# Africa Research in Sustainable Intensification for the Next Generation in Ethiopian Highlands project

## Technical report

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The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research in development projects supported by the United States Agency for International Development (USAID) as part of the US government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING is creating opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program's monitoring, evaluation and impact assessment. http://africa-rising.net/

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# Contents

Acronyms ..... 7
Summary ..... 8
Introduction ..... 10
Highlights from the current reporting period ..... 12
Feed and forage innovations ..... 12
Introduction ..... 12
Research methodologies/approaches ..... 13
Status of planned activities ..... 13
Capacity development ..... 15
Key messages including challenges and lessons ..... 16
Crop varieties and management ..... 16
Introduction ..... 16
Research methodologies/approaches ..... 16
Status of planned activities ..... 17
Capacity development ..... 23
Problems encountered ..... 23
Key messages ..... 24
Crowdsourcing and seasonal food availability assessment ..... 24
Introduction ..... 24
Research methodologies/approaches ..... 25
Status of planned activities ..... 26
Capacity development ..... 27
Problems encountered ..... 27
Next plan ..... 28
High value fruit trees ..... 28
Introduction ..... 28
Research methodologies/approaches ..... 29
Status of planned activities ..... 30
Capacity development ..... 31
Problems encountered ..... 31
Managing soil fertility ..... 31
Introduction ..... 31

Research methodologies/approaches ..... 32
Status of planned activities ..... 34
Capacity development ..... 34
Problems encountered ..... 35
Agricultural mechanization ..... 35
Introduction ..... 35
Research methodologies/approaches ..... 36
Status of planned activities ..... 37
Capacity development ..... 40
Problems encountered ..... 41
Water lifting and delivery ..... 41
Introduction ..... 41
Research methodologies/approaches ..... 41
Status of planned activities ..... 43
Capacity development ..... 43
Problems encountered ..... 44
Integrated landscape management ..... 45
Introduction ..... 45
Research methodologies/approaches ..... 46
Status of planned activities ..... 47
Capacity development ..... 52
RHoMIS studies ..... 52
Introduction of planned research activities ..... 52
Objectives of the planned activities ..... 54
Methods used to undertake planned activities ..... 54
Beneficiaries / people engaged in the study and training ..... 55
Lessons/messages ..... 55
Challenges ..... 55
Gender studies ..... 55
Introduction of your planned research activities ..... 55
Objectives of the planned activities ..... 56
Methods used to undertake planned activities ..... 56
Beneficiaries / people engaged in the study and training ..... 57

Lessons/messages ..... 58
Challenges ..... 59
Spillover assessment of crop and forage innovations ..... 60
Introduction of your planned research activities ..... 60
Objectives/research questions of the planned activities ..... 60
Methods used to undertake planned activities ..... 61
Beneficiaries / people engaged in the study and training ..... 62
Lessons/messages ..... 62
Assessing opportunities and constraints in scaling some promoted crop and feed and forage innovations. ..... 63
Introducing your planned research activities ..... 63
Objectives of the planned activities ..... 63
Methods used to undertake planned activities ..... 64
Beneficiaries / people engaged in the study and training ..... 64
Lessons and challenges ..... 64
Establishing feed and forage innovations technology parks ..... 66
Introducing your planned research activities ..... 66
Objectives of the planned activities ..... 66
Methods used to undertake planned activities ..... 67
Beneficiaries / people engaged in the study and training ..... 68
Lessons/messages ..... 68
Challenges ..... 70
Capacity development at the project level ..... 70
Communications and knowledge sharing ..... 72
Events from our sites, coordination office and CGIAR partners ..... 73
CGIAR centers ..... 73
Coordination office ..... 73
Africa RISING sites ..... 73
Africa RISING Ethiopia highlands outputs by type ..... 75
Journal articles ..... 75
Briefs ..... 76
Presentations ..... 76
Reports ..... 78
Photo report ..... 78

Podcast ..... 79
Opportunities and challenges ..... 79
Project partners ..... 80
References ..... 81

