pilot content (advisory service) and dissemination mechanisms for later scaling).
Centers	[CIAT ('A'), with ICRISAT, CIMMYT, and IITA ('R')
DEMAND DESCRIPTION	
Demand partner	At a project level, Digital Green is the partner who is interested to receive agroadvisory services in order to disseminate to local farmers using the network of extension agents. Digital Green's approach is such that its FarmStack tool will design dissemination mechanisms (to relay agroadvisory service) to extension workers. In some instances, the team can use ATA's one-stop shop' approach and/or farmers field schools to display advisories (using 'signposts' or signage) for farmers to watch and adopt those technologies through the support of extension workers.
Demand description	Digital Green has a large BMGF supported project aimed to promote and enhance technology dissemination to farmers (through extension workers) using videos, sms messages, IVR push-calls, papers, radios,

	one-on-one communication, etc. They aim to connect farmers and data! They intend to get content from different service providers based on the commodity at hand. Through our discussion with them (FarmStack team) we have established an entry point such that EiA 2030 and CoW team supported by EIA 2030R and EARCS will focus on generating appropriate content for dissemination. We will also co-develop a system (including customize Awaaze De) such that we can collect feedback from farmers. The focus is on the wheat value chain (but they are flexible if we want to focus on another and many commodities). The target agronomic products include climate (seasonal forecast) based yield predictions, planting time, and guides on varieties and nutrient management targeted to specific household typologies. The scale of operation will be plot – landscape – national levels. Digital Green aims to reach 3.5 million farmers in the four regions, 40% of which will be women. They expect about 50% adoption rate across the participating farmers.
Sources of information	As it stands now, the FarmStack component of Digital Green are planning to engage with 'content providers' related to their value chain of interest. With regards to 'crop commodity', they are interested to work with CoW (through the CIAT) as lead content developers. CoW team has collated data from different sources and developed national database related to 'crop response to fertilizer application'. The team also supported EIA 2030R to develop digital agroclimate advisory service platform, which can be linked with fertilizer responses. Considering that advisories cannot be provided to each individual farmer and/or aggregated to broad geographical scale will not be appropriate, the CoW team has developed recommendation domains (homogeneous units) where similar processes and responses prevail. These will be the basis of advisory. In addition, a compendium of good agronomic practices (GAPs) will be developed to accompany fertilizer recommendation for specific household typologies.
Sharing of information	There will be multiple communication channels: 'Digital Green will relay content to farmers through extension workers and the reverse – feedback to Digital Green from farmers through extension workers, which will then be relayed to EiA 2030 and CoW team. Content development for dissemination and designing communication channels to extension workers will be co-developed by this project team and Digital Green. The Digital Green team will lead development and testing of different means of communication (dissemination avenues) including videos, text

	messages, mobiles, paper tools, IVR push call, radios, and one-on-one exchange.
EX-ANTE IMPACT	
Potential impact of the recommend-dations	Crop yield in Ethiopia is below its potential due to climatic and input use constraints. In terms of wheat the national average is about 2.5 t hja-1 yr-1 with a potential of close to 6 t ha-1 yr-1. In this study, wheat yield increment of 25% - 50% will be attained through application of improved advisory services. There will be 50% adoption of the newly disseminated technologies by smallholder farmers. With regards to quality, a 100% increase in Se (selinium) will be achieved. Wheat grain Zn concentration target will be 20% increase compared with farmers practice or the old recommendations of DAP+Urea.
Targets of the intervention	Digital Green plans to reach about 3.5 million farmers in the four regions over five years, out of which 40% will be women. This can cover about 1,750,000 ha considering a farm size of 0.5 ha per capita. Within the coming 18 months, EiA 2030T and CoW team will develop relevant tools for Digital Green reach their target population (by disseminating right advisory for specific users at the right time.
Feedback received	We will create feedback loop between farmers (who implemented technologies) and the research team (EiA 2030 and CoW). The extension workers will be responsible to play the middle part of the loop but we will also engage with lead farmers to receive their feedback and communicate results. Input from extension and farmers will then be re-input into the database for further analysis. We also intend to collect data from farmers related to their household conditions, agronomic practices etc. to help refine recommendations for corresponding domains.

The EiA Theory of Change



Research Approach

The national database available at the CoW and the additional ones to be collected will be used to develop predictive model of yield estimation (Fig. 1.1). Our preliminary analysis with the currently available data already showed capacity to predict yield response by over 70%. With additional data, this can improve to over 80%. This will enable developing site-specific fertilizer recommendation (SCR). In order to account climate variables and agronomic practices, the fertilizer recommendation will be integrated with climate advisory service platform that is developed by EIA 2030R with the support of CIAT and its partners. In addition, we will develop a compendium of good agronomic practices that will also be linked with the fertilizer recommendation and climate advisory. These advisories should be tailored to specific household groups considering different attributes. We will use socio-economic data available at the central statistical authority (CSA) to characterize households into different 'groups' and create household typology (poor-medium-rich). This enables making recommendations specific to defined entities and enable developing site- and context-specific decision support system (SCSDSS).

Ethiopia is very heterogeneous country with diverse agro-ecological zones, farming systems and topographic forms. This means processes vary over short distance complicating development of advisory services. On the other hand, it will not be possible to provide advisory for every individual farmer. To tackle this challenge, we have partitioned Ethiopia into homogeneous units (recommendation domains, top-left side of Figure 1) within which similar processes prevail and similar responses are likely expected. After validation and fine-tuning, the recommendation domains will be used for targeting interventions at national scale. This will be complemented with detailed land suitability mapping and technology matching at local scale. Crop model- based specific fertilizer recommendation will be used to enhance applicability at more detailed farm/plot levels. Great strides in agronomic advisories will be made by coupling big-data based model predictions with dynamic crop model recommendations, which will be explored under this use case.

Considering the above developments, it is possible to see that the CoW and EiA 2030 project team have laid a good foundation to develop and validate SCSDSS for pilot sites within 18 months. Then team can support delivering right and appropriate content related to fertilizer, climate and good agronomic practices (planting date, plat density, fertilizer type and amount for specific wheat varieties) under defined socio-economic conditions that can be used by Digital Green. The SCSDSS will have feedback loops whereby extension agents and/or farmers will provide feedback related to advisories they received and their observations (impacts) on the ground to Digital Green who will further loop-in to EiA 2030.

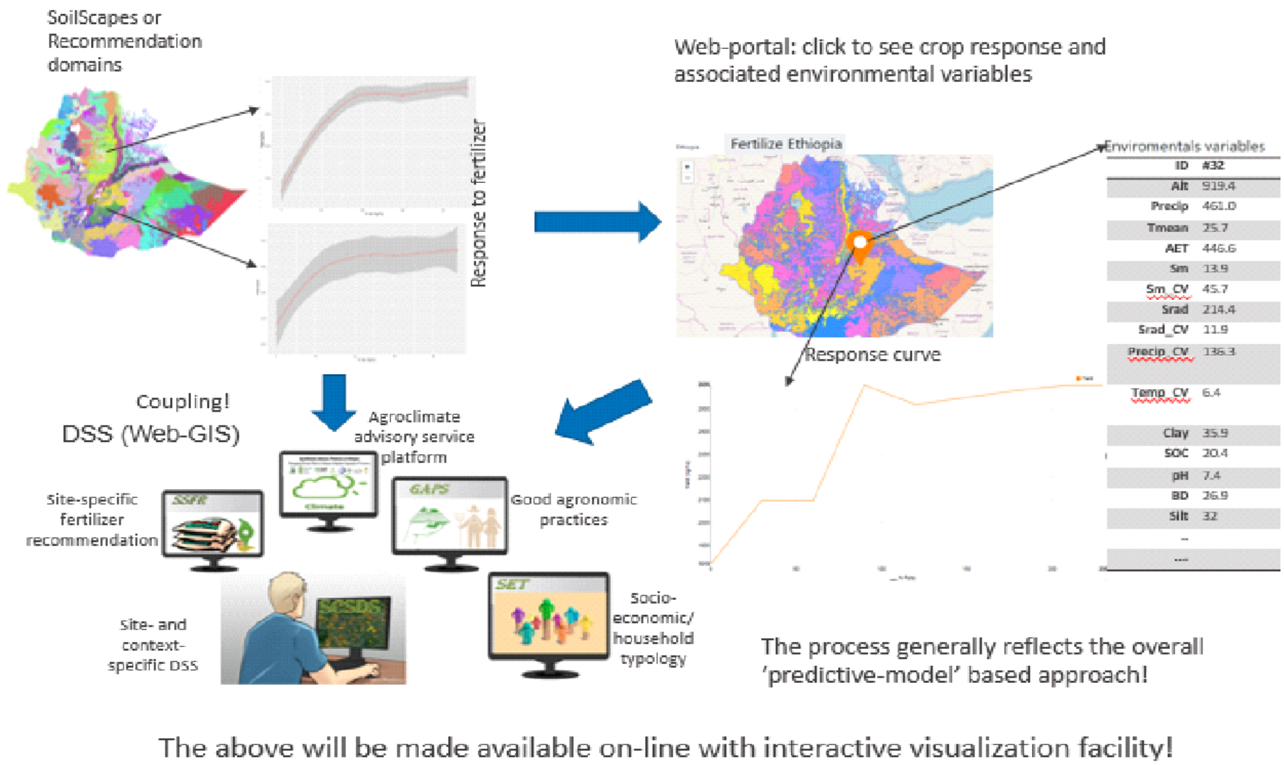


Figure 1.1. Workflow related to the development of site- and context-specific agroadvisory tool.

Key activities

Related to TRANSFORM

Activity 1: To develop web-based soils/agronomy database

- Collect remaining crop response to fertilizer data from different institutions based on the existing 'data holders and characterization' document
- Collect geospatial data (co-varieties) that will be used in the prediction model
- Build database following FAIR principles
- Develop web-based database (soils, agronomy, crop, co-variates, etc.)
- Conduct big data analytics to assess crop response to fertilizer application
- Validate and fine-tune recommendation domains to be used for targeting
- Derive household typology using CSA data and experts' consultations
- Develop automated summary, visualization etc. options

Related to INNOVATE

Activity 2: To develop site- and context-specific advisory services

- Develop interactive tool to link fertilizer recommendation-agroadvisory service platform-household typology features to target services to specific needs
- Develop crop model-based fertilizer recommendation at higher resolution

- Couple ‘predictive-model-’ and ‘crop model-based’ fertilizer recommendation to enable targeting at different scales and synergize across scale
- Develop site- and context-specific fertilizer recommendation (SCSDSS)
- Design SCSDSS generic with built-in feedback loop to retrieve users’ feedback
- Re-integrate feedback from stakeholders (mainly farmers) into the SCSDSS to improve and customize content through adaptive learning

Related to DELIVER

Activity 3: To deploy integrated ‘agro-advisory’ services (SCSDSS) to users

- Test and deploy the SCSDSS
- Link with dissemination agents to communicate content to stakeholders
- Validate advisories (fertilizer, crop, agronomy, climate) delivered to farmers and fine-tune for improvement
- Provide training on data analytics (big data, machine learning, etc.)
- Enhance local capacity related to analytics and recommendation
- Build capacity on model integration and feedback loop

Part II: Development of Integrated Agroadvisory tool

Data and database establishment

This component refers to collating additional datasets from various partners, organizing those datasets in standard format and integrating them into the existing database. The Alliance has continued to play its coordination role to mobilize the coalition of the willing (CoW) and continue engagement to tackle significant problems of national importance using innovative approaches. The team has made significant advances in collating and organize data, building database, creating data standardization guidelines. In this regards, the team has now (a) collated, cleaned and organized additional datasets from different institutes including SG2000, ICRISAT and EIAR/RARIS; (b) reviewed, edited and published additional data standardization guidelines. Crop response to fertilizer application data available under GIZ-ISFM were georeferenced to make them interoperable. Legacy soil profile data were collated from various sources in order to use as a basis to develop soil resource map of Ethiopia. The effort to get data from CASCAPE was not successful mainly because only few georeferenced data were available and it was difficult to trace those who participated in the initial data collection exercise to geo-locate the sites. An effort will be made to work with national partners to georeference those sites. Awareness was created on the needs and benefits of data sharing and the development of standardization guidelines. With the above exercises, closer to 20,000 soil profile and over 15,000 crop to fertilizer response data have been collated covering the majority of the country (Fig. 2.1). These were instrumental to conduct integrated data analysis and generate quality and high-resolution outputs.

Despite the successful efforts to gather data, there are some unaccomplished tasks such as operationalization of the data portal and initiation to publish raw data. The first is due to a lengthy bureaucratic process involving EIAR and Alliance/CIAT as well as leadership turnover in the former. Progress is made including signing MoU between the two which can facilitate collaboration. In addition, publication of raw data has been discussed but is delayed for the time being until the data sharing policy is enacted and implemented.

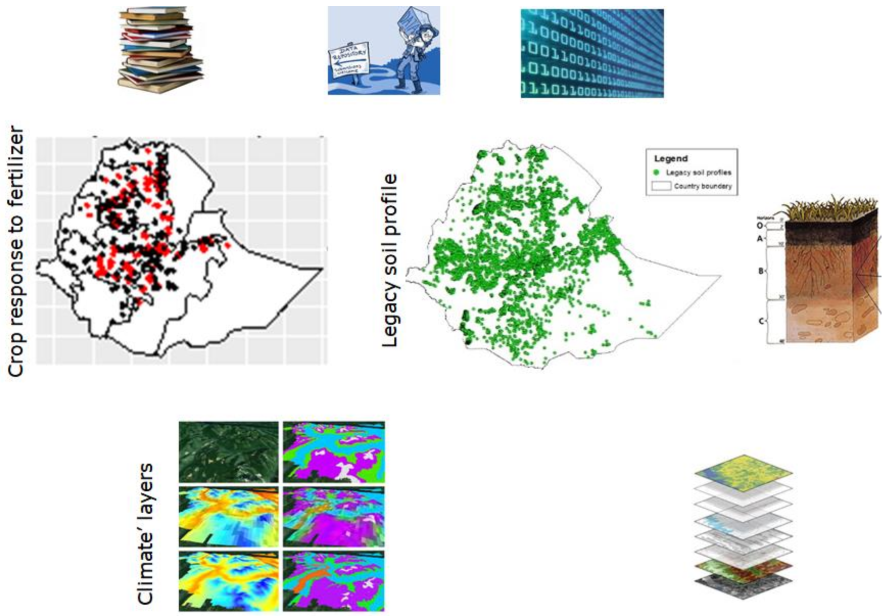


Figure 2.1. Point data collation related to crop response to fertilizer application and soil profile, data organization and harmonization, and collection of corresponding co-variate data to facilitate development of predictive models

Data policy and standardization guidelines

Key activities envisioned under this category include operationalizing the CoW soils/agronomy data sharing guideline and advocating and promoting data sharing practices and policy. These were promoted through trainings, one on one meetings and consultations with different partners. These efforts have created awareness leading to acquisition of additional datasets from different CoW members.

In addition, supporting the implementation and operationalization of the MoA soil and agronomy data-sharing policy and advocating the drafting of national data-sharing policy were among the planned activities of 2021. The soil/agronomy data sharing policy developed by the CoW and partners was launched two years ago but not operationalized yet because the policy is not signed. With support by different actors and the current State Minister, significance advance is made to accept the 'soils/agronomy data policy' as 'soils/agronomy data sharing directive'. This is because enacting a policy requires approval by Council of Ministers and the Ministry restored to 'directive' until we develop a comprehensive 'agriculture data sharing policy' which embraces different themes beyond soils/agronomy such as livestock, water, forest, breeding, etc. The CoW team will make concerted effort to work on this exercise and possibly submit early 2023. The team will also work with relevant partners (e.g., higher education and Ministry of Health) to develop national data sharing policy.

Considering the fact that data have been collected using different approaches and divergent units of measurements, it created difficulty to bring those together for integrated analysis. There was thus a need to standardize datasets to make them interoperable. This will be useful in order to enable standardized data collection and easy the complication of integrating data from various sources. A technical team of senior soils/agronomists of the CoW was thus tasked to develop various guidelines, some of which are already published (e.g., (https://cgspace.cgiar.org/handle/10568/110586, https://cgspace.cgiar.org/handle/10568/110585, https://hdl.handle.net/10568/115840) and see (Fig. 2.2). Additional guidelines related to soil survey, natural resources management and agricultural water management will be published in 2022/2023.

Figure 2.2. Data standardization guidelines related to Agronomy and Soil Fertility, Soil Microbiology, and Laboratory Analysis (soil, water and plant tissues)

Geospatial analysis and data mining solutions

Develop location-specific fertilizer recommendation tool

Though the CoW was initiated to facilitate and guide data access and sharing, the ultimate aim was to develop location-specific fertilizer recommendation tool. After collating datasets representing many parts of the country (dominantly the cropping systems of the highlands), an integrated fertilizer recommendation tool has been developed to provide location-specific advisory across scale. This is one of the very important achievement of the CoW. Figure 2.3 shows the overall framework followed. The processes and steps followed to achieve this have been documented (Abera et al., 2022).

The next steps will be to develop economically optimal fertilizer rate recommendations considering household typology. This will be based on the refined advisory as well as farmer typology dataset that will be collected by Digital Green (to be possibly available for selected sites later in 2022 or in 2023). The household typology information is expected to provide data about the 'wealth' category so that an optimal fertilizer amount cab be recommended for 'poor, medium, and rich farmers' making it context-specific. It is however important to note that detailed socio-economic information about household resources endowments and economic status will be crucial to estimate how much fertilizer will be needed at national level. We are exploring such data from the Central Statistical Authority (CSA) and hopefully this can be handled in 2023.