# Acronyms

| | |
|---|---|
| Africa RISING | Africa Research in Sustainable Intensification for the Next Generation |
| AICCRA | Accelerating the Impact of CGIAR Climate Research for Africa |
| BoA | Bureau of Agriculture |
| CIAT | International Center for Tropical Agriculture |
| CIMMYT | International Maize and Wheat Improvement Center |
| DAP | Diammonium Phosphate |
| DST | Decision Support Tool |
| EFSPMA | Ethiopian Forage Seed Producers and Marketers Association |
| FDG | Focus Group Discussion |
| FTC | Farmers Training Center |
| ICARDA | International Center for Agricultural Research in the Dry Areas |
| ICRAF | World Agroforestry Center |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| IFPRI | International Food Policy Research Institute |
| ILRI | International Livestock Research Institute |
| ILSSI | Innovation Lab for Small-Scale Irrigation |
| ISFM | Integrated Soil Fertility Management |
| IWMI | International Water Management Institute |
| KII | Key Informant Interview |
| LDN | Land Degradation Neutrality |
| PVS | Participatory Varietal Selection |
| R4D | Research for Development |
| RHoMIs | Rural Household Multi-Indicator Survey |
| SIAF | Sustainable Intensification Assessment Tool |
| SLMP | Sustainable Land Management Program |
| SNNPR | Southern Nations, Nationalities and People's Region |
| SWC | Soil and Water Conservation |
| 2-WT | Two-Wheel Tractor |
| USAID | United States Agency for International Development |

# Summary

Several field research and scaling, capacity development, legacy product preparation and survey activities have been implemented in the current reporting period with the participation of core CGIAR and local partners.

The livestock feed and forage research team carried out major activities such as planting of on-farm experiments (R4D), supporting scaling of feeds and forage technologies, capacity building to farmers, partners and local media workers and establishing feeds and forages technology parks at selected locations for farmers and partners to use as a learning point and sources of seed. A total of 9,971 farmers (8,490 males and 1,481 females) have been reached with the forage varieties issued across the three sites and scaling with the inputs from partners.

The focus of crop varieties and management research in the current reporting period was more on participatory variety selection (PVS) and community-based seed production and scaling of crop innovations. The project provided early generation seeds of four bread wheat varieties under revolving seed scheme to farmers. In most intervention sites, seed production followed a cluster approach for better management of the crop and experience sharing among farmers. Partners scaled out farmer preferred crop varieties to wider areas. Over 16,846 farmers benefited from scaling of improved crop varieties in the project operational areas.

The soil fertility management research work was initiated to validate landscape-based site-specific fertilizer recommendations for wheat in selected wheat-producing areas; generate information on fertilizer that will help develop fertilizer decision support tool (DST); validate viable ISFM practices for wheat production and generate information on ISFM that could help develop fertilizer DST in the country; and improve the capacity of research and development actors, including farmers.

Planned activities during the reporting period by the small-scale mechanization team include conducting mechanization adoption survey, analyzing survey data and developing a survey report, monitoring service provision, establishment of on-farm trials and producing technical and legacy project reports. A total of 497 sample respondents (244 mechanization service users and 253 non-users) actively participated in the mechanization adoption studies. The findings of the household surveys on the adoption of mechanization show that labor is substantially reduced, for both men and women, that the productivity, at least for wheat, is substantially increased. Further, household income of adopters is higher than that of non-adopters.

Activities related to small scale irrigation focussed on identification of market demands and segments for solar-based irrigation bundles; creation of engagement and exchange sphere for value chain actors; demonstration a solar-based irrigation bundle; and setting up the sales and service networks. Demonstrations of solar pumps were undertaken to introduce and create

awareness about the technologies for farmers and other actors in the irrigation value chain. Solar irrigation bundles were also introduced and promoted. In total 96 women and 334 men participated in consultation workshops and irrigation pump demonstrations.

The landscape management work in the reporting period targeted activities such as supporting land restoration efforts and national Green Legacy initiative; develop scaling strategy using ex-ante and modeling analysis and prepare compendium of technologies for various areas; progressing on the development of Landscape Doctor Toolbox; and provide capacity building of stakeholders. Data collection and analysis for various indicators across the five SI domains are started in two multifunctional watersheds related to SIAF. Various data sources including RHoMIS dataset and satellite historical images have been used for SIAF assessment. GIS and Remote Sensing techniques are used to process and analyze satellite images that will support generating data on land use/cover types, biomass crop productivity, soil erosion and water productivity at landscape scale.

Several exploratory and impact assessment studies related to AR validated technologies conducted during the current reporting periods. RHoMIS, Gender, Slipover and Scaling scan are some of the studies executed in AR operational areas. More than 1,807 beneficiaries engaged in the survey and training programs for the exploratory and impact / adoption assessment studies.