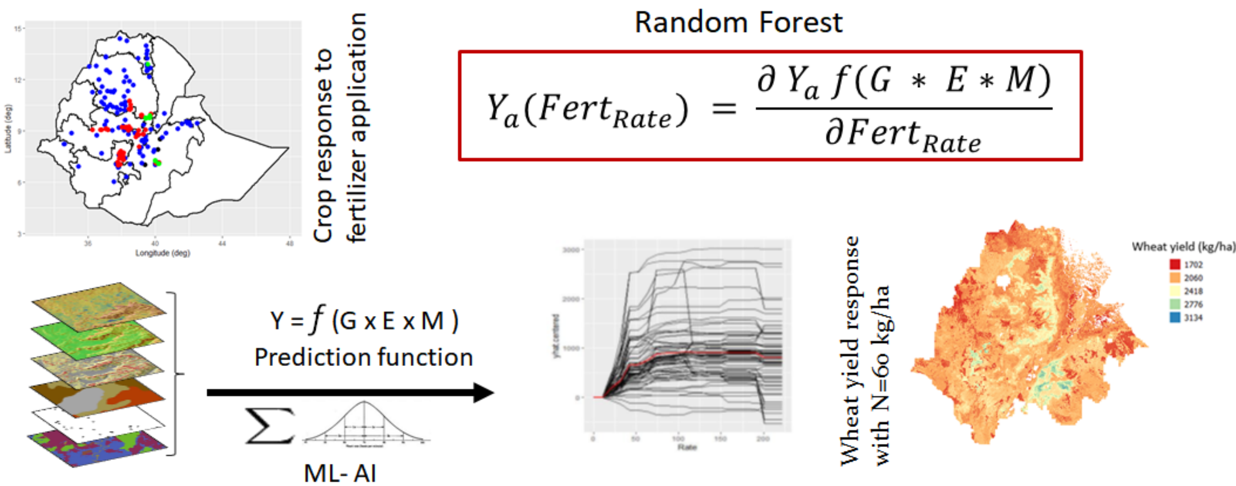


Figure 2.3. Framework to estimate fertilizer responses at any location by varying fertilizer application rate under the prevailing environmental condition

The above CoW sequential activities have shown success nationally and are also being scaled to other countries. For this purpose, presentation was made at BMGF-GAIA Webinar entitled "Soil & Agronomy Data Sharing Perspectives: Lessons Learned from Ethiopia & Rwanda (https://www.youtube.com/watch?v=Tq3jei2of6U). This webinar has an aim to scale the experiences of the CoW to Tanzania. An earlier presentation was made for the Rwanda team (……).

A next critical step of the CoW is to develop an integrated agroadvisory decision support system consisting of fertilizer, climate, disease and ISFM practices. Such coupled advisory can help tackle the multiple challenges farmers face and possible accelerate adoption. This component is expected to be finalized early 2023.

Develop similar response units (SRUs) for targeting and scaling

The blanket recommendation that prescribes almost similar amounts of fertilizer to heterogeneous locations is being condemned by research and development partners. At the same time, providing explicit advisory to every pixel and/or farmer's plot will not be possible considering the current circumstances. It is thus essential to stratify locations into similar response units within which similar processes prevail and similar advisories can be provided for optimum return. In this regard, an automated system has been developed to enable harvesting data from different sources, defining areas of interest and running clustering algorithms of different options to generate so-called agronomic response units (ARUs). The overall framework, processes and steps employed to generate the ARUs are submitted for publication under Experimental Agriculture Journal. The SRUs generated in this study are shown in Fig. 2. 4.

The prototype ARUs have been validated using expert consultation and also by comparing with the currently available agro-ecological zone map. The results show that the SRUs show low within unit variability, reflecting that similar response units are grouped that can help targeting and scaling of technologies. While the current units can be useful to target similar 'advisories', there is still a need to produce more detailed 'clusters' that can capture the diversity of the heterogeneous landscapes of Ethiopia. The results will thus be improved using additional high resolution and improved processing algorithms. The available dynamic geospatial web clustering and visualization tool (https://github.com/EiA2030/validation) that is available for public use can be a good basis to advance developing refined SRUs.

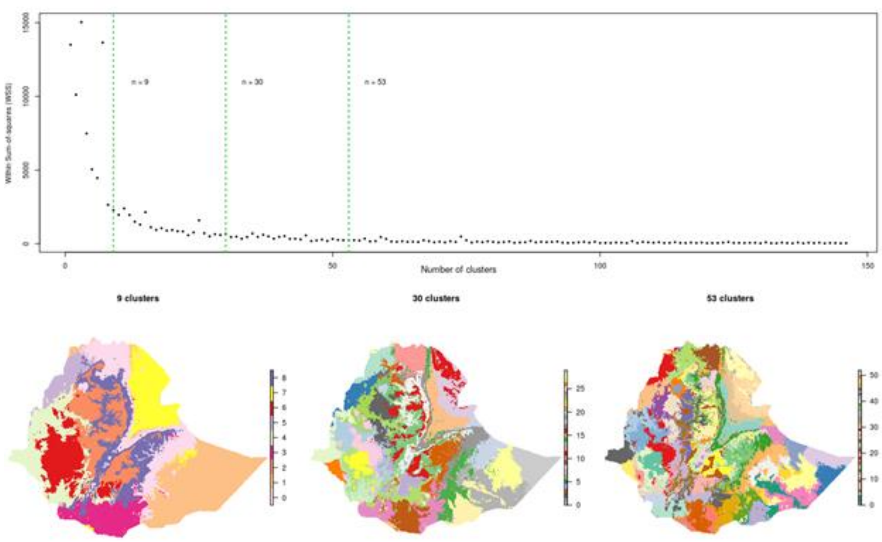


Figure 2. 4. (a) Number of clusters using the elbow method in K-means clustering and (b) examples of clusters (SRUs) with three different number of classes

Generate digital soil resource map for Ethiopia

Soils determine agricultural activities and are the basis of life. Detailed information about soil types and characteristics can be crucial for agriculture and hydrology related decisions. Besides the SRUs, availability of detailed soil type map can thus be a good entry point to target and scale technologies. This is because a single soil type is a composition of similar geomorphic, climatic and human actions. However, Ethiopia uses dated soil-type map generated in the 1980s using a minimum dataset of less than 2000 points for the whole of the country. Such a map cannot be a basis to make informed decisions, because it cannot reflect the reality on the ground. As a result, the CoW members started to collate available soil profile legacy data. The data have then been cleaned and harmonized for further processing. Senior soil pedology experts and others who have experiences were used in two writeshop sessions to check the accuracy of the data and harmonize them to facilitate integrated analysis.

Once the data were prepared, appropriate modelling techniques were explored to produce a soil resource map based on legacy data and corresponding co-variates. Beta soil resource map was generated in 2021 for validation and assessment. Expert knowledge was used to assess the map based on which recommendations were suggested. Based on the suggestions and by adding more datasets (closer to 20,000 points), a preliminary soil resource map was generated at a spatial resolution of 250m (Fig. 2. 5). The accuracy of the map at this level was close to 60%, which can be considered adequate for high level planning.

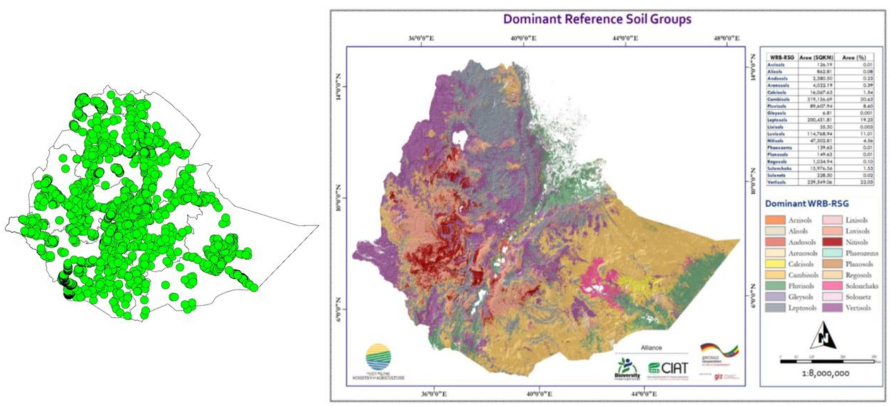


Figure 2. 5. (a) The spatial distribution of compiled soil profile data and (b) most probable soil type/reference group map of Ethiopia at 1km grid. Note that the digital soil profile database used to generate the current preliminary map contains about 14,200 comprehensive unique soil profiles containing more than 36,000 soil layers each with 133 soil attributes (77 soil morphological layer attribute data, and 56 soil physico-chemical and mineralogical variables).

The steps and processes followed as well as the final version 1 map are presented for discussion (https://egusphere.copernicus.org/preprints/2022/egusphere-2022-301/). Generally, experts' judgements and evaluations have shown the relevance of the map to be used for practical reasons. There is this great opportunity to use the map as co-variate when generating SRUs or can be used to target advisories until refined SRUs are available.

Pilot digital advisories with private and government partners

In the above subsequent sections, we have highlighted the various steps and processes followed to collate and prepare data and conduct different analyses. The next step was then to disseminate the outputs to relevant users, in this case the Ministry of Agriculture, the extension agents and farmers. After discussion with the MoA Crop and Extension Directorates, the location-specific fertilizer recommendation has been validating with the support of Digital Green. Being demand partners under the EiA arrangement, the Digital Green team has played an instrumental role in validating the recommendation. The fertilizer recommendation has been tested in four districts of the Amhara, Oromia and SNNP regions, covering about 300 trails across the four districts. The trials are based on national blanket recommendation, local optimal recommendation and the location-specific recommendation developed in this study. The trials were managed in partnership with Alliance, Digital Green, Office of Agriculture, and communities in the respective Woredas. Details related to the 'validation' exercises are presented in the following subsequent sections.

PART III: Validation trial protocol

Overall framework

The above sections documented the various activities undertaken to develop the prototype fertilizer recommendation tool by the Digital Green Use Case (DGUC) team. The next step was this to validate/test the recommendation by comparing with existing advisories using controlled trials. Considering the time and resource constraint during the growing season of 2021, validation was conducted in four Woredas/districts of three regions (Amhara, Oromia and SNNP). The pilot sites correspond to Digital Green intervention Kebeles and development groups. A development group is a subset of a Kebele with relatively smaller geographical areas, composed of 10 to 35 farmers. Basona Woerna, Siyadebir, Goba and Lemo Woredas (Fig. 3.1) have been identified to test the recommendations in the main season of 2021. The main objective was to validate and demonstrate fertilizer (N, P, S) recommendation for wheat in the above four Woredas of Ethiopia. The major component of the validation procedure was based on on-farm trials with treatment and control plots. Below we present, first, the steps that will be followed to validate the advisory using trials and controls on farmers' plots and the feedback collection from groups.

The Alliance, Digital Green and agricultural experts at the respective woredas guided the validation exercise. At the woreda level a coordinator was identified to oversees the group of DAs who are serving at different Kebeles within the respective woredas. In addition to seeds and fertilizers, the DGUS team provided training of trainers and step-down trainings for and together with the woreda coordinators. The training covered how to match farmers' plots to the site-specific fertilizer advice, farmers and experimental site selection, trial setup and field management and use of digital tools to manage the data. The DGUS team also distributed EA and household Id cards that were used during data collection.

The woreda coordinator was assigned to be responsible to select the DAs per kebele and provide the seed and the fertilizer package to Kebele experts, matching the location specific recommendations. The woreda coordinator was also registered DAs using the "register DA" digital form and provided IDs for every DA which was then used whenever the DA interacts with the farmers hosting validation trial. The DAs in turn were overseeing all crucial implementation steps in the field from famers and experimental plots selection to trial layout, fertilizer application, field supervision and data collection until harvest. During site selection, and using the ids provided by the woreda coordinator, Das registered households and collected data from every field. The DAs also received a field book and a protocol that guided them through the process of the validation trial.

Practical steps to be followed are:

- Provide training of trainers and step-down trainings
- The woreda coordinator engages with the DAs to identify representative farmers At this time, the woreda coordinator will register the selected DAs using the ODK form "Register or Verify Extension Agent".
- The selected and registered DAs will scout for farmers to hold validation on their farm and register these farmers using the ODK form "Register or Verify Household"
- For the field registered farmers, the EA will use the ODK form "Validation of Site Specific Fertilizer Recommendations for wheat in Ethiopia" while being on the farmers field and obtain location specific fertilizer and planting date advice.
- The DA must register every the farmer's name, household ID and the advice he gets on the field book he is provided with
- DA informs the woreda coordinator once this process is completed for his kebele.
- After this step is completed for all kebeles within the woreda, the woreda coordinator should inform the Alliance CIAT to download the data and send him.
- The Alliance downloads data from ONA server and sends it to the woreda coordinator. The data will have DA name and ID, farmer name and ID, farm location (kebele and GPS reading), fertilizer types and application rates for the two plots and best planting date.
- Woreda coordinators prepare a package for every farmer with the right fertilizers and seeds. It will print out the planting date, fertilizer rates and application dates as shown in figure 1 and attach this info to the corresponding package.
- DA collects the packages for his/her farmers and during that time DA should compare the information on his field book to the information attached to the package by the coordinator. In case of conflict the Alliance needs to be informed and solutions need to be provided.
- Starting from laying out the validation trial, DA will use the form "Validation of Site Specific Fertilizer Recommendations for wheat in Ethiopia - Data collection" to collect data.

EA name:
EA ID:
Farmer name:
Farmer ID:
Farmer Kebele:

	Planting date	Fertilizer type	Fertilizer rate	Time of application (in days after sowing)
Site specific plot				
Extension package plot				
Farmers practice				

Figure 3.1. Template to be used for attaching information for every package going to a specific farmer

Identification of trial hosting farmers

Validation and demonstration trials considering fertilizer type, rate, and time of application were conducted on farmer fields. For this purpose, four districts were selected from three different regions in Ethiopia: Basona Woerna and Siyadebir districts (Amhara), Goba (Oromia), and Lemo (SNNP) regions. These districts are selected considering their potential for wheat production, accessibility and suitability for the validation exercise. After discussion with Woreda Bureaus of Agriculture experts and extension officials, different Kebeles were identified within each Woreda. The major criteria used to define the number and distribution of Kebeles were diversity in soil type and wheat production potential (suggested by extension and Woreda Bureau of agriculture experts). Accordingly, 3-4 Kebeles were identified for each Woreda within which 40-60 hosting farmers will be identified. Ultimately, 100 farmers will be selected from Basona Werena and Siyadebir districts in the Amhara region, 40 farmers from Goba in Oromia, and 44 farmers from Lemo district in SNNP (Fig. 3.2).

Selection criteria for participating farmers:

- Wheat farmers in the major wheat growing areas.
- Farmers willing to participate in the validation and can commit 3 plots in their wheat field where by every plot will have 10m * 10m area.
- Wheat farmers with accessible farms for manageable logistics during field setup, supervision and data collection.
- Farmers willing to perform the farming operations in the validation plots except the fertilizer application, harvest and data collection activities.
- Special effort should be made to involve female farmers to have a good gender representation.

Selection criteria for the validation plot:

- Not too close to river, gully, road or homestead to avoid disturbance, contamination and fertilization
- soil type: covering main soil types used to grow wheat
- the slope gradient for the three validation plots should be as similar as possible,
    - avoid farms located on steep slope

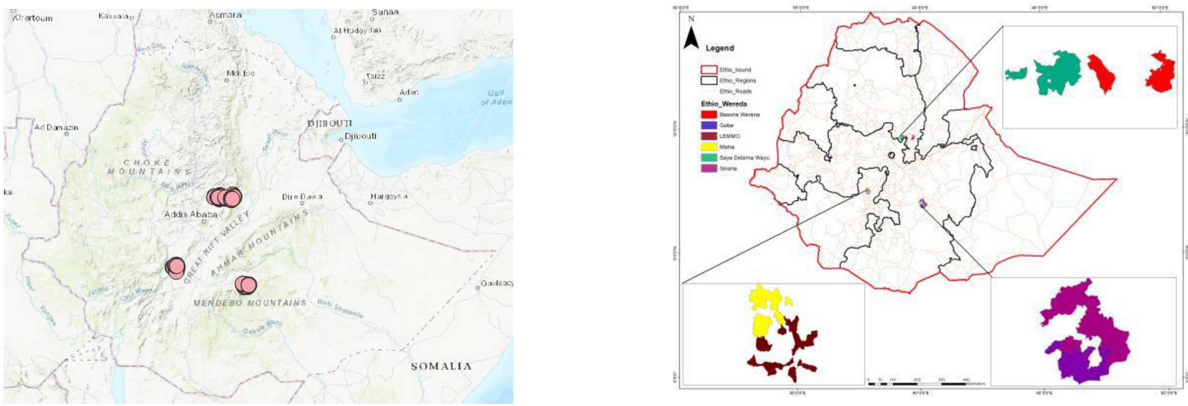


Figure 3.2. Location of the four wheat growing and demonstration Woredas in Ethiopia where trials will be installed to validate the fertilizer advisory

Trail Treatments

The validation experiment had three treatments: (1) DGUC recommended NPS fertilizer rate (treatment), (2) national extension recommended fertilizer types and rates (control), and (3) local extension recommended fertilizer types and rates (control). The trails were conducted under rainfed condition for the 2021/2022 growing seasons. Around 300 farers participated in these treatments.

Experimental design and plot size

Each of the experimental plots per farmer field had a gross plot size of 21.20 m by 21.20 m and a net plot size of 10m by 10m and the treatments were set at a random order. In each plot wheat was sown at inter row spacing of 20 cm by drilling seed at planting depth of 2-3 cm. Intra row spacing of 2cm was maintained for good plant geometry and distribution in a row (Fig 3.3). The amounts of fertilizer to be applied per plot, as defined by the land unit the farm belongs to, and information about the time of fertilizer application were provided for the participating farmers through the DA. The source of fertilizer was blended NPS (19N-38P-7S), and Urea (46N-0P-0k) depending on current fertilizer sources recommendations. The time of fertilizer application for the treatments and 'control' was the same.

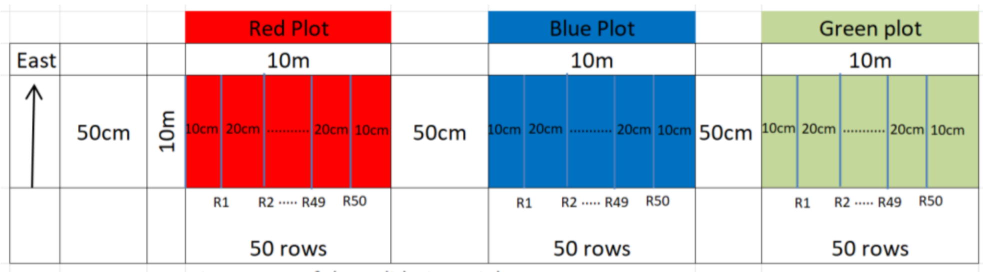


Figure 3.3. Layout of proposed on-farm experimental design to be replicated across the four Woredas and trial-hosting farmers in Ethiopia

Data management tools

There are four ODK based digital forms used for this validation.

1. Register DA: DA name, phone number, gender, kebele he operates and few more data that were used to monitor data quality assurance
2. Register household: captured farmers name, farm location, gender, education level and some additional data that can be used in the data analytics to tune the advice further
3. Get the advice: holds data on advised fertilizer rates, types and application dates for every farmer
4. Collect data: used for data collection throughout the validation trial.

Data collected from the treatments

Field information

A. Site name: Woreda, Kebele, village, and farmer group
B. Latitude (decimal degrees)
C. Longitude (decimal degrees)
D. Altitude (m)
E. Slope (steep, gentle, bottomland)
F. Drainage condition (well drained, moderately drained, poorly drainage)
G. Last season crop
H. Water management system (rainfed, irrigated)
I. Fertilizer application history (fertilized, unfertilized)
J. Crop residue (maintained, not maintained)

Extension workers in each Kebele were allocated to collect the above data and monitor the experiment from planting to harvesting. Discussions have been held for this undertaking. In addition, the DGUS team has disused with the Director of the Crop Development Directorate to communicate with the Regions and Districts for their support.

Crop and management information

A. Crop variety:
B. Tillage type and frequency:
C. Planting date:
D. Weeding time:
E. Chemical application (record type, amount and time of application):

Data related to crop parameters

A. Record any observed wheat nutrient deficiency (yellowish-green color, blue-ish green) and disease: make follow up and record types of disease or nutrient deficiency through visual observation on crop stand at tillering (35 days after planting), heading (70 days after planting) and physiological maturity (120 days after planting) depending on the highland varieties type. In addition, disease scoring were done including wheat rust occurrence.
B. Stand count at emergence: count number of plants in a meter square (count plants in 5-rows of 1-m length) at emergence (in 4-8 days after planting).
C. Stand count at physiological maturity: count number of plants per meter square (count plants in 5-rows of 1-m length) at physiological maturity.
D. Number of productive and non-productive tillers: count number of productive and non-productive tillers in a meter square (count plants in 5-rows of 1-m length) at physiological maturity. Productive tillers contain seeds in their spikelets whereas the spikelets of the non-productive ones don't have seed.
E. Plant height [cm]: This is the mean height of 10 randomly selected plants at physiological maturity measured from the base of the stem of the main plant to the tip of the main shoot/spike, excluding awns, for other crops using a yardstick.
F. Number of spikelets per spike for small cereals [number per plant]: The average number of spikelets per spike from 10 randomly selected plants is counted from a net plot area at physiological maturity.
G. Aboveground biomass [kg/ha]: This is measured by obtaining the weight of the aboveground biomass for plants in 4 m^2 plot area at harvest maturity and converting it to kg per hectare. This is also called biological yield.
H. Grain yield [kg/ha]: This is measured by obtaining the weight of the grains for plants in a 4 m^2 net plot area at harvest maturity and converting it to kg per hectare after adjusting the grain to 12.5% moisture content. Measure the grain moisture content using moisture meter and indicate the moisture content at which the yield is expressed. This is also called economic yield.
I. Thousand seed weight [g] for cereals: This is the weight of 1,000 seeds/grains randomly selected from the net plot harvest and is used to calculate the adjusted

yield of the harvest at 12.5% grain moisture content (note that this can vary depending on crop type).

J. Harvest index [ratio] is calculated on a plot basis as the ratio of grain yield to total aboveground biomass yield.

Partial net return and nutrient use efficiency

Data on fertilizer cost and wheat grain price were recorded. Fertilizer cost was recorded for each district during the fertilizer purchase. Farmgate grain price were obtained at harvest for the target districts. These data were used to calculate smallholder farmers partial net return from investment on fertilizer. Grain yield harvested and fertilizer application rate were used to calculate nutrient use efficiency of the wheat crop. Nutrient use efficiency was determined by dividing wheat grain yield (kg) to fertilizer applied (kg).

Water productivity

Rainfall data from planting to physiological maturity were obtained from nearby meteorological stations in each Kebele within a Woreda. If a weather station is not available, the NASA generated rainfall data was used. Rainfall data for each experimental field or Kebele can be downloaded from NASA website using trial site geographic information (latitude, longitude and altitude). Water productivity is calculated as the ratio of grain yield (gm) to the amount of rainfall (mm) received at each farmer field from planting to physiological maturity of the crop.

Agronomic survey

Agronomic survey was conducted to determine gaps and variability in wheat grain yield between different farmer fields and identify the determinant factors. This can be used to develop strategies of improving the less-productive low-yield farms through targeted advisory and technology transfer such as co-learning. Data on wheat harvest and agronomic practices (field history and management of current crop including type of cropping system, residue use, fallowing, frequency of manure application, plant density, thinning, weeding frequency and herbicide use, number of years field is under cultivation, timing of planting, variety, slope and distance of field from homestead) were collected from plots of households selected for the trials. For each farmer field, the agronomic management information was obtained based on a questionnaire and observation.

Data analysis and report writing

Data from the field experiments were analyzed using a mixed linear model using R software. The results of the analyses are being used to fine-tune the existing fertilizer recommendation tool. Among others, a partial budget analysis limited to fertilizer use costs and farmgate values of increased wheat grain production was used to calculate profitability of fertilizer rates. Therefore, variables for fertilizer economic analysis such as economic optimal and grain price to fertilizer cost of nitrogen, phosphorus or sulphur were conducted using fertilizer cost and grain price partial budget. The detailed analyses steps and results will be presented through detailed reports. In addition, manuscripts will be developed to be published in peer-reviewed journals.

Part IV: On-farm validation of location-specific fertilizer advisory

DGUC Field Book

Field book was prepared considering variables to be measured for the wheat agroclimate advisory and fertilizer rate validation trial study. The target variables included in the Field Book are EA and farmer identification; fertilizer rates to be used in the wheat plots; list of data collection events; land and crop management activities; plant stand counts at emergence time (1 WAP); rating the wheat trial at heading stage (10 WAP); rating the trial at harvest; measure wheat grain yield and grain moisture at harvest; and taking note on any observations or issues encountered in the validation plots (see Annex Table 4.1).

Customization of data forms on ODK

Data collection task in Ethiopia is performed with paper and pen which made it prone to error and loss due to poor documentation, difficult to conduct on a large scale, and high in transaction costs. Data management tools such as smart android mobile devices and software such as ODK that allow users to create surveys, collect, manage and upload data to storage facilities in real-time have reduced the conventional challenges associated with remote data collection. Data form "Data collection DG" was developed by IITA scientist to use for validation trial digital data collection in Ethiopia. Working virtual with the IITA scientist, the data form was customized as suitable for wheat validation trial digital data collection in Ethiopia.

Trial hosting district selection, visit and discussions with experts

The DGUC team selected regions, districts, Kebeles, and Farmer Development Groups (DG) where the model generated location specific fertilizer rate validation trail will be conducted. The districts, Kebeles and DG were selected from the sites already in the Digital Green mandate areas. The regions, districts, Kebeles and DG were selected based on importance of wheat as food crop and source of income for the smallholder, availability and accessibility of farmland for trial establishment, trial visit, data collection and follow up. Amhara, Oromia and SNNP are the three regions selected for validation trial implementation. Four districts were selected for the study in Ethiopia. In each district, 3-6 Kebeles and 2-8 DG were purposely selected within the districts to host the validation trial experiment (Annex Table 4.2). Basona Woerna and Siyadebir districts were selected from Amhara region while Goba and Lemo were from Oromia and SNNP regions, respectively.

Alliance (CIAT) team visited Basona and Siyadebir districts from the Amhara region, Goba from the Oromia and Lemo from the SNNP regions. During the trip to the districts, the team held short meetings with the district head of bureau of agriculture and extension experts as well Kebele extension agents (EA) and discussed on farmers selection for the validation experiment. Brief information about the purposes and objectives of the validation trial to be conducted and criteria set for Kebele, DG, and experimental plot selections were conveyed to the experts and EAs of the target districts and Kebeles visited.

Training and planning workshop on validation trial implementation

Trainings were held at Basona Worena, Siyadebir, Goba, and Lemo districts. The purposes of the trainings were to create awareness and give insights on the fertilizer rate validation trial implementation, management, plant parameters targeted for data collection and ways to measure them, and digital data collection using ODK. Participants were from Zone, district and Kebele offices of agriculture which were selected for the validation trial hosting. The total number of experts attended the training were 80 out of which 21 were women and 59 were men. The numbers of women and men participants were 11 and 12, 3 and 12, 4 and 20, and 3 and 15 at Siyadebir, Basona Woerna, Goba and Lemo districts, respectively (Fig 4.1). The training at a district was covered in three different sessions in a day. The first session of the training covered how machine algorithms and crop simulation models were applied to develop agroclimate advisory information and fertilizer recommendations. In this session, the trainers gave detail information about the EiA project, and uses and objectives of the designed validation experiment.

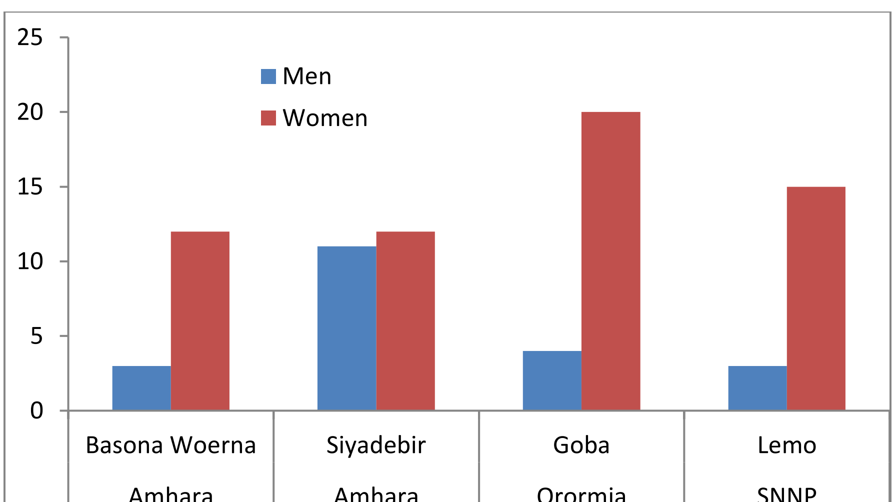


Fig 4.1. Participants attended planning workshop and agroclimate advisory training on validation trial implementation, management, and data collection using ODK in Ethiopia

The second session of the training covered details on how to establish validation of location-specific fertilizer advisory service for wheat in Ethiopia. This included general introduction and background about the designed validation trial; how to select trail hosting Kebeles and farmers and experimental plots; awareness on validation trial treatments; trial design and plot size; important data events; data to be collected for every and each even; details of data to be collected at each event; description of how to take plant parameters; and wheat nutrient deficiency description using specific symptoms of N, P, S, and B in wheat crop. The training was supported by imagery and graphics to help the trainee understand and get insight about the experimental design, plant parameters to be measured and how to take the data, how to collect soil samples, wheat development stage and data collection events and types of nutrient deficiency symptoms in wheat (Fig 4.2).

Fig 4. 2. Training on wheat agroclimate advisory and fertilizer rate validation trial management

The last part of the trainings was exercises on data management and digital data collection tool. Conventional data collection using paper and pen are prone to error, difficult to conduct in large scale and high in transaction costs. This practical training session covered setting up ONA and the use of ODK app on smart phone for the validation trial digital data collection. The trainees were shown practically how to get ODK based app on their android smartphone and setting up ONA to get data form from the https://ona.io website. Using the ODK app and ONA, the trainee downloaded data form on their smartphone from the website. The data forms available were “Register EA DG”, “Register Household DG”, “Data collection DG”, and “Agroadvisory revised version”. They exercised on how to get and fill the form. Each of these data forms were shown to the trainee during the practical session to make sure they understood the app, survey questionnaires and plant parameters and data forms for the planned digital data collection (Fig 4.3).

Fig 4.3. Practical trainings and exercises on data management and digital data collection tool using ODK on smartphone

After the practical session of the training, general discussions were held at each district to get feedback from the experts and decide on the way forward. After sharing ideas on opportunities and challenges of implementing the validation trial and digital data collection tools, agreements were reached on the importance of the study and possible application. The participants confessed their interest in using the ODK for digital data collection. Furthermore, ways of trial implementation were put forward and responsibilities were shared among participants based on their experts (Fig 4.4).

Fig 4.4. General discussion and planning on validation trial implementation

Barcoded identification card preparation for digital data collection

Barcoded identification card is an important tool in digital data collection. The softcopy of barcoded digital identification cards were prepared by IITA scientist for the wheat fertilizer and agroclimate advisory validation trial to be conducted in Ethiopia. After identifying responsible extension agent (EA) and trial hosting farmers (HH) names, barcoded identification cards were prepared and distributed to each Kebele. About 400 barcoded identification cards were printed, laminated and distributed to the target districts for identification of EAs and HH during the digital data collection (Fig 4.5).

Fig 4.5. Extension agent (EA) and farmers (HH) identification card preparation

Fertilizer treatment set up for the target development group (DG)

Generated fertilizer recommendations for wheat in Ethiopia are development group specific. For the implementation of wheat fertilizer validation trial, fertilizer rates advisory information should be targeted to trial hosting development group. Hence, the recommendations were identified from country agroclimate advisory information database for the selected development group where the validation trial to be conducted (See Annex Table 4.3).

Research material distribution and trial establishment follow up

Fertilizer NPS and Urea and improved wheat Hidase variety seed were bought for the validation trail implementation. A total of 1,648 kg NPS, 2612 kg Urea, and 1,553 kg seed of Hidase variety were bought, weighted for each development group based on their fertilizer treatments and distributed to the trial hosting Kebeles. The inputs were distributed to districts based on the number of selected farmers and the fertilizer rate treatments. Basona Worena received 618 kg Urea, 380 kg NPS, 202 kg Hidase wheat seed. Siyadebir received 666 kg Urea, 420 kg NPS, and 450 kg of Hidase seed. Goba district received 684 kg Urea, 418 kg NPS and 450 kg improved seed. Lemao received 644 kg Urea, 430 kg NPS and 450 kg improved seed.

Research materials important for the validation trial field layout preparation and establishment were bought and given to the districts bureau of agriculture hosting the validation trial. A total of 18 meter, 18 rope (50-m length), and 3,400 plastic bag pieces with 3-kg capacity were distributed for the trial design and layout preparation and establishment. The research materials were distributed to the Kebeles based on the number of farmers hosting the wheat validation trial. The research materials will also be used for the trial establishment in 2022 crop season.

On farmer field trial design layout implementation, seedbed preparation, planting, fertilizer application and other activities important for trial establishment were followed during the wheat planting time at the selected development group (Fig 4.6).

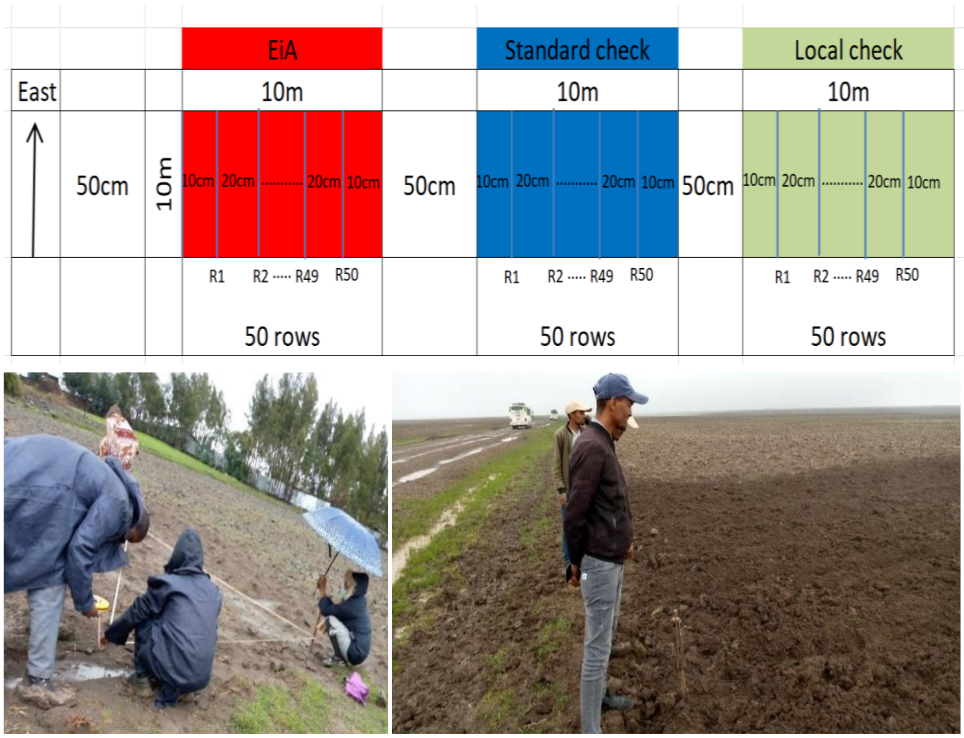


Fig. 4.6. Layout preparation and planting of wheat validation trial

Trial visit by Alliance (CIAT) and Digital Green Team

Wheat fertilizer rate validation trials established were visited in August by Alliance (CIAT) scientist, Digital Green Country Director and national and regional project coordinators (Fig 4.7). During the field visit, the team discussed importance of effectively managing the trial to reduce experimental costs and on sharing the experimental costs between Alliance and Digital Green. Agreement was reached and decisions were made on covering the trial operational costs. The two entities decided on sharing field operational, herbicides and fungicides costs.

Fig4.7. Wheat agroclimate advisory and fertilizer trial field visit by Alliance (CIAT), Digital Green teams and district experts in Ethiopia (August, 2021

Trial visit and on-hand ODK data collect tool revision training

Visit to trial hosting districts were conducted to supervise wheat fertilizer validation trial status and to update EAs on ODK data collect tool. Field visit and on-hand revision training on ODK data collect were conducted from 06-09-Sep-2021 at Basona and Siyadebir and from 14-19-Sept-2021 at Lemo and Goba districts.

ODK data collect revision training

DA and Experts took ODK tool and data collection training in June, 2021 (Fig 4.8). But the training was given within short period of time with limited hand-on exercise. Also, after the first training, due to work overload and other assignments data collectors did not practice the tool and the DA could not use the ODK tool for data collection. In addition, some revisions were made on ODK data formats and on URL. Therefore, this ODK tool and data collection revision training was organized for the second time and provided for representative DAs assigned to collect data using the ODK and district focal persons in the four districts. The training was given for 5 male DAs at Goba and Siyadebir, for 3 male DAs at Basona Woerna, and for 4 DAs at Lemo out of which 3 were male and 1 was female DA. The training was arranged at each district Agricultural office. The training included all the steps necessary to use ODK data collect. These were:

1. Downloading ODK tool from Play Store and installing it on their smart-phone;
2. Setting up the ODK tool to get the necessary data forms from the https://odk.ona.io
3. Trained on how to correct the data incase error is committed during the data collection and entry on ODK
4. Agroadvisory, EA register, HH register and Field Data Collection Formats were obtained from the ONA website and used for practical data recording using ODK

on the DA smart-phone. So, they were trained on how to use Agroadvisory forms, EA registration, HH registration, and Filed Data Collection.

5. The DAs were given orientation and revision on data to be collected and how to collect the data and fill out using the forms on ODK at trial sites
6. Finally the practical training addressed how to submit the data collected using the ODK tool.

Data collection was conducted at planting, emergence, tillering, heading, physiological maturity, and at harvest maturity data events. Orientation was given to help the DAs understand variables and how to measure the variables for which the data is collected. We repeatedly explained the practice until DAs understand well about the tool, phrases, variables, terminologies and data recording procedures. The DAs were equipped with the necessary skills on using the tool for data collection.