The Africa RISING project in the Ethiopian highlands managed to conduct different capacity development programs including training, field visits, field days, workshops and meetings. In this regard, the program engaged with over 4,989 beneficiaries during the current reporting period. The project has also benefited 14 MSc and PhD (new and continuing) students through its research attachment schemes.

# Introduction

The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research for development projects supported by the United States Agency for International Development (USAID) as part of the US government's Feed the Future initiative.

In its second phase, the Africa RISING project in the Ethiopian highlands is seeking to elaborate the generic research questions presented in the program umbrella document for issues identified largely during phase I (2011–16). The research questions addressed by our five (see below) specific activities will contribute insights from specific sustainable intensification-related activities and geographic areas within the country.

**Trade-offs and synergies**
Umbrella research questions: What are the environmental, economic, human and social impacts of productivity-enhancing interventions?

**Adaptation and adoptability**
Umbrella research question: How are these interventions aiming at increasing productivity and improving environmental conditions to benefit diverse farmer typologies in the target areas?

**Livelihoods**
Umbrella research question: How do changes in the management of specific activities or a combination of activities within a farm (e.g. a field or a livestock unit) affect overall livelihood conditions for different farmer typologies?

**Enabling environments**
Umbrella research question: How do enabling conditions affect the nature (variety, agro-inputs, complexity and diversity) of promising interventions moving towards sustainable intensification (SI)?

**Equity**
Umbrella research question: How does social capital affect community productivity, cooperation and wellbeing along with the scaling up of SI innovations?
Africa RISING in Ethiopia is led by scientists from the International Livestock Research Institute (ILRI) in partnership with scientists from other CGIAR Centers, the Ethiopian national agricultural research system and local communities.

In its second phase (2016–22), the project has been targeting 0.7 million households with sustainable intensification (SI) technologies. So far, the project has managed to reach and benefit more than 441,473 households (HHs) with its validated technologies and 42,691 beneficiaries through capacity building initiatives. The focussed operating in 15 woredas and 3

zones in the current reporting period. Before the project phasing out, we will seek to generate wider evidence for the benefits of the novel R4D techniques adopted in the project, synthesize the lessons learned and deliver the tools required to support wider employment of these approaches.

# Highlights from the current reporting period

The Africa RISING project in the Ethiopia highlands reached more than 29,447 households and covered 10,192 ha of land during the cropping season June–September 2022. Of the total beneficiaries, 12.4% were female-headed households. Table 1 gives details of the beneficiaries by region and household. The project's development partners, based on the research evidence presented from Phase I and 2, co-invested in the scaling initiatives jointly designed around the validated technologies. Africa RISING supported research and capacity development activities but a large share of investment in the scaling process came from development partners.

Table 1. Scaling and R4D initiatives in the 2021 cropping season.

| Region | Zone | Number of woredas | Technology type | Male-headed HHs | Female-headed HHs | Total HHs | Area (ha) |
|---|---|---|---|---|---|---|---|
| Amhara | N Shewa | 4 | Crop, livestock, NRM | 21,233 | 3,180 | 24,413 | 9,390.1 |
| Oromia | Bale | 4 | Crop, livestock, NRM | 2,051 | 107 | 2,158 | 691.2 |
| SNNP | Hadiya | 7 | Crop, livestock, NRM | 2,504 | 372 | 2,876 | 110.3 |
| Total | 3 | 15 | Crop, livestock, NRM | 25,788 | 3,659 | 29,447 | 10,192 |

# Feed and forage innovations

## Introduction

The major activities during the reporting period include planting of on-farm experiments (R4D), supporting scaling of feeds and forage technologies, capacity building to farmers, partners and local media workers and establishing feeds and forages technology parks at selected locations for farmers and partners to use as a learning point and seed base even after the project lifetime. The on-farm experiments are a follow up of the previous trials to collect multi-locational and multi-season data to generate farm-level evidence as backstopping research on technologies already at scale.

The R4D experiments under continuous evaluation include oat varieties cutting management trial and tree lucerne management trial. The capacity building activity was implemented in collaboration with AICCRA project targeting farmers and other stakeholders involved along the feed and forage value chain. Scaling partners were supported technically and logistically to reach new farmers with Africa RISING (AR) technologies. The main objective of the engagement

in the reporting period was to ensure smooth exit of the AR project with enhanced local capacity to continue development efforts in feeds and forages.