Fig 4.8. ODK training at Goba (Wabishebele Hotel) and Goshebado Kebele (Basona)

Validation trial field visit

Validation trial field visit and data collection and chemical spray supervision were conducted in Siyadebir and Basona Worena farmer fields. Imagery taken during the visit is shown in Figure-9. At Siyadebir kebele DAs finished the herbicide sprays and we observed most weeds are drying, but some resistant weeds need hand weeding, and we notice the DAs to follow the status of the weed and manage it. At Wole kebele, they sprayed palace only until the time of visit and it couldn't control broad leaf weeds. We noticed the DA to spray Richway soon and to control some herbicide resistant weed manually. At both kebele of the Siyadebir woreda, trials showed treatment difference among plots and plots received the EiA treatment showed better vegetative growth.

At Basona Werena Woreda, we visited trial status and performance and management at Goshebado, Gudoberet and Bakelo Kebeles. Herbicide spray was completed at the three Kebeles. However, at Goshebado kebele the spray was done late and trials there was weed infestation. During the visit we observed four very poorly performed trial due to water logging. At Gudo- beret and Bakelo kebeles, all trials were in good status and we observed differences among plots which received the fertilizer treatment. DAs were recommended to use daily labor to control weeds in highly infested plots and trial hosting farmers to manage plots with low weed infestation.

Fig 4.9. Trial status at Wole kebele (Siyadebir Woreda) and Bakelo (Basona Woerna) taken from Local Check-to- Standard Check-to-EiA plots side view

In Lemo woreda we visited trials at Ambicho kebele. Trials are in good status, and we observed difference among the three plots that received the different fertilizer treatments. Most trials are around the homestead, and there were high broad leaf weed infestation even after the herbicide spray. We also observed, sever wheat rust disease occurred in the nearby farmers field and mild symptoms in the trial plots (Fig 4.10). Similarly, we visited trials at Alesho kebele in Goba woreda (Fig 4.11), and we observed wheat rust problem. At Alesho kebele trials are in good status and the herbicides control well the weed since the sprays were made on the right growth stage of the weed.

The trials were promising at all districts. We advised the DAs to control the weed by herbicide or manually as needed. We also recommended them to start spraying the distributed fungicide to control the wheat rust disease. The DAs and experts were noticed to closely follow-up the trials, control the weed infestation and wheat rust.

Fig 4.10. Image showing wheat rust disease outbreak at Ambicho Kebele in Lemo woreda

Fig *4.11*. Trials picture at Alesho Kebele (Goba) captured from EiA-to-Standard Check-to-Local Check side view

Herbicides for weed and fungicides for wheat disease control

Weed and wheat disease management was very important in wheat production system in Ethiopia. We found both broad and narrow leaf types of weed are economically important in the trial hosting districts. When trials are simultaneously conducted on many farmers field, it is difficult to control weed manually before it cause economic yield loss. Therefore, after knowing types of weeds which are important in each trail testing sites, Palace and Richway herbicides were purchased and distributed based on weed prevalence at each district and applied at two weeks after emergence to fully control the weed at early growth stage (Table 4.1).

Table 4.1. Herbicides and fungicides distributed during trial management.

District	Herbicides		Fungicides	
	Palace (l)	Richway (kg)	Tilt (l)	Rex Duo (l)
Basona	0.48	0.034	0.48	3
Siadebr	1.125	0.075	1.125	0
Lemo	1.215	0.082	0.915	0
Goba	1.455	0.1	1.455	0

Participatory Evaluation of Trials

Field days and validation trial performance evaluation by farmers and experts

Field days were organized in November 2021, at Basona Worena, Siyadebir, Lemo and Goba districts at wheat dough stage to show performance of on farmer plots and to compare and evaluate wheat plots that received three different fertilizer treatments (the new site specific fertilizer rate, the standard fertilizer rate, and the local fertilizer rate). Farmers near the trial hosting sites, DAs, district and zonal experts participated on the field days (Fig 4.12; Fig 4.13).

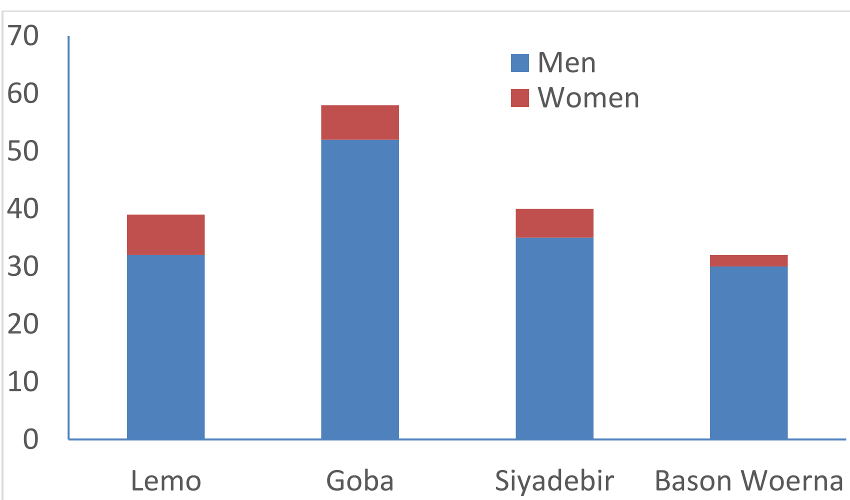


Fig 4. 12. Farmers, DAs and experts participated on wheat fertilizer validation trial field days held at four districts in Ethiopia, 2021

Fig 4.13. On-farm field day conducted at Basona woerna, Siyadebir, Lemo and Goba districts in 2021 cropping season

During the field days, participants visited five different farmer fields. Three major activities were accomplished during the field days: (1) participants were told about the trial management and guided by the Digital Green Field Coordinator during the field day to visit the wheat fertilizer validation trial plots; (2) the fertilizer treatments were evaluated for tehir performance based on wheat plots; and (3) participants were finally asked for their feedback on the trial and other related issue on a short meeting after the field visit.

Orientations were given for participants on ranking the treatments based on wheat crop performance indicators (Fig 4.14). Wheat crop performance indicators such as plant height, number of productive tiller, spike length, and other general plant aspects were used to evaluate the treatments effect visually on field by the technology end users. Three cards with different colors were prepared and distributed for ranking the treatments based on wheat crop performance on field. Based on this, participants were informed to assign green color card (first rank) to best performing plots, yellow color (second rank) to medium performing plots, and red color (third rank) to poorly performed plots. Based on the performance evaluation, site-specific fertilizer rate (new fertilizer rate) got high votes followed by standard check (research recommended rate) (Fig 4.15 and Fig 4.16).

Fig 4.14. On-farm wheat fertilizer validation trial performance evaluation by farmers, DAs, and district and zonal experts in 2021

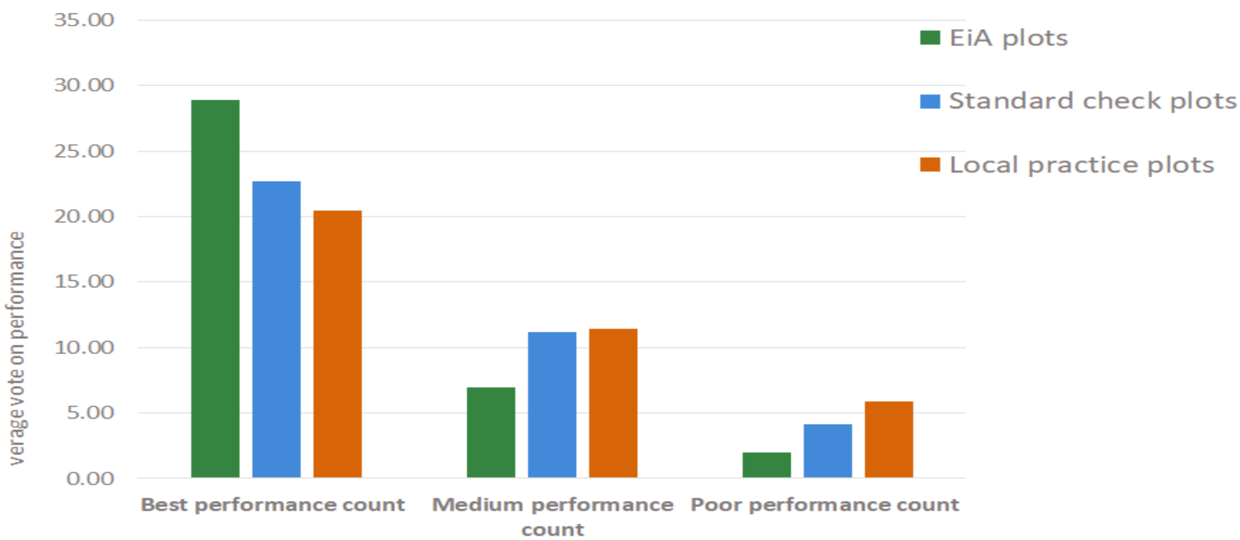


Fig 4.15. Participatory performance evaluation of wheat fertilizer rate and agroadvisory treatments

(Note that EIA plots refer to the data-driver fertilizer advisory developed by the DGUC team).

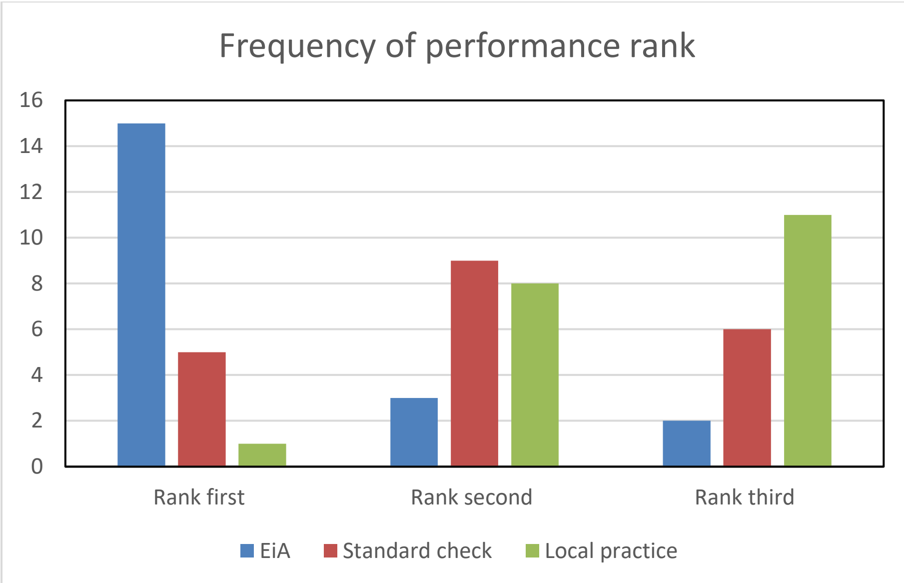


Fig 4.16. Participatory ranking of wheat fertilizer rate and agroadvisory treatments

Participants were requested for their reflections on the performance of the fertilizer treatments and what they learnt from the trial management during the field days. Based on farmers' evaluation results, EiA gets the higher vote (29 out of 38) for best performance and the least vote for poor performance (only 2 out of 38 votes). The extension recommendation has the second highest best performance vote (23 out of 38) and the second least vote for poor performance of the plot (4 out of 38). The local practice got the higher vote for poor performance vote (6 out of 38) and less vote for best performance.

Feedback from the field day participants on validation trial

- ✓ The local plots show early maturity, tinny stems and with smaller grain size, and the grain yield is expected to be less as compared to the treatment and standard trials on some plots at Siaydebir
- ✓ In addition to the wheat, it will be good to consider teff fertilizer rate trials for the next year in Siyadebir.
- ✓ Experts suggested to use breeder or basic seed rather than C1 seed for better performance. But the study used certified seed which is recommended for trials, and there is negligible effect on yield.
- ✓ Target varieties based on Kebeles interest for next season.
- ✓ Since there is weather variability in Goba area, for reliable result, participants requested to repeat the trials at least for one additional year.
- ✓ The famers appreciated the new location-specific fertilizer rate since it takes into consideration the soil type and status unlike the blanket rates.

- ✓ Besides the trials hosting farmers, adjacent farmers are learning from the trials management practices applying like herbicides and fungicides.
- ✓ In the Basona site farmers use criteria like biomass, tillering, plant height, plant vigor and kernel size to evaluate the three plots.
- ✓ The performance of the DGUC plot was better from both the national and the local recommendation separately evaluated by the farmers' group and expert group.
- ✓ The performances of extension and local recommendations were not consistent.
- ✓ Most of the farmers appreciated the performance of the EiA plot compared with the local at each visited farm and with their own fields.
- ✓ Some farmers said that they simply apply the fertilizer purchased to the farm plot they have at hand (mostly below the recommended amount).
- ✓ Farmers acknowledge the DGUC improved production and productivity.
- ✓ Farmers urged to get training on the recommended EiA fertilizer recommendation.
- ✓ Some farmers asked to get the recommendation written from (Manual or leaflet).
- ✓ The Kebele DA's stressed the importance of such activities on production and productivity improvement in particular and changing the livelihood of the community at large. They acknowledged CIAT's effort in this regard.
- ✓ The experts commented to start early and have enough time for both farmer and site selection process. Proper planning is important to secure representative plots.
- ✓ Some of the DA's said it is better to do at 5 to 6 farmers per kebele effectively rather than struggling with numbers. Similarly, the Woreda experts commented to do the experiment in a representative 'Gote' with limited numbers.
- ✓ The Kebele DA's commented that the local recommendation is different for vertisol (Black) and red soils. However, we use the same standard check plot for both soils.
- ✓ An input expert commented to use Dendea wheat variety which is popular in the area instead of Hidase for the experiment. His department is willing to support by facilitating special access to fertilizers (Urea and NPSB) if communicated timely.
- ✓ Woreda experts mentioned the DGUC team should strengthen monitoring and follow-up on the ground (i.e., field level support). They mentioned one- or two-times field level support which is not enough.
- ✓ Training for participant farmers will have paramount importance to get good results from the experiment.
- ✓ Digital Green site coordinator recognized all ups and downs during the implementation of the activity on the ground (from farmer selection until now) and promised to improve.
- ✓ Digital Green coordinator also promised to produce video on the fertilizer recommendation and distribute to farmers through their development groups at Kebele level for the coming season.

Data collection and submission using ODK tool

The DAs and woreda experts have collected and submitted data on EA registration, household registration, number of agroadvisory information used, and plant parameter for the wheat fertilizer validation trials at the target districts. Based on the information sumbitted to ONA using the ODK tool, 48 EA registration, 301 farmers registration, 143 agradvisory information use, and trail field information and plant paramters data of 1,985 were submitted during the crop year (Fig 4.17; https:///odk.ona.io).

Shared Forms List of forms shared with you.

Name	Submissions	Enter Data	View	Download	Last Submission	Active	
Register EA DG Shared by iita_nrm CREATED: June 28, 2021	48	Web		csv xls kml	Feb. 19, 2022	true	
Register Household DG Shared by iita_nrm CREATED: June 28, 2021	301	Web		csv xls kml	Feb. 07, 2022	true	
Agroadvisory revised version Shared by iita_nrm CREATED: July 02, 2021	143	Web		csv xls kml	Oct. 16, 2021	true	
DG Field Data collection Shared by iita_nrm CREATED: July 23, 2021	1,985	Web		csv xls kml	Feb. 07, 2022	true	
Investment Prioritization Tool Kogi Shared by iita_nrm CREATED: Nov. 22, 2021	0	Web				true	

Fig 4.17. Data of fertilizer validation trial submitted to ONA database (https:///odk.ona.io) using ODK tool until Nov 19, 2021.

Capacity building and knowledge management

A key component of the project is capacity building through various means. An important intervention is enabling some of the CoW members to publish their peer-reviewed papers (developed as part of the data sharing exercise) under Experimental Agriculture Special Issue, thanks to the support of the GIZ and BMGF. This has opened the eyes of the young scientists and developed their confidence to engage in the publication of their paper in peer-reviewed journals. Observing the engagement and commitment of senior scientists to serve CoW and the interesting products are incentivizing, the CoW team is further inspired and is committed to continue working on developing interventions that can support the agricultural transformation agenda of the country. We hope that the CoW will put its mark on many fronts among which the two critical ones are developing: National Location-Specific Agroadvisory Decision Support Tool.

Capacity building is an important component of the project. The project generally supported CoW activities including the publication of guidelines and organizing writeshops to clean and organize datasets. In addition, writeshop was organized to finalize manuscripts for the Special Issue in Experimental Agriculture. In the year 2021, capacity building focused on three components: (b) train GIZ team to handle georeferenced data collection and use of the standard guidelines; train extension workers and development agents on designing and managing experimental trials; and (c) train farmers on the need for and processes of fertilizer application and management. Table 1 provides summary of capacity building sessions executed in 2021.

Table 4.2. Training conducted in various sites to build capacity of actors and partners. The capacity building sessions were coordinated by the Alliance in partnership with MoA, District Agricultural offices, Digital Green, EiA, and GIZ

No	**Title of the training**	**Number of participants**			**No. of participants by Affiliation**
		Male	**Female**	**Total**	
	Create awareness on agroadvisory and fertilizer rate validation trial implementation, management targeted for measurement and digital data collection using ODK (ODK)	59	21	80	DAs and Extension workers
2	Farmers experience exchange and participatory evaluation of fertilizer validation trial	69	6	75	Farmers
4	Ag-extension experience exchange and participatory evaluation of fertilizer validation trial	39	7	45	DAs and Experts
5	Writeshop to enhance capacity of PhD students to produce manuscripts	7	1	8	PhD students from Addis Ababa, Bahir Dar, Haromaya Universities
6	Writeshop to capacitate PhD students to produce manuscripts	3	o	3	PhD students from Addis Ababa, Bahir Dar universities
8	Training on data encoding, clearing and standardization for soil resource map	10	3	13	Experts from MOA
9	Training on soil data cleaning, modelling and mapping task	11	3	14	Experts from MOA

10	Training and write shop on CSA for experts from various institutions	18	1	19	Experts from MOA, AAU, PhD Students; EIAR

The above training session does not include the one conducted in the form of farmers' field days. That will be finalized and report soon. Because some of the standardization guidelines are not ready for publication, it was not possible to publish a comprehensive guideline as a compendium. More to be done in 2022.

Results from validation trial

Performance of fertilizer advisory across sites

Performance of fertilizer rates generated by models can be validated using different indices. Linear regression coefficients (slope and intercept) are the most important indicators that can be used to evaluate performance of model generated fertilizer rates based on crop yield response to applied fertilizer. Therefore, performance of random forest machine learning algorithm generated location-specific fertilizer rate (SSR) across sites in Amhara, Oromia, and SNNP were compared with standard (control) and local fertilizer rates using wheat grain yield responses to applied fertilizers (Fig 4. 18). Performance evaluation showed location-specific fertilizer rates had higher agreement (slope closer to 1 and intercept less than 1.5) with both standard and local check fertilizer rates across 277 farmer fields in Ethiopia. Site-specific fertilizer rate performance was highly related to standard check (researchers recommended fertilizer rate) across all sites compared with local check rates (local extension rate). Therefore, the fertilizer recommendation generated in this project can be applied to generate site-specific fertilizer rate for improved wheat productivity in Ethiopia.

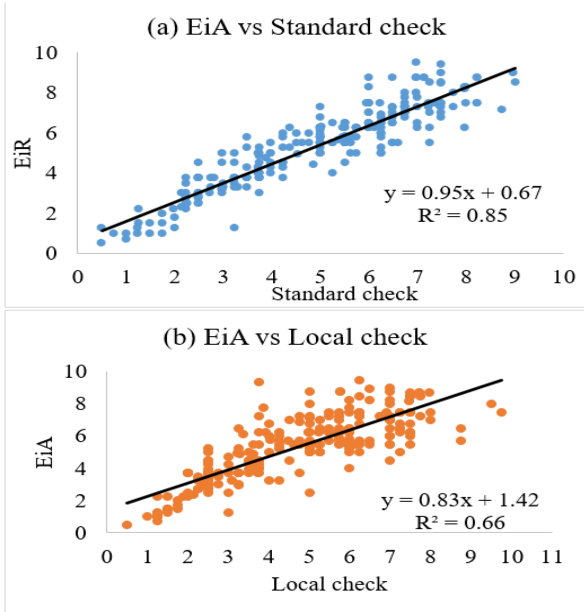


Fig 4. 18. Regression of wheat grain yield response to machine algorithm generated site-specific fertilizer rate (EiA) with standard (a) and local (b) checks

Effect of location-specific fertilizer rate on wheat growth and yields

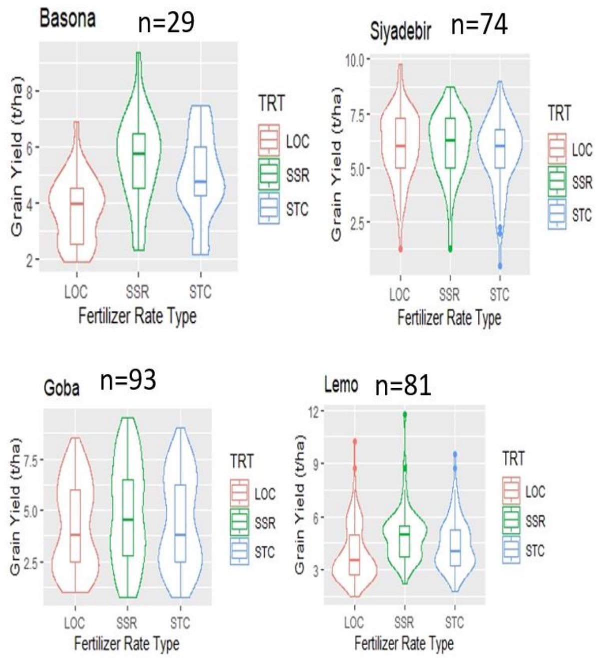
The effects of fertilizer rates on wheat parameters were analyzed using general linear model given by: wheat parameter = μ + fertilizer rate + replication + error. Analysis of variance showed effect of machine learning algorithm generated site specific fertilizer rates were highly significant as compared to standard and local fertilizer rates on wheat grain yield, biomass, thousand seed weight, plant vigor at tillering stage, and plant height (Table 4.3).

Table 4.3. Analysis of variance for wheat parameters from data of 2021 wheat validation trial in Ethiopia.

Variables	Mean squares	CV	F-value	P-value
Grain yield	23**	15	44.52	0.0001
Thousand seed weight	70**	6	6.61	0.0015
Biomass yield	53**	16	20.43	0.0001
Plant height	400**	6	15	0.0001
Plant vigor at tillering stage	1.49**	14	6.89	0.0011

***, highly significant; CV, coefficient of variation

Analysis of variance across sites in each district showed wheat grain yield were significantly affected by fertilizer rates except at Siyadebir district (Fig. 4.19). Grain yield were improved by 47, 27, and 17% at Basona Werena, Lemo, and Goba, respectively. Grain yield was improved by 5.4% at Siyadebir sites-specific fertilizer rate (SSR) compared to standard check (STC). On average, grain yield was improved by 24% across the four testing districts in Ethiopia. The highest grain yield increase at Basona Werena district could be due to the degraded land in the district which require high management and application of appropriate amount of fertilizer for better harvest. The low yield increase at Siyadebir was due to high-rate application of fertilizer through local and standard recommendations even at rate that can harm soil health.



District	GY (t/ha)	GY increase (t/ha)
Basona		SSR vs LOC or STC
LOC	3.78c	1.78
SSR	5.55a	
STC	4.89b	
Goba		
LOC	4.17b	0.70
SSR	4.87a	
STC	4.41b	
Lemo		
LOC	3.91c	1.04
SSR	4.95a	
STC	4.43b	
Siyadebir		
LOC	6.04a	
SSR	6.01a	
STC	5.70a	0.31
Grand Total	**4.88**	

Fig. 4.19. The effect of site-specific fertilizer (SSR), standard (STC), and local (LOC) checks on wheat grain yields at Basona, Goba, Lemo, Siyadebir districts in 2021 crop season in Ethiopia.

Combined analysis across the three regions indicated wheat biomass yields were significantly affected by the three fertilizer rates across sites in Ethiopia (Fig.4.20). Wheat above ground biomass was higher with site-specific fertilizer rate compared to standard and local fertilizer rates. Biomass was improved by 12% (0.87 t/ha), SSR compared with local check (Fig.4.20). This indicated site specific fertilizer rate boosted not only grain yield but also biomass yield, which is the most valuable product for feeding livestock in Ethiopia. In addition thousand seed weight, plant height and stand vigor were higher with site-specific fertilizer rate compared with others (Table 4.4). This confirm site-specific fertilizer rate improved plant performance in the field during the crop growing season.

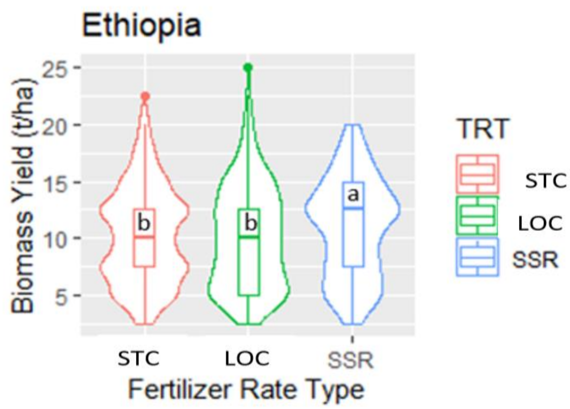


Fig. 4.20. Wheat biomass as affected by the main effect of site-specific fertilizer rate (SSR), standard check (STC), and local check (LOC) treatments across Ethiopia. Means with the same letter are not significantly different (P < 0.05).

Table 4.4. The main effect of fertilizer rates on wheat thousand grain weight, plant height, and plant vigor at tillering stage.

Fertilizer treatment	Thousand seed weight (g)	Plant height(cm)	Plant vigor at tillering
Sites-specific rate	52.42a	82.4a	3.46a
Standard check	51.75ab	83.7b	3.45a
Local check	51.34b	79.9c	3.32b
LSD	0.70	1.10	0.10

*means followed by the same letter are not significantly affected at 0.05 level of significance.

Cumulative distribution function graph showed, the probability of getting yield and plant height difference were higher when SSR was compared with both control and local check fertilizer rates (Fig.4.21). The chance of getting wheat grain yield difference of 2 t/ha and plant height difference of 4 cm was 90%.

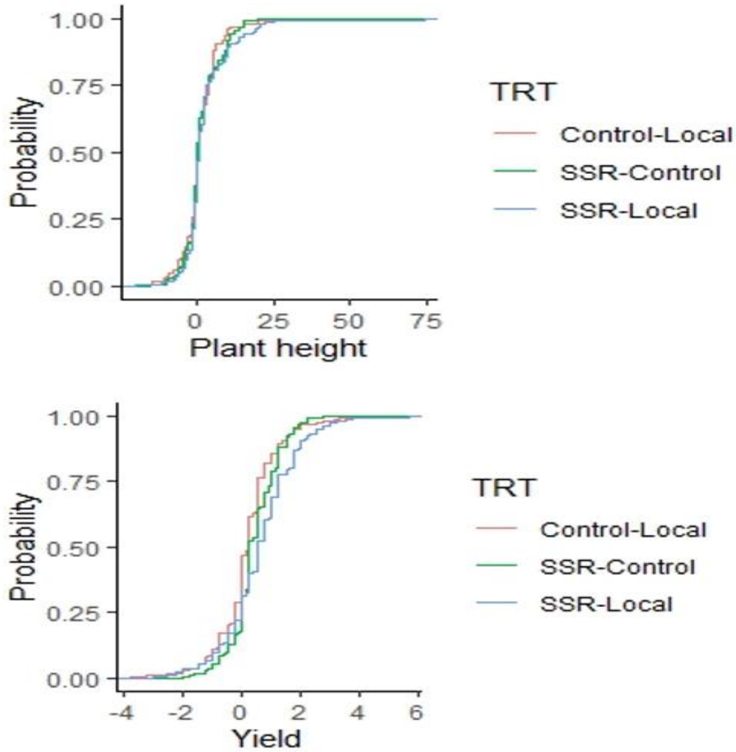


Fig.4.21. Cumulative distribution function of wheat plant height (cm) and grain yield (t/ha) differences for control (standard) check deducted from SSR (SSR-control), local check deducted from SSR (SSR-local) and local check deducted from control fertilizer rate based on 241 grain yield and plant height responses to the applied fertilizers

Profitability, nutrient and water use, and relative agronomic efficiency

- Sites-specific fertilizer rate (SSR) was more profitable than both standard (STC) and local (LOC) fertilizer rates (Fig.4.21)
  - Maximum profit of 1,166 US$ (55, 968 ETB) per ha was due to high wheat productivity associated with site-specific fertilizer rate at Basona district.
- Compared to recommended standard fertilizer rate (STC), application of sites-specific fertilizer rate (SSR) improved nutrient use efficiency of wheat by 40% in Ethiopia (Fig.4.21).
- The highest relative agronomic efficiency (economic return from wheat) of 12 kg/kg at both Basona and Lemo was due to site-specific fertilizer rate application and agroclimate advisory (Fig.4.21).
- Compared to recommended local fertilizer rate, applying site-specific fertilizer rates and agroclimate advisory improved rain water use efficiency of wheat by 15% across districts in Ethiopia (Fig.4.21).

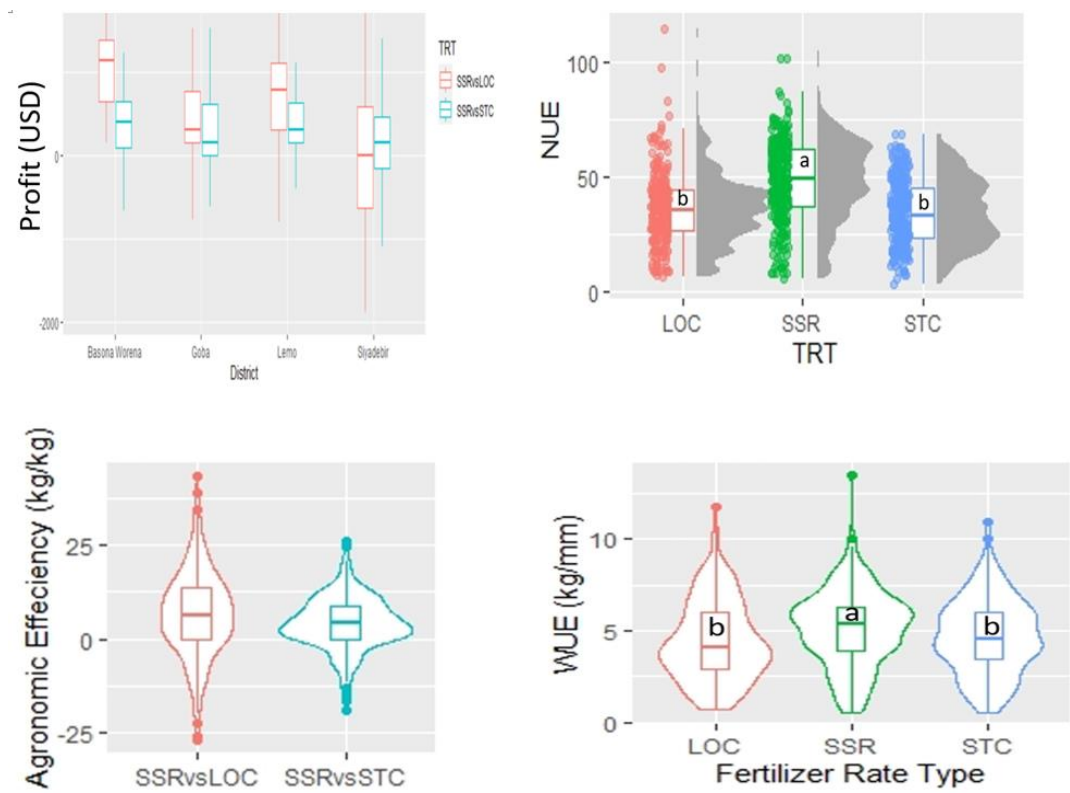


Fig. 4. 22. The effect of site-specific (SSR), standard (STC) and local (LOC) fertilizer rate recommendations on wheat profitability, nutrient use efficiency (NUE), relative agronomic efficiency and water use efficiency across 277 testing sites in Ethiopia.

PART V: Challenges and remedial measures

Challenges and learning through the implementation process of the trials

Site, farmers, and plot selection timing: initially the plan was to plant the trials at 100 farmers field per district. However, farmers and site selection were started late after many farmers allocate their plot for other varieties and crops. The plot selection and input arrangement did not consider the planting time difference across region. Example, In Basona plots should be identified in May as the planting time is early than the other districts. In Goba planting time started late, and were able to plant with the planned number of farmers. Delay in site and farmer selection causes to miss some important plot selection criteria and forced to plant trials on the available plots. Some of the plots around the homestead were fertile and manured which could not represent most farmer's fields and some other trials planted at water logging areas. In Siadebr district fertilizer was delivered late and there was some mixed-up between treatments. In Siadebr district, planting was very challenging because of the black soil nature. In general, due to late planning, plot selection and input delivery, only 32, 75, and 80 trials were planted at basona, Siadebr and lemo districts respectively.

Number of trials: as woreda focal persons reported the number of trials were not manageable. Due to plot selection criteria to address different villages, trials were far apart and difficult to plant, visit and follow up. Both the data and events to be recorded was too much and time consuming.

Delay in input delivery and use: the herbicides were delivered after the broadleaf weeds were growing and it was less effective to control the weeds. This had its own effect on trial performance. In Siadebr because of the fertilizer delay we missed some representative plots. In Lemo district UREA was applied once at planting and this may have its own effect on the crop performance.

Dropping/falling of trials: In Goba district 100 trials were planted, however due to heavy rainfall and erosion 5 trials were failed Wocho mishrge kebele. Every five years there is a heavy rainfall and erosion problem, this year in Goba district the heavy erosion damages the crop field and marketplace and kills animals and peoples. One trial at woltee Tosha was failed due to moisture shortage and excluded from data collection. At planting the moisture was not enough for germination, and after planting for 20 days there was not rain. This causes germination problems and less plant population. In Basona worena, 4 trials failed due to water logging and were dropped from data collection. In Siadebr 1 trail was harvested and mixed by mistake (by "Debo") and unable to record the yield data.

Varieties selection: Because of the late planning, preferred wheat varieties were not available, and we used the available wheat varieties for the trials plot. Example, in Lemo we used the Ogolcho variety, which is susceptible to yellow rust, and wane and danfe were the preferred wheat varieties. Similarly in Goba we used Kingbird while the area is more suitable for danfe. As a result, some of the trials plot performed less than the surrounding farmer's plot. With the preferred varieties the trials performance and grain yield result would be much better comparing the farmers field surrounding the plot.

Disease and pest: yellow rust was the challenge in all the district and place was applied three times, however in Goba district the three-time place spray could not control the sever wheat rust and rexido was sprayed additionally. Aphid was also a challenge in the three kebeles of the district and dimethoate was sprayed to control it. In the three kebele there was herbicide resistant weed ("Muja") and hand weeding was done to control. Rainfall shortage at tillering stage and cutworms at maturity stage were problems in three kebeles of the goba district.

The fertilizer rate difference between farmers practice and local treatment: The Basona focal person reported that the local treatment fertilizer does not represent the farmers' practice. The research recommendation in the areas and the standard treatment rate also differ.

Training time and ODK data collection: The training time was not enough for DAs and experts to have concept and knowledge about ODK and data collection. Planting was done by group (both DAs and experts) and data was recorded on hard copy and later using mobile up. Some DAs' mobile phones could not support the ODK app. They also have a skill gap and need much support to collect data using ODK. Data at planting and emergency recorded using hard copy and start using the ODK after the revision training. At Goba and Siadebr district most DAs could not use the ODK even after the revision training. At Goba district all-events data were recorded by Kubsa kebele DA (Tesfaye Yigezu), similarly at Siadebr, almost all the data were recorded by the woreda focal person (Shimelis Nigusie). Some DAs were busy with their own regular activities and unable to visit and collect data timely.

Payment related challenges: due to some financial procedure, DAs and experts' incentives payments were not done timely. As the data collection tasks were very time demanding some DAs are not happy with the amount of incentives they received. Still, they are asking for some additional payments (specifically the Lemon site). Payment for daily laborers during planting and harvesting was 400 to 600 birrs, but the DG/CIAT's rate was 300. Trashing and 1000 seed count was very tedious tasks and incentives for these tasks were not enough for DAs.

Few farmers engagement during evaluation: due to financial limitation, only few farmers were engaged in field day and evaluation of the trials. There was less farmers' engagement in the trial's evaluation, they did not evaluate the trials by different parameters at different stages. Experts and some model farmers during the field day noted this as a weakness.

Gender: since the trials were based on the system generated fertilizer rate and the interest of farmers, it was difficult to engage more women to implement the trials. To capture some gender issues, a socio-economic survey is needed.

COVI-19: Because of the 2nd stage Covid outbreak and travel restriction CIAT staff could not travel frequently and support the data collection work.

Social unrest: the instability and security problems are another challenge to travel to each site and provide necessary support to local partners. Around September and October, the peak of social unrest lowered people's morale and discouraged to the field work.