## Research methodologies/approaches

The research methods followed for the R4D trials were the same as the previous year. For the oat variety trial, three oat varieties (two food oat varieties and one forage oat variety) were subjected to two cutting regimes a) twice cut treatment—at vegetative stage and then the regrowth at grain maturity stage b) once cut treatment—at grain maturity stage (Photo 1). The treatments were replicated three times. The objective is to evaluate the effect of different cutting management on the total yield and quality of forage oat and food oat varieties.

The tree lucerne cutting management trial plots had been established in the 2021 planting season to generate additional evidence on the optimal cutting height and frequency under field conditions. Two cutting heights (1.0 and 1.5 meter) and three cutting intervals (three, four and six months) are under evaluation. Key results and findings from past harvests of both experiments were included in the previous season's report. Moreover, a new experiment was implemented in the current growing season in collaboration with ILSSI project to evaluate the suitability of maize–lablab intercropping to improve feed resource availability and soil fertility.

The practice is believed to be useful in areas like Sinana where farmers have a tradition of growing maize for fodder. Lablab, being a legume crop, is good for soil fertility as it fixes nitrogen, in addition to its contribution as a high-quality feed supplement. Lablab is also known to suppress weeds when planted as a pure stand or intercropped with other crops like maize. Hence it is intended to validate this at farm level by planting lablab in mixture with maize on the same plot without competing for land. A total of 31 farmers in Sinana district have received lablab seeds to plant as an intercrop in their already established maize fields on a total of 1.5 ha of land. This is intended to conduct farmer led evaluation of the practice. Side-by-side a controlled experiment has been established in three farmer fields in Bahir Dar Zuria district to collect detailed agronomic data (Photo 2). The controlled trial contained different planting dates as treatments: a) lablab planted at the time of maize planting, b) lablab planted 20 days after maize planting and c) lablab planted 40 days after maize planting. The effect of the practice on grain yield, forage yield and soil fertility will be explored. Pure maize and lablab plots are included in the experiment for comparison purposes.

## Status of planned activities

Among the feeds and forages technologies, oats and vetch varieties have increasing demand across all the sites. Due to the large number of farmers requesting for these varieties, there is still a deficit in meeting the demand. Based on the request presented by farmers through extension partners, a total of 2,750 kg oats and 1,250 kg of vetch varieties have been

distributed to farmers who participated in the capacity development training and more other farmers who requested to plant these materials for the first time. A total of 10,699 farmers (9,178 males and 1,521 females) have been reached with the forage varieties issued across the three sites and scaling with the inputs from partners (at one of the sites). Data on the scaling progress through the inputs from the extension and development partners for the three Africa RISING sites will be reported in due course.

Photo 1. Oats varieties cutting management trial at Lemo Africa RISING site.



Photo 2. Maize–Lablab intercrop field.



## Capacity development

In collaboration with the Accelerating Impacts of CGIAR's Climate Research for Africa (AICCRA) project and local partners, successive trainings were delivered to extension workers who in turn trained farmers at the three Africa RISING sites (Lemo, Basona and Sinana). The objectives of the training were: a) provide practical skills and knowledge on cultivated forage production, management, utilization and seed multiplication under smallholder conditions, b) to increase the commitment of extension workers and smallholder farmers to promote adoption of cultivated forages and c) to provide practical advice on feed budgeting and better utilization of local feed resources including crop residues. The trained experts from the three sites have cascaded the training to farmers, development agents and other experts who did not take part in the training of trainers (ToT). A total of 1,233 farmers (1,065 males and 168 females) and 111 experts and DAs (84 males and 27 females) have been trained at the three sites by the trainers who participated in the ToT.

The forage seed production and management training included participants from the recently established Ethiopian Forage Seed Producers and Marketers Association (EFSPMA). The association is assisted technically by ILRI and other stakeholders to enhance the local forage seed production and supply system in Ethiopia. The training contained important topics including livestock feed production and utilization: opportunities, challenges and the way forward, basics of forage seeds harvesting and processing, basic field management practices of forage seed production, basic business concepts principle and challenge of forage seed producer. In addition to the theoretical concepts, the participants visited forage seed production fields and seed processing facilities at ILRI's forage seed unit in Addis Ababa and Debre Zeit sites.

Twelve local media staff from Amhara, Oromia and SNNPR have been invited for two days of training accompanied by a field visit to farmers' forage plots at Debre Birhan Africa RISING site. Following the training, the journalists exercised content development on key technologies and practices with the help of ILRI scientists and researchers. They then went back to their respective sites and started broadcasting of the radio programs by developing contents in discussion with ILRI scientists regarding Africa RISING feeds and forage technologies using local languages. This approach is expected to speed up scaling of feeds and forage technologies in the project sites and beyond.