Lesson learnt

Proper planning: timely planning site, farmers, and plot selection and input arrangement is key for successful implementation of the trials by placing trials on the right plots based on the specified criteria. With proper planning and clear communication, the extension partners play a major role to implement participatory research trials. Engaging the agricultural office from the beginning helps the extension peoples to own the trials, experts, and DAs to make it a part of their day today activities. Involving partners during planning is important to identifying the preferred crop varieties and the local practice. Example in basona district, experts reported that our local treatment does not represent the local practice fertilizer rate.

Training: Proper training arrangement helps Experts and DAs to have interest for the research trials and knowledge to plant trials and collect all necessary data. From DAs and Experts feedback, enough time allocation for training and exercising of the data collection tool is very important. Shallow and highlight training is a waste of time.

District focal person: assigning district level focal persons helps to support, follow up and frequently communicate DAs and farmers. The presence of the district focal person also helps to facilitate the communication between DAs and CIAT/DG staff. Experts also help to collect the data when DAs are unable to use ODK and fail to collect the data.

Communication and technical support from CIAT/DG side: close follow up and frequent communication with experts and DAs helps to identify gaps and provide practical and remote support. Friendly approaching and coaching of DAs and experts contribute a lot to improve the trials management and data collection works. Field visit and exercising the data collection with DAs also enhanced the data collection process. The telegram group communication was an important means to encourage and note experts and DAs. Some encouraging feedback from CIAT/DG could motivate experts and DAs. There was also competition between sites to improve trials management and post better field pictures.

Incentives and payments: providing incentives for the local partners to keep their good commitment, however incentive also could be a means of complaint and discouragement if their expectation is not managed. Open discussion with partners on the planned incentives and expected deliverables are key means to avoid disagreement and keep them motivated. Mobile card incentives help experts to charge their mobile and communicate with the CIAT staff frequently to get advice and support. The wage rate should consider each locality rate, otherwise it will be difficult to get a daily laborer.

The use of herbicides: at each farmer's field herbicides were sprayed at a similar rate and time. This helps treatments to receive similar management and avoid biases in terms of rate and time.

Treatment type: including the farmers practice and local research recommendation in the trials helps to compare treatment (EiA) with the existing practice in each site.

Field day and farmers evaluation: organizing field visits for extension and farmers could develop interest and create ground for scaling and uptake of the research result and recommendations. The field day aimed DAs, experts, and office representatives to visit the trials and share experience and evaluate the performance treatment. It also helps DAs and experts to get better support from their office side. In all trials sites, farmers' performance evaluation and treatment rank are consistent with the sample yield data. Hence, combining the participatory evaluation with the sample yield data could triangulate and increase the reliability of the trials result.

PART VI: **Summary and Conclusion**

"Fertilizer related research" has an old history in Ethiopia. However, blanket recommendation is being applied thus far. This is mainly the research undertakings were not systematic, learnings among and between researchers were limited and most importantly, there was very limited data sharing experience. It was thus not possible to build on data, tools and lessons to improve recommendations and advisories. The CoW team has gone far to rectify this problem through creating awareness and developing guidelines to facilitate data access and sharing. Through this process, the Alliance of Bioversity and CIAT and its partners have managed to galvanize large number of soil science and agronomy experts to collate large dataset mainly for maize and wheat and significant amount for the major crops. This was, however, not without its ups and downs. There were many challenges and obstacles along the way. However, the team persisted and managed to reach where we are now.

Ethiopia is a large country with diverse and heterogeneous landscapes. Because of this the number and spatial distribution of agronomic research are enormous. This means there are still large amounts of datasets that are not collated yet. There are different reasons for this but the most important ones are limited institutional memory (when someone with data leaves nothing remains and those replacing the person do not have the full data with its metadata), some partners are just not willing to share because of lack of confidence and/or trust, some data are lostdue to different reasons and/or are not usable due to lack of key information. The effort to collate those data and others should thus continue as with big data there is a lot that can be done with the recent advances in data analytics. The CoW team and its partners will thus continue to collate data (of different types) to ensure detailed 'plot-specific advisory'. Additional data available until the first quarter of 2022 can be integrated into the 'update recommendation' if necessary.

Despite some of the remaining datasets to be made available for the CoW database, it is important to note that the current available data (e.g., for wheat) is good enough to develop applicable recommendations for large part of the country. The validation exercise (measures yield) as well as 'farmers' rankings' also very much reflected the accuracy of the advisory that can be generated with the available data. In addition, there is a potential to use the recently available datasets from ICRISAT and other partners.

Thanks to GIZ-Ethiopia which supported the CoW for the last five years, the team has advanced in many perspectives (Fig. 6.1) including building national soils/agronomy database, development of data sharing guidelines (CoW), development of data standardization guidelines, and advancing in the development of location-specific fertilizer recommendation. Geospatial analysis experts collaborate with soil scientists and agronomists to tackle practical problems related to agricultural transformation. These developments are attracting attention, which also led to the selection of Ethiopia to host two Use Cases for the Excellence in Agronomy program. In addition, the Alliance in Ethiopia is leading the 'data and fertilizer advisory' components of the World Bank funded AICCRA project. The fact that we are working with Digital Green, which has agile advisory dissemination systems has made our partnership very interesting where 'demand and supply' match appropriately. This successful endeavor has led to the attraction of various projects to the country including EiA, Accelerating Impact of CGIAR Climate Research in Africa (AICCRA) that enabled the advancement of the CoW activities. However, there was no pre-allocated funding to validate the 'MVP' developed in this project. This has caused wide implementation with Digital Green, who needed to get validated advisory. Because of limited funding from EiA for operations, the Alliance needed to scramble to get resources from different sources that enabled testing the advisory during the 2021 main season. Despite limited pre-planned funding, the validation exercise went very well with good number of trains (close to 300) implemented across three regions of four districts. It is important to mention here that Digital Green also provided financial support during the co-implementation exercise. Their support is highly appreciated considering the fact that the budget was not pre-planned. With these developments, the team is very inspired and is committed to continue working on developing interventions that can support the agricultural transformation agenda of the country. This shows that the coming years can even be brighter as the team will more engage in producing tangible products.

The first and second quarters of 2021 were difficult due to COVID-19 – it spread and attacked many people. Many staff members of the Alliance and Digital Green were affected, which influenced the finalization of the advisory tool. Because of this and other reasons, it was not possible to develop APIs from which advisories were planned to be extracted. However the team managed to finalize the advisories on time and extracted excel-based advisories for the validation work.

CoW is a collaborative effort aimed to support agricultural transformation in Ethiopia through digital solutions. Most interventions are planned based on discussion of the taskforce and CoW members. Both activity plans, progresses and results used to be discussed at CoW workshops, generally happening about twice a year. However, due to COVID-19, the depth and width of engagement in various activities such as workshops, writeshops, meetings and field travels were restricted. These undermined our ability to bring partners together to share experiences and plan activities. However, most of the deliverables and achievements were presented and discussed online with key CoW members as part of a collaborative engagement.

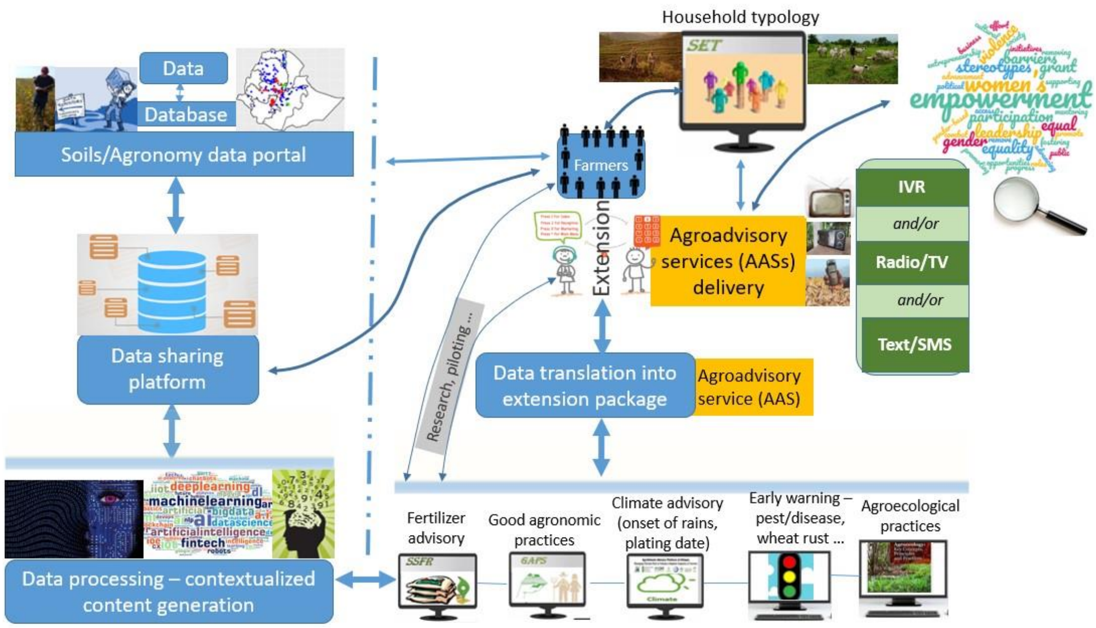


Fig. 6.1. Pictorial summary of procedures employed to develop and pilot location-specific fertilizer recommendation in Ethiopia using datasets collected from different sources and harmonized for integrated analysis. Note that this figure represents additional features (advisories) that are planned to be incorporated in the 2022/23 season.

In order to ensure representation, the trials identified for validation of the MVP were many – compared to the resources and time available. This created pressure on the team (both Alliance and Digital Green). But through our sound partnership with the local partners (via Alliance and Digital Green) we managed to get the necessary support from the national partners that hugely facilitated implementation on the ground. It is also important to note that the Digital Green team on the ground provided great support – including through their field staff.

The conflict in the northern part of the country was a serious bottleneck for various operations in 2021. This has implications on some activities in some sites, especially the two Woredas in the Amhara region. However, our local partners in the two sites have played instrumental role to make sure that activities were executed as planned. At this juncture, we appreciate their resilience and support!

Considering that the CoW is getting good support from GIZ, EiA, AICCRA and its national partners and the fact that Digital Green has well advanced and applicable 'information dissemination and feedback collection' tools, we are confident that the team will play a significant contribution to the agricultural transformation effort of Ethiopia and beyond!

Acknowledgments

First and foremost, the whole team and partners sincerely appreciated the tremendous support of GIZ-Ethiopia and the Alliance of Bioversity and CIAT whose sound and effective collaboration have advanced the development of digital solutions in Ethiopia through promoting data sharing and collaborative analysis. This collaboration also led to the birth of the coalition of the willing (CoW) who are instrumental in advancing the development of the tool tested in this project. The over 100 CoW members and the CoW taskforce team have been behind in advancing data sharing, standardization, and improved analytics. The Technical Team of the CoW who developed the data standardization guidelines deserve huge acknowledgment. The geospatial and data science experts who volunteered to support topics and agendas in agriculture and beyond and who always stood up for challenges are very much appreciated. The team who developed the web-portal also deserve a lot of credit. The experts who worked on collating, encoding, harmonizing, and processing the soil survey legacy data are the foundation for the soil resource map and their backbreaking and unforgettable work is sincerely appreciated. The senior pedologists and soil survey/classification experts who provided invaluable support to check and harmonize thousands of soil profile and laboratory results are sincerely appreciated. In addition, the same group of experts and additional ones who supported validation of the preliminary soil resource map deserve lots of credit for their knowledge of the various parts of the country and their commitment to contribute their experiences. The supports received from the Ethiopian Institute of Agricultural Research and the Ministry of Agriculture were instrumental to sustain the CoW efforts and succeed in the implementation of the planned activities. It will be wise to mention the very helpful support of the Crop and Extension Directorate of the Ministry of Agriculture. Digital Green who are engaged in the dissemination of agroadvisories were very important partners not only to help support dissemination technologies and feedback but also provided various supports during the field validation exercise. We would also like to sincerely thank Excellence in Agronomy (EiA) which has brought huge contribution towards this project in terms of funding and skillets of the various teams. The way EiA is organized to provide support across different components is interesting and we are thankful for the unreserved support provided to us. The Water, Land and Ecosystems (WLE) and Climate Change, Agriculture and Food Security (CCAFS) programs of the CGIAR also provided support in various forms at the earlier stage of the work. CABI and ODI brought their experiences in policies, data sharing and other skills that boosted the performances of some of the CoW activities. We also thank their team who supported organizing the very successful first CoW webinar! Recently, the project is benefiting from the Accelerating Impacts CGIAR Climate Research in Africa (AICCRA) project supported by the World Bank in terms of data, analytics, and resources to support data linkage and integration.

Example complementary references

The CoW data access and sharing guideline: data access and sharing guideline.

Tamene L; Erkossa T; Tafesse T; Abera W; Schultz S. 2021. Coalition of the Willing - Powering data-driven solutions for Ethiopian Agriculture. CIAT Publication No. 518. International Center for Tropical Agriculture (CIAT). Addis Ababa, Ethiopia. 34 p. https://cgspace.cgiar.org/bitstream/handle/10568/118145/Coalition_Desta_2021.pdf?sequence=1&isAllowed=y

Lulseged Tamene, Wuletawu Abera, Teklu Erkossa (2020). Digital solutions to transform agriculture: lessons and experiences in Ethiopia. https://cgspace.cgiar.org/bitstream/handle/10568/111778/Digital%20solutions_Tamene_2021.pdf?sequence=3&isAllowed=y

Coalition of the Willing. 2020. Coalition of the Willing for soil and agronomy data access, management and sharing: Data sharing guidelines. Addis Ababa, Ethiopia: Ethiopian Institute of Agricultural Research. 32 p. https://cgspace.cgiar.org/handle/10568/107988

Ali, A.; Lulseged, T.; Teklu, E. 2020. Identifying, cataloging, and mapping soil and agronomic data in Ethiopia. Addis Ababa, Ethiopia: International Center for Tropical Agriculture. 42 p. https://cgspace.cgiar.org/handle/10568/110868

Lessons and expeirences of the CoW to facilitate data gathering, sharing and improved analytics (example see the lessons and steps).

A dynamic geospatial web clustering and visualization tool to develop ,similar response units (SRUs) to guide targeted agroadvisory is available for public use (https://github.com/EiA2030/validation)

"Soil & Agronomy Data Sharing Perspectives: Lessons Learned from Ethiopia & Rwanda" (**https://www.youtube.com/watch?v=Tq3jei2of6U**).

Wuletawu Abera, Lulseged ***Tamene***, Kindie Tesfaye, Daniel Jiménez, Hugo Dorado, Teklu Erkossa, Job Kihara, Jemal Seid, Tilahun Amede, Julian Ramirez-Villegas (2022). A data mining approach for developing site-specific fertilizer response functions across the wheat growing environments in Ethiopia. Experimental Agriculture, 1-16. doi:10.1017/S0014479722000047

Erkossa, T., Laekemariam, F., Abera, W., & ***Tamene, L***. (2022). Evolution of soil fertility research and development in Ethiopia: From reconnaissance to data-mining approaches. Experimental Agriculture, 1-12. doi:10.1017/S0014479721000235

Keynote address by Christian Witt of the Gates Foundation at one of the CoW progress report webinars: https://www.youtube.com/watch?v=oT-V2JMsSp8

The collation of voluminous soil profile data

Ethiopia soil resource map (version 1)presented for discussion (https://egusphere.copernicus.org/preprints/2022/egusphere-2022-301/).

Appendices

Annex Table 4.1

Training and planning workshop conducted at Basona Werena, Goba, Lemo and Siyadebir districts in 2021.

Title	Responsible person	
Registration	Participants	9:00 – 9: 10
Welcome and opening remarks	Dr. Wuletawu Abera	9:10 – 9: 15 am
Agroclimate advisory and survey	Dr. Wuletawu Abera	9:15 – 10:30 am
Tea break	Participants	10:30 – 11:00 am
Fertilizer validation trial establishment and data collection	Dr. Feyera Merga	11:00 – 12:30 am
Lunch	Participants	12:30 – 1:30 pm
ODK tool installation and ONA setting up exercise	Dr. Wuletwu A. and Dr.Feyera M	1:30 – 2:30 pm
EA and HH ID card confirmation	Dr. Feyera and all participants	2:30 – 3:00 pm
General discussion	Dr. Wuletwu A. and Dr.Feyera M	3:00 – 3:30 pm

Annex Table 4.2. EiA Digital Green - Field book - 2021

Annex Table 4.2.1. DA and Farmer identification

Farmer	DGHHNG _ _ _ _ _ _	Name:
Extension Agent	DGEANG _ _ _ _ _ _	Name:
Woreda:		
Kebele:		
Village:		
Wheat field area	Enter the area measured for FIP Survey [m²]:	

Annex Table 4. 2.2. Fertilizer rates to be used in the Wheat plots:

Fertilizer application timing and amount	**Fertilizer rates (g per plot)** for the **standard check plot** – Research Recommedation		**Fertilizer rates (g per plot)** for the **EiA plot** – Site-specific recommendation		**Fertilizer rates (g per plot)** for the **local check plot** – Extension recommendation	
	NPS	Urea	NPS	Urea		
First application At planting	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _		
Second application At tillering (5 WAP	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _ _ _		

Annex Table 4.2. Continued

Annex Table 4.2. 3. List of data collection events
Please tick each activity that you have completed for this farm

Event number	Data collection event	Completed?	Date scheduled*
1	Register DA	☐	2 WBP
2	Register household	☐	2 WBP
3	Soil sample collection	☐	2 WBP
4	Crop and management information	☐	0 WAP
5	Field information	☐	0 WAP
6	Monitoring at planting and fertilizer application	☐	0 WAP
	Stand count at emergence	☐	1 WAP
7	Fertilizer urea second application at tillering (5 WAP)	☐	5 WAP
8	Monitoring at tillering stage	☐	5 WAP
9	Monitoring at heading stage	☐	10 WAP
10	Monitoring at physiological maturity	☐	17 WAP
11	Stand count at physiological maturity	☐	17 WAP
12	Number of productive tillers	☐	17 WAP
13	Number of non-productive tillers	☐	17 WAP
15	Plant height	☐	17 WAP
15	Number of spikelets per spike	☐	17 WAP
16	Aboveground biomass	☐	18 WAP
17	Grain yield	☐	18 WAP
18	Thousand seed weight	☐	18 WAP
19	Harvest index	☐	18 WAP

*WBP, week before planting; WAP, week after planting

Annex Table 4. 2 Continued

Annex Table 4. 2.4. Land and crop management activities

Activities (Event)	Date (dd/mm/yyyy)	Method
1st Tillage	_ _ / _ _ / _ _ _ _	☐ Animal-drawn ☐ Small mechanical tiller ☐ Tractor
2nd Tillage	_ _ / _ _ / _ _ _ _	☐ Animal-drawn ☐ Small mechanical tiller ☐ Tractor
3rd Tillage	_ _ / _ _ / _ _ _ _	☐ Animal-drawn ☐ Small mechanical tiller ☐ Tractor
Land preparation	_ _ / _ _ / _ _ _ _	☐ Flat ☐ Raised seed bed ☐Furrow
Organic fertilizer inputs	_ _ / _ _ / _ _ _ _	☐ crop residue ☐ animal manure ☐ others
1st Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide
2nd Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide
3rd Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide
4th Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide
5th Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide

6th Weeding	_ _ / _ _ / _ _ _ _	☐ manual ☐ Mechanical weeder ☐ Herbicide
Harvest	_ _ / _ _ / _ _ _ _	

Annex Table 4. 2 Continued

Annex Table 4. 2.5. Plant stand counts at emergence time at 1 WAP

Date (dd/mm/yyyy) _ _ / _ _ / _ _ _ _

Number of plants in a m^2 for standard check plot	
Number of plants in a m^2 for EiA plot	
Number of plants in a m^2 local check plot	

Annex Table 4. 2.6. Rate the wheat trial at heading stage (10 WAP):

Date (dd/mm/yyyy) _ _ / _ _ / _ _ _ _

Rating done by: ☐ Extension agent

	Absent	**Mild**	**Moderate**	**Severe**	**Crop lost**	**Don't know**
Drought	☐	☐	☐	☐	☐	☐
Water logging	☐	☐	☐	☐	☐	☐
Crop lodging / storm damage	☐	☐	☐	☐	☐	☐
Animal grazing	☐	☐	☐	☐	☐	☐
Pests	☐	☐	☐	☐	☐	☐
Weeds	☐	☐	☐	☐	☐	☐
Wheat rust damage symptoms	☐	☐	☐	☐	☐	☐
Other diseases	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐

Annex Table 2.7. Plant stand counts at harvest: 18 WAP

Date (dd/mm/yyyy) _ _ / _ _ / _ _ _ _

Number of plants in a m^2 for Standard check plot	
Number of plants in a m^2 for EiA plot	
Number of plants in a m^2 local check plot	

Annex Table 4. 2 Continued

Annex Table 4. 2.7. Rate the trial at harvest:

Date (dd/mm/yyyy) _ _ / _ _ / _ _ _ _

Rating done by:☒ Extension agent

	Absent	Mild	Moderate	Severe	Crop lost	Don't know
Drought	☒	☒	☒	☒	☒	☒
Water logging	☒	☒	☒	☒	☒	☒
Crop lodging / storm damage	☒	☒	☒	☒	☒	☒
Animal grazing	☒	☒	☒	☒	☒	☒
Pests	☒	☒	☒	☒	☒	☒
Weeds	☒	☒	☒	☒	☒	☒
Wheat rust damage symptoms	☒	☒	☒	☒	☒	☒
Other diseases	☒	☒	☒	☒	☒	☒

Annex Table 4. 2.8. Wheat grain yield and grain moisture at harvest:

Date (dd/mm/yyyy) _ _ / _ _ / _ _ _ _

	Grain yield (kg/ha)	Grain moisture* content	Adjusted grain yield (kg/ha)	
Standard checkvplot				
EiA plot				
Local check plot				

***Grain moisture content will be measured using moisture meter to adjust grain yield at 12.5% moisture.**

Annex Table 4. 2 Continued

Annex Table 4. 2.9. Please note any observations or issues encountered in the validation plots:

Date	Name observer	Description
_ _ / _ _ / _ _ _ _		
_ _ / _ _ / _ _ _ _		
_ _ / _ _ / _ _ _ _		
_ _ / _ _ / _ _ _ _		

Annex Table 4. 2 Continued

Please note any other comments:

Annex Table 4. 3

Annex Table 4. 3.1. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at planting tailored for the 10 m x 10 m validation trial at Basona Woerna district.

District: Bosana Woerna Kebele: Goshebado	Number of farmer	EiA rate		Standard check		Local Check		Seed (kg)
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row Plant
Betkerstiyan Amba	3	2.601	0.693	1.00	0.833	1.000	0.500	1.25
Goch amba	3	2.601	0.751	1.00	0.833	1.000	0.500	1.25
Goshebado-1 or 2	6	2.117	0.578	1.00	0.833	1.000	0.500	1.25
Key Afer	2	2.722	1.053	1.00	0.833	1.000	0.500	1.25
Kirtie	3	2.601	0.903	1.00	0.833	1.000	0.500	1.25
konbele /hudad	3	2.420	0.689	1.00	0.833	1.000	0.500	1.25
Moign Meda	4	2.722	1.053	1.00	0.833	1.000	0.500	1.25
Kebele: Gudoberet								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plan
Gebi	2	2.117	0.542	1.00	0.833	1.000	0.500	1.25
Mush layamba	8	2.117	0.578	1.00	0.833	1.000	0.500	1.25
Kebele: Bakelo								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Ametseigna ager	9	2.117	0.969	1.00	0.833	1.000	0.500	1.25
Gimbechu No 2	5	2.117	0.919	1.00	0.833	1.000	0.500	1.25
Liyu (laymba or Chercher)	1	2.117	0.585	1.00	0.833	1.000	0.500	1.25
Sengaberet	1	2.117	0.506	1.00	0.833	1.000	0.500	1.25

Annex Table 4. 3 Continued

Annex Table 4.3.2. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at tillering tailored for the 10 m x 10 m validation trial at Basona Woerna district.

District: Bosana Woerna Kebele: Goshebado	Number of farmer	EiA rate	Standard check	Local Check
DG		Urea(kg)	Urea(kg)	Urea(kg)
Betkerstiyan Amba	1	1.385	1.667	1.000
Goch amba	3	1.501	1.667	1.000
Goshebado-1 or 2	3	1.156	1.667	1.000
Kirtie	3	1.805	1.667	1.000
konbele /hudad	3	1.377	1.667	1.000
Moign Meda	3	2.105	1.667	1.000
Kebele: Gudoberet				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Gebi (Gudoberet-1)	2	1.084	1.667	1.000
Mush layamba	4	1.156	1.667	1.000
Kebele: Bakelo				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Ametseigna ager	5	1.939	1.667	1.000
Gimbechu No 2	3	1.837	1.667	1.000
Sengaberet	1	1.011	1.667	1.000

Annex Table 4. 3 Continued

Annex Table 4.3.3. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at planting tailored for the 10 m x 10 m validation trial at Siyadebir district.

Kebele: Abaya	Number of farmer	EiA rate		Standard check		Local check		Seed (kg)
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Chancho-1	5	2.117	0.506	1.00	0.833	2.250	0.917	1.25
Kamp	10	2.117	0.520	1.00	0.833	2.250	0.917	1.25

Kebele: Dawo								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant

Geber-1	14	2.117	0.506	1.00	0.833	2.250	0.917	1.25

Kebele: Siyadebir								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Edoro-2	5	2.420	0.464	1.00	0.833	2.250	0.917	1.25
Mehele Gebeya-1	1	2.299	0.481	1.00	0.833	2.250	0.917	1.25
Sefer selam No 1	12	2.238	0.489	1.00	0.833	2.250	0.917	1.25
Sefer selam No 2	3	2.238	0.489	1.00	0.833	2.250	0.917	1.25

Kebele: Romie								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Admie	2	2.12	0.53	1.00	0.833	2.25	0.92	1.25
Chefie	5	2.12	0.55	1.00	0.833	2.25	0.92	1.25
Dekilie	3	2.12	0.51	1.00	0.833	2.25	0.92	1.25
Derie	5	2.12	0.54	1.00	0.833	2.25	0.92	1.25
Gendelega-2	2	2.12	0.53	1.00	0.833	2.25	0.92	1.25
Wabie	2	2.12	0.55	1.00	0.833	2.25	0.92	1.25
Weyiraba	1	2.12	0.53	1.00	0.833	2.25	0.92	1.25

Kebele: Wole								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Chancho-1	2	2.117	0.506	1.00	0.833	2.250	0.917	1.25
Chancho-2	1	2.117	0.506	1.00	0.833	2.250	0.917	1.25
Eselamameba	8	2.117	0.506	1.00	0.833	2.250	0.917	1.25
Wole koro	7	2.117	0.520	1.00	0.833	2.250	0.917	1.25
Wole kombo	2	2.117	0.513	1.00	0.833	2.250	0.917	1.25

Annex Table 4. 3 Continued

Annex Table 4. 3.4. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at tillering tailored for the 10 m x 10 m validation trial at Siyadebir district.

Kebele: Abaya	Number of farmer	EiA rate	Standard check	Local check
DG		Urea(kg)	Urea(kg)	Urea(kg)
Chancho-1	2	1.011	1.667	1.833
Kamp	8	1.040	1.667	1.833

Kebele: Dawo				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Geber-1	10	1.011	1.667	1.833
Kebele: Siyadebir				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Edoro-2	5	0.928	1.667	1.833
Mehele Gebeya-1	1	0.961	1.667	1.833
Sefer selam No 1	11	0.978	1.667	1.833
Sefer selam No 2	3	0.978	1.667	1.833
Kebele: Romie				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Admie	2	1.069	1.667	1.833
Chefie	5	1.098	1.667	1.833
Dekilie	3	1.011	1.667	1.833
Derie	5	1.084	1.667	1.833
Gendelega-2	2	1.069	1.667	1.833
Wabie	2	1.098	1.667	1.833
Weyiraba	1	1.055	1.667	1.833
Kebele: Wole				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Chancho-1	2	1.011	1.667	1.833
Chancho-2	1	1.011	1.667	1.833
Eselamameba	4	1.011	1.667	1.833
Wole koro	7	1.040	1.667	1.833
Wole kombo	1	1.026	1.667	1.833

Annex Table 4. 3 Continued

Annex Table 4. 3.5. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at planting tailored for the 10 m x 10 m validation trial at Lemo district.

Kebele: Ambicho	Number of farmer	EiA rate		Standard check		Local check		Seed (kg)
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Bulad	10	2.299	0.481	1.00	0.833	1.000	0.500	1.250
Ende	6	2.299	0.481	1.00	0.833	1.000	0.500	1.250
Gode Meguba	1	2.299	0.481	1.00	0.833	1.000	0.500	1.250
Gude Duna	1	2.299	0.481	1.00	0.833	1.000	0.500	1.250
Mehal Ambicho	2	2.299	0.481	1.00	0.833	1.000	0.500	1.250
Kebele: Bukuna								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Abermo	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Checheyincho	3	2.299	0.481	1.00	0.833	1.000	0.500	1.25

Denbaba	6	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Firish Boya	1	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Lay Bukuna	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Lolase	3	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Kebele: Hayese								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Eight	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Five	3	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Four	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Nine	1	2.299	0.481	1.00	0.833	1.000	0.500	1.25
One	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Seven	3	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Six	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Ten	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Three	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Two	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Kebele: Shurmo								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Anie	4	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Bushe	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Harbucho	5	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Hayiche	1	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Jeto Gedo	4	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Kutir 1 Abeyo	2	2.299	0.481	1.00	0.833	1.000	0.500	1.25
Mesmo	3	2.299	0.481	1.00	0.833	1.000	0.500	1.25

Annex Table 4. 3 Continued

Annex Table 4. 3.6. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at tillering tailored for the 10 m x 10 m validation trial at Lemo district.

Kebele: Ambicho	Number of farmer	EiA rate	Standard check	Local check
DG		Urea(kg)	Urea(kg)	Urea(kg)
Bulad	10	0.961	1.667	1.000
Ende	6	0.961	1.667	1.000
Gode Meguba	1	0.961	1.667	1.000
Gude Duna	1	0.961	1.667	1.000
Mehal Ambicho	2	0.961	1.667	1.000
Kebele: Bukuna				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Abermo	2	0.961	1.667	1.000
Checheyincho	3	0.961	1.667	1.000
Denbaba	6	0.961	1.667	1.000

Firish Boya	1	0.961	1.667	1.000
Lay Bukuna	2	0.961	1.667	1.000
Lolase	3	0.961	1.667	1.000
Kebele: Hayese				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Eight	2	0.961	1.667	1.000
Five	3	0.961	1.667	1.000
Four	2	0.961	1.667	1.000
Nine	1	0.961	1.667	1.000
One	2	0.961	1.667	1.000
Seven	3	0.961	1.667	1.000
Six	2	0.961	1.667	1.000
Ten	2	0.961	1.667	1.000
Three	2	0.961	1.667	1.000
Two	2	0.961	1.667	1.000
Kebele: Shurmo				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Anie	4	0.961	1.667	1.000
Bushe	2	0.961	1.667	1.000
Harbucho	5	0.961	1.667	1.000
Hayiche	1	0.961	1.667	1.000
Jeto Gedo	4	0.961	1.667	1.000
Kutir 1 Abeyo	2	0.961	1.667	1.000
Mesmo	3	0.961	1.667	1.000

Annex Table 4. 3 Continued

Annex Table 4. 3.7. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at planting tailored for the 10 m x 10 m validation trial at Goba district.

Kebele: A.Tilo	Number of farmer	EiA rate		Standard check		Local check		Seed (kg)
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
G/Bari	7	1.210	0.739	1.00	0.833	1.500	0.833	1.250
Miner	1	1.210	0.717	1.00	0.833	1.500	0.833	1.250
Nebelbal	8	1.210	0.74	1.00	0.833	1.500	0.833	1.250
Oda	2	1.210	0.688	1.00	0.833	1.500	0.833	1.250
Kebele: Magida								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant

Adele (Bakalcha)	1	2.420	0.674	1.000	0.833	1.500	0.833	1.250
Ashawe (Qanani)	6	2.359	0.639	1.000	0.833	1.500	0.833	1.250
Biftu (Waltahi)	6	2.420	0.609	1.000	0.833	1.500	0.833	1.250
Goro Bari (Qubsa)	5	2.420	0.609	1.000	0.833	1.500	0.833	1.250
Hanbaqa	2	2.420	0.623	1.000	0.833	1.500	0.833	1.250
Kebele: Quubsa								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Chancho	3	2.420	0.551	1.000	0.833	1.500	0.833	1.250
Donsa	1	2.178	0.562	1.000	0.833	1.500	0.833	1.250
Qaladi	1	2.359	0.487	1.000	0.833	1.500	0.833	1.250
Kinawe	1	2.420	0.544	1.000	0.833	1.500	0.833	1.250
Koyye	1	2.359	0.581	1.000	0.833	1.500	0.833	1.250
Burure	6	2.420	0.681	1.000	0.833	1.500	0.833	1.250
Busoytu	1	2.420	0.681	1.000	0.833	1.500	0.833	1.250
Habako	6	2.420	0.602	1.000	0.833	1.500	0.833	1.250
Kebele: Tosha								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Ablami	2	2.420	0.544	1.000	0.833	1.500	0.833	1.250
Guduba	3	2.420	0.602	1.000	0.833	1.500	0.833	1.250
Kalchabaha	2	2.420	0.478	1.000	0.833	1.500	0.833	1.250
Tosha	2	2.359	0.472	1.000	0.833	1.500	0.833	1.250
Kebele: Wacho								
DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Gadisa Oda	5	2.057	0.514	1.000	0.833	1.500	0.833	1.250
Lakku	5	2.117	0.535	1.000	0.833	1.500	0.833	1.250
Walargi	5	2.420	0.674	1.000	0.833	1.500	0.833	1.250
Kebele: Mishirge								

DG		NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	NPS(kg)	Urea(kg)	Row plant
Biftu	2	1.936	0.531	1.000	0.833	1.500	0.833	1.250
Ejersa	3	2.420	0.536	1.000	0.833	1.500	0.833	1.250
ILU	1	1.996	0.522	1.000	0.833	1.500	0.833	1.250
Qajela	1	2.238	0.489	1.000	0.833	1.500	0.833	1.250
Kallacha	1	2.420	0.536	1.000	0.833	1.500	0.833	1.250
Kanisa	3	2.057	0.514	1.000	0.833	1.500	0.833	1.250
Wajira	3	2.420	0.631	1.000	0.833	1.500	0.833	1.250

Annex Table 4. 3.8. The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea that will be applied at tillering tailored for the 10 m x 10 m validation trial at Goba district.