Regarding formal trainings, two MSc graduate fellows have been sponsored to conduct their thesis research under the project. One of the student has completed thesis write up and the other student is still collecting field data. Additionally, two new graduate students have been recruited to work on rhizobia inoculum development for selected forage legumes including vetch, alfalfa, lupin and tree lucerne. The rhizobia isolation characterization and authentication will be conducted in collaboration with Arba Minch University. This is intended to enhance the biological nitrogen fixation of forage legumes and reduce dependency on chemical fertilizers.

### Key messages including challenges and lessons

- Capacity building activities done in collaboration with other projects indicate that joint efforts yield better than individual efforts in terms of resource uses, avoid duplication of efforts and facilitate cross learning
- Establishing technology parks for partners appeared to be important as it helps to ensure continuity in the adoption of AR technologies after the project closes
- Transmitting information about AR validated technologies and practices through local media is expected to boost awareness and adoption of technologies
- Recruiting students from local universities for joint research work is helping to strengthen our collaboration and partnerships with local institutions and increase capacity of local personnel.

## Crop varieties and management

### Introduction

Cereals (tef, wheat and barley) and food legumes (faba bean, field pea, chickpea and lentil) are key components of the mixed farming system in the Ethiopian highlands. The productivity of these crops is low due to biotic (diseases), abiotic (waterlogging, acid soils and drought) factors and low inputs uses mainly poor access to good quality seeds of farmer preferred varieties. Most farmers use their own saved seeds for planting that contributed to low productivity of these crops. During the two AR project phases, several farmers' preferred varieties of cereals and food legumes were identified, demonstrated and seeds were produced and marketed through few farmer unions operating in target sites. The seed unions are markete-oriented rural enterprises engaged in local seed business. The biggest challenge was getting access to early generation seeds (pre-basic and basic seeds) of malt barley, durum wheat and faba bean as compared with bread wheat from breeding centers in the national and regional research institutes. The objectives of this study include:

- Facilitating scaling crop innovations through the production of early generation seeds of crop varieties by linking with seed producing unions in Bale, Hadiya and North Shewa zones.
- Identifying new high yielding varieties of bread wheat.
- Promoting the uses of fungicide seed treatment in managing faba bean gall disease.
- Facilitating scaling through knowledge sharing by contributing to legacy product development (SIAF, extension manual, policy brief) and exist project strategy

### Research methodologies/approaches

*Participatory Variety Selection (PVS):* The on-farm action research was done using released bread wheat and highland maize varieties by different research centers in North Shewa, Bale and Hadiya zones. Seven newly released varieties with standard check (cv. Deka) were planted on 25 $m^2$ plots per variety on farmers' fields. The PVS was planted by two host farmers per action sites of the project. Moreover, with the request of the Siyadebre district in North Shewa, we arranged evaluations of seven released highland maize varieties and the BoA planted the trail at East Amba kebele Farmer Training Center.

*Community based seed production and scaling of crop innovations*: The project provided early generation seeds of four bread wheat varieties under revolving seed scheme to farmers in Bale and North Shewa zones. In most intervention sites, seed production followed cluster approach for better management of the crop and experience sharing among farmers. Partners scaled out farmer preferred crop varieties hosted by male and female farmers.

## Status of planned activities

*Participatory variety selection:* The performance of the bread wheat trials is very good in all locations visited and is at different growth stages (Photos 3 and 4). Crop management practices were applied so that the varieties can show their potential under rainfed condition. However, the performance of maize trial is poor due to excessive rainfall that caused waterlogging (Photo 5).

Photo 3. Performance of bread wheat PVS, Moretina Jiru, North Shewa.



Photo 4. Performance of bread wheat PVS at Lemo (Left) and Doyogena (Right) sites.



Photo 5. Participatory variety trial of highland maize, North Shewa.



*Community seed production and scaling*: Community seed production was supported through provision of early generation bread wheat seeds through the project; revolving seeds from last season and seed purchases by farmers from seed growers.

*Africa RISING supported early generation seed production*: The project provided four t of pre-basic seeds of farmer preferred bread wheat varieties to seed growers in Bale and North Shewa zones (Table 2).