Kebele: A.Tilo	Number of farmer	EiA rate	Standard check	Local check
DG		Urea(kg)	Urea(kg)	Urea(kg)
G/Bari	7	1.478	1.667	1.667
Miner	1	1.435	1.667	1.667
Nebelbal	8	1.478	1.667	1.667
Oda	2	1.377	1.667	1.667
Kebele: Magida				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Adele (Bakalcha)	1	1.348	1.667	1.667
Ashawe (Qanani)	6	1.278	1.667	1.667
Biftu (Waltahi)	6	1.218	1.667	1.667
Goro Bari (Qubsa)	5	1.218	1.667	1.667
Hanbaqa	2	1.247	1.667	1.667
Kebele: Quubsa				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Chancho	3	1.102	1.667	1.667
Donsa	1	1.125	1.667	1.667
Qaladi	1	0.974	1.667	1.667
Kinawe	1	1.087	1.667	1.667
Koyye	1	1.162	1.667	1.667
Burure	6	1.363	1.667	1.667
Busoytu	1	1.363	1.667	1.667
Habako	6	1.203	1.667	1.667
Kebele: Tosha				
DG		Urea(kg)	Urea(kg)	Urea(kg)

Ablami	2	1.087	1.667	1.667
Guduba	3	1.203	1.667	1.667
Kalchabaha	2	0.957	1.667	1.667
Tosha	2	0.945	1.667	1.667
Kebele: Wacho				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Gadisa Oda	5	1.028	1.667	1.667
Lakku	5	1.069	1.667	1.667
Walargi	5	1.348	1.667	1.667
Kebele: Mishirge				
DG		Urea(kg)	Urea(kg)	Urea(kg)
Biftu	2	1.061	1.667	1.667
Ejersa	3	1.073	1.667	1.667
ILU	1	1.044	1.667	1.667
Qajela	1	0.978	1.667	1.667
Kallacha	1	1.073	1.667	1.667
Kanisa	3	1.028	1.667	1.667
Wajira	3	1.261	1.667	1.667

Annex Table 4.4

The amount of EiA, standard check (research recommendation) and local check (district extension recommendation) NPS and Urea tailored for the 10 m x 10 m validation trial plot size for the four districts

Woreda	Kebele	Gotte.Village	DG	EiA_NPS	EiA_Urea	Stand_NPS	Stand_Urea	Loc_NPS	Loc_Urea
Basona Woerna_FS	Abamote	Abamote	Abamote	2117	2647	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Birbirsa	Birbirsa	2117	1756	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Gulte amba	Gulte amba	2178	1709	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Msagnagtram	Msagnagtr am	2117	2125	1000	2500	1000	1500
Basona Woerna_FS	Abamote	msreta	msreta	2117	1669	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Qorqoro dej	Qorqoro dej	2420	1609	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Wenber amaba	Wenber amaba	2420	1609	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Worke	Worke	2117	3408	1000	2500	1000	1500
Basona Woerna_FS	Abamote	Zebtnakech	Zebtnakech	2359	1634	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Ametseigna ager	Ametseigna ager	2117	2908	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Dirrie	Dirrie	2117	1756	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Gimbechu No 2	Gimbechu No 2	2117	2756	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Kimbuager	Kimbuager	2117	2495	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Liyu Chercher	Liyu Chercher	2117	1756	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Liyu laymba	Liyu layamba	2117	1756	1000	2500	1000	1500
Basona Woerna_FS	Bakilo	Sengaberet	Sengaberet	2117	1517	1000	2500	1000	1500

Basona Woerna_FS	Bakilo	Shengo	Shengo	2117	1517	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Arda	Arda	2057	1737	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Kashim ena ketemal	Kashim ena ketemal	1875	1834	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Margeja	Margeja	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Megedsa	Megedsa	2057	1759	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Meskeya/kure/	Meskeya/ku re/	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Basodeng ora	Tach jb wosha	Tach jb wosha	2057	1759	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Chirarodeber No 1	Chirarodeb er No 1	2117	1799	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Chirarodeber No 2	Chirarodeb er No 2	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Gamigna No 1	Gamigna No 1	2117	2952	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Gamigna No 2	Gamigna No 2	2117	2386	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Gedam Afaf	Gedamafaf	2117	2952	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Gedeba	Gedeba	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Lay Gerado No 1	Lay Gerado No 1	2117	2408	1000	2500	1000	1500
Basona Woerna_FS	Chirarode ber	Lay Gerado No 2	Lay Gerado No 2	2117	1778	1000	2500	1000	1500
Basona Woerna_FS	Goshebad o	Betkerstiyan Amba	Betkerstiya n Amba	2601	2078	1000	2500	1000	1500
Basona Woerna_FS	Goshebad o	Goch amba	Goch amba	2601	2252	1000	2500	1000	1500
Basona Woerna_FS	Goshebad o	Goshebado-1	Goshebado -1	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Goshebad o	Goshebado-2	Goshebado -2	2117	1734	1000	2500	1000	1500

Basona Woerna_FS	Goshebado	Key Afer	Key Afer	2722	3158	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	Kirtie	Kirtie	2601	2708	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	Kirtie	Kirtie	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	konbele /hudad	konbele /hudad	2420	2066	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	Moign Meda	Moign Meda	2722	3158	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	Weyra	Weyra	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Goshebado	Work Gor	Work Gor	2722	3223	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	AmbanaArda	AmbanaArda	2178	1753	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gbi	Gbi	2117	1625	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gbi	Gbi	2117	1625	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gosh	Gosh	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gudoberet-1	Gudoberet-1	2057	1716	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gurba	Gurba	2117	1625	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Gurba	Gurba	2117	1647	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	KlkyAnban ahy megleby	Klky Anban ahy megleby	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Koskusnamba mado	Koskusnamba mado	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Mush layamba	Mush layamba	2117	1734	1000	2500	1000	1500
Basona Woerna_FS	Gudoberet	Wana gudoberet	Wana gudoberet	2057	1694	1000	2500	1000	1500

Basona Woerna_FS	Gudoberet	Weregen tachamba	Weregen tachamba	1875	1638	1000	2500	1000	1500
Basona Woerna_FS	keyt	Genet -1	Genet -1	2117	1517	1000	2500	1000	1500
Basona Woerna_FS	keyt	Genet -3	Genet -3	2117	1517	1000	2500	1000	1500
Basona Woerna_FS	keyt	Genet 2	Genet 2	2117	1582	1000	2500	1000	1500
Basona Woerna_FS	keyt	Gunagunit-1	Gunagunit-1	2117	1560	1000	2500	1000	1500
Basona Woerna_FS	keyt	keyit kuter 4	keyit kuter 4	2117	1517	1000	2500	1000	1500
Basona Woerna_FS	keyt	Lamdam No 1	Lamdam No 1	2117	1517	1000	2500	1000	1500
Basona Woerna_FS	keyt	Lamdam No 2	Lamdam No 2	2117	1517	1000	2500	1000	1500
Siyadebir_FS	Abaya	Aleko	Aleko no 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Abaya	Chancho	Chancho 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Abaya	Chancho	Chancho 2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Abaya	Gara	Gara no 2	2117	1712	1000	2500	2250	2750
Siyadebir_FS	Abaya	Gerengerie	Gerengerie	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Abaya	Kamp	Kamp 2	2117	1560	1000	2500	2250	2750
Siyadebir_FS	Abaya	Meye	Meye no1	2117	1669	1000	2500	2250	2750
Siyadebir_FS	Abaya	Wefi	Wefi no1	2117	1582	1000	2500	2250	2750
Siyadebir_FS	Abaya	Wefi	Wefi no2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Dubira	Dubira No 4	1996	2088	1000	2500	2250	2750
Siyadebir_FS	Agegn	Dubira	Dubira no1	1996	2241	1000	2500	2250	2750
Siyadebir_FS	Agegn	Gob Afafe	Gob Afafe	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Gob	gob No 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Gob	Gob no 2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Menekuti	Menekuti no1	2057	1542	1000	2500	2250	2750
Siyadebir_FS	Agegn	Menekuti	Menekuti no2	1996	1567	1000	2500	2250	2750

Siyadebir_FS	Agegn	Yeguache	Yeguache no1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Yeguache	Yeguache no2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Yeguache	Yeguache no3	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Agegn	Yeguache	Yeguache no3	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Dawo	Emeri	No 1	2238	1749	1000	2500	2250	2750
Siyadebir_FS	Dawo	Emeri	No 4	2541	2624	1000	2500	2250	2750
Siyadebir_FS	Dawo	Geber	No 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Dawo	Golele	No 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Dawo	Kombolcha	No 1	2238	1880	1000	2500	2250	2750
Siyadebir_FS	Dawo	kombolcha	No 2	2480	2454	1000	2500	2250	2750
Siyadebir_FS	Dawo	kombolcha	No 3	2420	2218	1000	2500	2250	2750
Siyadebir_FS	Dawo	Mesekel	No 1	2057	1542	1000	2500	2250	2750
Siyadebir_FS	Dawo	Tenegego	No 1	2420	2240	1000	2500	2250	2750
Siyadebir_FS	Dawo	Tenegego	No 2	2662	2857	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Eselamamba	Eselamamb a no 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Gotet Dega	Gotete dega No 3	2117	2278	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Gotet	Gotet No 2	2057	1672	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Gotet	Gotet No.1	2117	3256	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Kubeti	kubeti no.2	1996	1567	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Kubeti	Kubeti no1	2057	1716	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Setamba	Set ameba no 3	2601	3056	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	Setamba	Setamba no 5	2117	3256	1000	2500	2250	2750

Siyadebir_FS	Ejeresa Kubeti	Setamba	Setamba no4	2117	3256	1000	2500	2250	2750
Siyadebir_FS	Ejeresa Kubeti	zenejrowuha	zenejrowuha no.1	2238	1597	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Esate Ameba	Esate Ameba	1996	1567	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Esate Ameba	Mekusara kuter 3	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Esate Ameba	Tiratire kuter 1	1936	1592	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Esate Ameba	Tiratire kuter 2	1936	1592	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Golele	Babolye no 1	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Golele	Babolye no 2	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Golele	Kuteba kuter 3	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Golele	kuter 2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Menelafeto	Gara kuter 1	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Menelafeto	Menelafeto	1996	1567	1000	2500	2250	2750
Siyadebir_FS	Esate Ameba	Menelafeto	Tedi	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Romie	Admie	Admie No 1	2117	1604	1000	2500	2250	2750
Siyadebir_FS	Romie	Admie	Admie No 3	2117	1669	1000	2500	2250	2750
Siyadebir_FS	Romie	Chefie	Chefie no2	2117	1647	1000	2500	2250	2750
Siyadebir_FS	Romie	Dekilie	DekilieNo 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Romie	Derie	Derie No 2	2117	1625	1000	2500	2250	2750
Siyadebir_FS	Romie	Derie	Derie NO3	2117	1625	1000	2500	2250	2750
Siyadebir_FS	Romie	Elanie	Elanie NO 2	2117	1560	1000	2500	2250	2750
Siyadebir_FS	Romie	Gendelega	Gendelega No 2	2117	1604	1000	2500	2250	2750
Siyadebir_FS	Romie	Wabie	Wabie NO 2	2117	1647	1000	2500	2250	2750

Siyadebir_FS	Romie	Weyiraba	Weyiraba no1	2117	1582	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Agemeso	Agemeso 2	2420	1392	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Aleyo	Kulkual Ameba 1	2420	1392	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Chelelekit	Chelelekit 1	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Chelelekit	Chelelekit 3	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Edoro	Edoro # 1	2420	1392	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Edoro	Edoro # 2	2420	1392	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Gende bureka 1	Gende bureka 1	2722	1267	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Mehale rede	Mehale rede	1875	1617	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Mehele Gebeya	No 1	2299	1442	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Rede Aleyo	Rede Aleyo	1815	1642	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Sefer selam No 1	Sefer selam No 1	2238	1467	1000	2500	2250	2750
Siyadebir_FS	Siyadebir	Sefer selam No 2	Sefer selam No 2	2238	1467	1000	2500	2250	2750
Siyadebir_FS	Wole	Arogie NO 1	Arogie NO 1	2117	1647	1000	2500	2250	2750
Siyadebir_FS	Wole	Chancho	Chancho No 1	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Wole	Chancho	Chancho No 2	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Wole	Eselamameba	Eselamame ba	2117	1517	1000	2500	2250	2750
Siyadebir_FS	Wole	Garahubo	Garahubo No 1	2117	1604	1000	2500	2250	2750
Siyadebir_FS	Wole	Garahubo	Garahubo No 2	2117	1582	1000	2500	2250	2750
Siyadebir_FS	Wole	Wefi no 1	Wefi no 1	2117	1647	1000	2500	2250	2750
Siyadebir_FS	Wole	Wefi no 2	Wefi no 2	2117	1582	1000	2500	2250	2750
Siyadebir_FS	Wole	Wole koro	Wole koro	2117	1560	1000	2500	2250	2750
Siyadebir_FS	Wole	Wolekombo	Wolekambo	2117	1538	1000	2500	2250	2750

Goba_FS	Aloshe Tilo	Aloshee	Mineer	1210	2152	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Shabakee	Fuccoo	1754	2080	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Shabakee	Go/Barii	1210	2218	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Shabakee	nabalbal	1210	2218	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	w xiilloo	Dobichoo	2420	1957	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	w xiilloo	Madda xonaa	2420	2022	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Aloshe	Abrasa	2359	1939	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Aloshe	Dagashe	2299	1464	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Shabaka	Akko	1754	2188	1000	2500	1500	2500
Goba_FS	Aloshe Tilo	Shabaka	Oda	1210	2065	1000	2500	1500	2500
Goba_FS	Ilaasaa	Dayu	Awaye	2117	1843	1000	2500	1500	2500
Goba_FS	Ilaasaa	Dayu	Ebera	2359	1721	1000	2500	1500	2500
Goba_FS	Ilaasaa	Dayu	Ejarso	2117	1734	1000	2500	1500	2500
Goba_FS	Ilaasaa	Fasila	Cire	2117	1538	1000	2500	1500	2500
Goba_FS	Ilaasaa	Fasila	Jida	2117	1712	1000	2500	1500	2500
Goba_FS	Ilaasaa	Fasila	Kure	2117	1886	1000	2500	1500	2500
Goba_FS	Ilaasaa	Oba Walashe	Bayo	2420	1827	1000	2500	1500	2500
Goba_FS	Ilaasaa	Walashe	A Naye	2420	1805	1000	2500	1500	2500
Goba_FS	Ilaasaa	Walashe	Barisaa	2420	1827	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Jaamii	Biiftuu	1936	1592	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Jaamii	Iluu	1996	1567	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Jaamii	Kenisa	2057	1542	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Jaamii	Leenca	1936	1592	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Miide	Ejersa	2420	1609	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Miide	Keneni	2117	1517	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Miide	Wajjira	2420	1892	1000	2500	1500	2500

Goba_FS	Wacho Mishrge	Waajjitu	Adis katama	2420	1653	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Waajjitu	Kallacha	2420	1609	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Waajjitu	Labuu	2420	1457	1000	2500	1500	2500
Goba_FS	Wacho Mishrge	Waajjitu	Qajeela	2238	1467	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Dawe	Barisa	1210	2174	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Dawe	Hanbaqa	2420	1935	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Dawe	Qanani	2359	1917	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Dawe	Qoco	1452	2226	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Misra	Bakalcha	2420	2022	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Misra	Biiftuu	2420	1479	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Misra	Goorobari	2420	1827	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Misra	Hanbaqa	2420	1870	1000	2500	1500	2500
Goba_FS	Waltahi Magida	Misra	Mada walabu	2420	1827	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Ams/boroo	bisooytuu	2420	2044	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Ams/boroo	Burure	2420	2044	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Doyoo	Hobooro	2420	2044	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Gamodoyyo	Habako	2420	1805	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Mach dagano	Caanco	2420	1653	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Mach dagano	Doonsaa	2178	1687	1000	2500	1500	2500

Goba_FS	Waltahi Quubsa	Mach dagano	Kinawe	2420	1631	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Mach dagano	kooyyee	2359	1743	1000	2500	1500	2500
Goba_FS	Waltahi Quubsa	Mach dagano	Qaladii	2359	1460	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Haawwuu	2420	1935	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Mada Nagegna	2238	1749	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Nagegna	2178	2144	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Shaphicho	2117	1734	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Tulu	2359	1873	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Itayyaa saayissullaa	Urjii bariisaa	2117	1669	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Shabe	Jalalaa	2420	1935	1000	2500	1500	2500
Goba_FS	Waltahi Shabe	Wajitu	Hagala	2117	1647	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Baamoo	Awugaroo	2420	1805	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Baamoo	Cuufoo	2420	1783	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Baamoo	Gichee	2420	1827	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Baamoo	Imaaroosh aa	2420	1609	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Baamoo	Tuuluu	2420	1827	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Burqitu	Burqaa	2420	1392	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Shayya	Ablami	2420	1631	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Shayya	Gudubaa	2420	1805	1000	2500	1500	2500

Goba_FS	Waltahi Tosha	Shayya	Kalchabah aa	2420	1435	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Shayya	Nagaya	1996	1567	1000	2500	1500	2500
Goba_FS	Waltahi Tosha	Shayya	Toshaa	2359	1417	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kaba	Gaadisa odaa	2057	1542	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kaba	Ifaa	2359	1612	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kaba	Lakkuu	2117	1604	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kaba	Nagaa	2299	1464	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kaba	Quubsaa	2117	1517	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kiba	Burqa	2359	1547	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kiba	Chorotu	2420	1566	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kiba	Habo	2420	1827	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Kiba	Walargi	2420	2022	1000	2500	1500	2500
Goba_FS	Waltahi Wacho	Sogido	Kanisa	2117	1517	1000	2500	1500	2500
Lemo_FS	Ambicho Gode	Bulad	Bulad 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Bulad	Bulad 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Ende	Ende 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Goda Cheba	Gode Cheba 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Gode Duna	Gode Duna 1 And 2	2299	1442	1000	2500	1000	1500

Lemo_FS	Ambicho Gode	Hdeya Mekeshe	Hdeya Mekeshe 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Lamora	Lamora 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Lamora	Lamora 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Lekamo	Lekamo 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Ambicho Gode	Mehal Ambicho	Mehal Ambicho 1 And 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Four	Shecha	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Three	Checheyeni cho 3	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Three	Denebeba	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Three	Denebeba	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Two	Aberamo	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Two	Chachayeni cho 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Two	Chachayeni cho 2	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyin cho	Two	Denebeba	2299	1442	1000	2500	1000	1500

Lemo_FS	Bukuna Checheyincho	Two	Ferishoboya	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyincho	Two	Lay Bukuna	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyincho	Two	Loalese	2299	1442	1000	2500	1000	1500
Lemo_FS	Bukuna Checheyincho	Two	Mehal Ashe	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	One	Four	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	One	Three	2299	1464	1000	2500	1000	1500
Lemo_FS	Hayese	One	Two	2299	1485	1000	2500	1000	1500
Lemo_FS	Hayese	Three	Eight	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	Three	Nine	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	Three	Seven	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	Two	Five	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	Two	Six	2299	1442	1000	2500	1000	1500
Lemo_FS	Hayese	Two	Ten	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Bedo	Bedo 1	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Donega	Donega One	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Donega	Donega Two	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Jewa Duna	Six	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Mehale Jewa	Eight	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Mehale Jewa	Eighteen	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Mehale Jewa	Seventeen	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Mehale Jewa	Sixteen	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Moroda	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Jewa	Moroda	Two	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Duna	Tamery	2299	1442	1000	2500	1000	1500

Lemo_FS	Lareba	Duna	Tesefay Cemeso	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Duna	Tesefay Cemeso	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Duna	Ymlese Lemate Budene	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Five	Masecafa	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Five	Roma	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	One	Adese Ketema	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	One	Genet Safer	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Three	Mehale Lareba 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Three	Mehale Lareba 03	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Three	Mehale Lareba 03	2299	1442	1000	2500	1000	1500
Lemo_FS	Lareba	Two	Betsega	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Ajito	Ajito 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Dunebaboy	Denbaboy 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Gagaba	Gagaba 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Gagaba	Gagaba 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Sabro	Sabro 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Shelela	Shelela	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Shelela	Shelela	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Tiwa	Tiwa 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lay Gana	Wito	Wito 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	One	Abache Oso	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	One	Abeyo Oso	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	One	Era	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	One	Gedabanec ha	2299	1442	1000	2500	1000	1500

Lemo_FS	Lemebuda	Three	Anech Ose 22	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	Three	Hanegada 20	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	Three	Olewa 18	2299	1572	1000	2500	1000	1500
Lemo_FS	Lemebuda	Two	Asemache	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	Two	Ede Ose	2299	1442	1000	2500	1000	1500
Lemo_FS	Lemebuda	Two	Gerada 14	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Adayoso	Kodada	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Adayoso	Mehale Adayeoso	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Adyborosa	Anicho	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Adyborosa	Boros 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Adyborosa	Bunacho	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Hemeneoso	Checho	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Hemeneoso	Ololamo	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Sherojeje	Sharo 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Masebira	Sherojeje	Sharo 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Abeyo 02	Abeyo 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Abiyo 1	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Abiyo 1	Two	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Bushe	01 & 02	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Hayecha	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Hayecha	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Hrebucho	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Jato Gada	Jato Gada	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Mesemo	One	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Une	Une 01	2299	1442	1000	2500	1000	1500
Lemo_FS	Shurmo	Une	Une 02	2299	1442	1000	2500	1000	1500