Table 2. Crop varieties and quantity of seeds provided to seed growers through revolving seed scheme, 2022/23 cropping season

| Crop | Varieties | North Shewa | Bale | Total |
|---|---|---|---|---|
| Bread wheat | Wane | 0.5 | 0.5 | 1 |

| | | | | |
|---|---|---|---|---|
| | Lemu | – | 1 | 1 |
| | Dandaá | 1.5 | – | 1.5 |
| | Daka | 0.5 | – | 0.5 |
| Total | 4 | 2.5 | 1.5 | 4 |

*Scaling crop innovations through revolving seed scheme*: Farmers in North Shewa and Hadiya zones, returned seeds they received from 2021/22 crop season and the BoA provided to other farmers for scaling purposes. In Basona Worana district 1.5 t of bread wheat cv. wane was planted on 7.5 ha of land. Moreover, 1.5 t of faba bean cv. Numan variety was planted on 7.5 ha of land and both the wheat and faba bean cultivars were planted in clusters (Photo 6). The project provided 30 kg of fungicide to manage faba bean gall. As a spillover effects, farmers in Siyadebirna Wayu district planted 12.5 ha of faba bean cv. Numan and bought 3.5 t of cv. Hachalu. The later variety is targeting waterlogged farms. In Hadiya zone, 82 male and female farmers were benefited from revolving seeds of bread wheat and faba bean cv. Tumsa (Table 3). The performance of faba bean was very good and expected to produce good quantity of grain (Photo 7).

Table 3. Revolving seed distributed and number of participants, Hadiya Zone, 2022/23 cropping season

| District | Crops | Varieties | Kebeles/cooperative | Quantity of seeds (t) | Area (ha) | Male | Female | Total HHs |
|---|---|---|---|---|---|---|---|---|
| Lemo | Faba bean | Tumsa | Ana belesa | 0.5 | 4 | 4 | 1 | 5 |
| Anlemo | Faba bean | Tumsa | S/Anlemo | 0.8 | 6.5 | 8 | | 8 |
| Misha | Bread wheat | Wane | Mirsito cooperative | 0.6 | 6 | 14 | 2 | 16 |
| Soro | Faba bean | Tumsa | Sundusana harchu | 0.7 | 5.5 | 19 | 7 | 26 |
| Duna | Bread wheat | Wane | N/wasgebeta and Dbiago | 1.8 | 18 | 26 | 1 | 27 |
| Total | 2 | 2 | | 4.4 | 40 | 71 | 11 | 82 |

Photo 6. Performance of community seed production of faba bean varieties in Basona Worana (left) and Siyadebirna Wayu (right).



Photo 7. Performance of faba bean planted from revolving seeds in Anlemo district.



*Partner scaling of crop innovations*: The project partners secured seeds produced by seed growers and included in their scaling activities in this season.

*North Shewa Zone:* A total of 16,437 farmers (14,673 male and 1,764 female) farmers were involved in scaling bread wheat (three varieties), durum wheat (three varieties), malt barley

(one variety), faba bean (four varieties) and potato (four varieties) in four districts covering 9,041 ha of farmland (Table 4).

Table 4. Scaling of farmers preferred crop varieties by partners, North Shewa, 2022/23 cropping season.

| Districts | Crops | Variety | # of kebeles | Beneficiary households (HHs) | | | Quantity of seeds (t) | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | Total | | |
| Basona Worena | Bread wheat | Wane | 18 | 179 | 58 | 237 | 21.4 | 142 |
| Moretina Jiru | Bread wheat | Wane | 6 | 983 | 93 | 1,076 | 67.1 | 609.5 |
| Hager Mariam | Bread wheat | Wane | 5 | 425 | 49 | 474 | 27.9 | 186 |
| Siyadebirna Wayu | Bread wheat | Wane | 5 | 231 | 30 | 261 | 13 | 87 |
| Moretina Jiru | Bread wheat | Daka | 4 | 415 | 39 | 454 | 36.3 | 358 |
| Basona Worena | Bread wheat | Hidase | 30 | 954 | 186 | 1,140 | 136.8 | 912 |
| Moretina Jiru | Bread wheat | Hidase | 7 | 4,182 | 408 | 4,590 | 445.8 | 4,310 |
| Hager Mariam | Bread wheat | Hidase | 6 | 315 | 28 | 343 | 17.6 | 117 |
| Siyadebirna Wayu | Bread wheat | Hidase | 11 | 4,416 | 550 | 4,966 | 220.5 | 1,470 |
| Moretina Jiru | Durum wheat | Mangudo | 3 | 220 | 5 | 225 | 6.1 | 55 |
| Siyadebirna Wayu | Durum wheat | Mangudo | 4 | 52 | 18 | 70 | 0.75 | 5 |
| Moretina Jiru | Durum wheat | Utuba | 1 | 10 | 3 | 13 | 0.8 | 2 |
| Siyadebirna Wayu | Durum wheat | Utuba | 3 | 23 | 2 | 25 | 1 | 6.25 |
| Moretina Jiru | Durum wheat | Fetan | 1 | 7 | 4 | 11 | 0.25 | 3 |
| Siyadebirna Wayu | Malt barley | HB1964 | 2 | 15 | 3 | 18 | 0.6 | 4.5 |
| Basona Worena | Faba bean | Numan | 8 | 243 | 47 | 290 | 27 | 135 |
| Moretina Jiru | Faba bean | Numan | 7 | 805 | 43 | 848 | 34.2 | 171 |
| Hager Mariam | Faba bean | Numan | 4 | 87 | 19 | 106 | 12.5 | 125 |
| Siyadebirna Wayu | Faba bean | Numan | 3 | 21 | 1 | 22 | 3.1 | 15.5 |
| Basona Worena | Faba bean | Dosha | 16 | 170 | 39 | 209 | 31.4 | 157 |
| Siyadebirna Wayu | Faba bean | Dosha | 5 | 63 | 5 | 68 | 3.4 | 17 |
| Basona Worena | Faba bean | Gora | 12 | 132 | 41 | 173 | 26 | 130 |
| Basona Worena | Potato | Gera, Shenkola, Belete Gudene | 6 | 84 | 32 | 116 | 58.3 | 23.34 |
| Total | | | | 14,032 | 1,703 | 15,735 | 1,192 | 9,041 |

*Hadiya zone*: A total of 892 HHs (796 male and 96 female) participated in scaling of faba bean and bread wheat technologies (Table 5). They used 90 t of quality declared seeds and covered over 830 ha of land. Two unions involved in seed production of bread wheat cv. Wane on 407 ha.

Table 5. Scaling of farmers preferred wheat and faba bean varieties, Hadiya zone, 2022/23 cropping season.

| District | Crops | Variety | Number of kebeles/unions | Quantity of seeds (t) | Male HHs | Female HHs | Total | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| Lemo | Faba bean | Tumsa | 6 | 8.8 | 107 | 13 | 120 | 50 |
| Anlemo | Faba bean | Tumsa | 7 | 5.7 | 60 | 5 | 65 | 45 |
| Misha | Bread wheat | Wane | Licha | 9 | – | – | – | 90 |
| Soro | Faba bean | Tumsa | 4 | 8.4 | 54 | 21 | 75 | 67 |
| Duna | Bread wheat | Wane | Zereta | 34 | – | – | – | 340 |
| | | | 3 | 24.3 | 575 | 57 | 632 | 242.5 |
| Total | 2 | 2 | 20 | 90.1 | 796 | 96 | 892 | 834.5 |

*Bale zone*: Scaling of bread wheat, durum wheat, food and malt barley as well as faba ban were done using 50 t of revolving seeds from 2021/22 cropping season (Table 6). A total of 219 male and female farmers benefited from the scaling activities in two districts of Bale zone. A total of 219 farmers benefited from revolving seed. Cooperatives were also involved in bread wheat seed production.

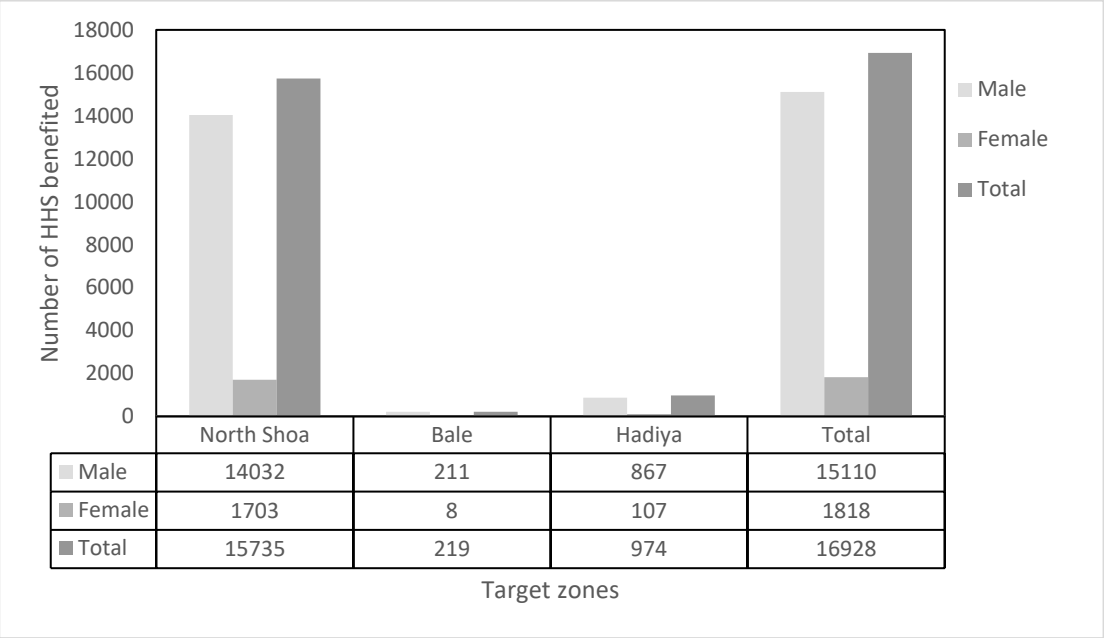
Table 6. Scaling cereals and food legume innovations using revolving seed in Bale zone, 2022/23 cropping season

| District | Kebeles/ cooperative | Crops | Varieties | Beneficiaries (HHs) | | | Quantity of seeds (t) | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | Total | | |
| Goba | A/kera | Durum wheat | Bulala | 40 | | 40 | 6.65 | 44.3 |
| | Cooperative | Bread wheat | Wane | | | | 0.5 | 3.3 |
| | | | Lemu | | | | 1 | 10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | W/Magida | Durum wheat | Bulala | 41 | 1 | 42 | 6.45 | 42.9 |
| | | Food barley | Adoshee | 3 | 1 | 4 | 0.5 | 3 |
| | | Malt barley | HB1963 | 3 | 1 | 4 | 0.5 | 3 |
| | | Faba bean | Numan | 46 | 1 | 47 | 14.2 | 72.8 |
| | | Malt barley | HB1963 | 38 | | 38 | 11.4 | 75.1 |
| | | Food barley | Adoshee | 34 | 2 | 36 | 8.2 | 53.7 |
| Dinsho | Mi'o | Faba bean | Numan | 5 | | 5 | 0.45 | 2.3 |
| | A/kera | | Numan | 1 | 2 | 3 | 0.45 | 2.3 |
| Total | | | | 211 | 8 | 219 | 50.3 | 312.6 |

*Beneficiaries from the innovations*: Over 16,900 male (89%) and female (11%) farmers headed HHs benefited from crop technologies through the project and partner scaling in the three intervention zones (Figure 1).

Figure 1. Number of beneficiaries from crop innovations in three project target zones.




| | North Shoa | Bale | Hadiya | Total |
|---|---|---|---|---|
| Male | 14032 | 211 | 867 | 15110 |
| Female | 1703 | 8 | 107 | 1818 |
| Total | 15735 | 219 | 974 | 16928 |

## Capacity development

Several capacity building programs have been conducted in the three sites and the number of beneficiaries from the training scheme reported in the capacity development at project level section. Concerning student attachment, three PhD students are working on their thesis research on key biotic constraints (parasitic weeds, faba bean gall and plant viruses) of faba bean and lentil.

## Problems encountered

- Getting early generation seeds (pre-basic and basic) from breeding centers is still a big problem to support seed growers
- Clusters seed production and timely field inspections are still a challenge for seed growers.

### Key messages

- Many crops selected and validated by the project are playing roles in diversifying the wheat-based production system
- During the cropping season many farmers benefited from revolving seeds collected from last season by BoA
- More and more unions and cooperatives are involved in seed multiplication of farmer preferred wheat, barley and faba bean cultivars in North Shewa, Bale and Hadiya zones
- Fungicide seed treatment and one-time foliar application was very effective in managing faba bean gall disease and encourage farmers to grow more areas
- Training of development agents and farmers is needed on high maize since the crop is new to the highlands of north Shewa.

## Crowdsourcing and seasonal food availability assessment

### Introduction

Climate change and loss of biodiversity is becoming a threat for agricultural production and productivity. The number of crops and varieties being cultivated are becoming few. This will leave farmers vulnerable to climate change and nutrition insecurity. Thus, sustainable future crop productivity will ultimately be achieved through an increased use of crop genetic resources, including landraces, wild relatives and exotic materials, to supplement the genetic diversity. The knowledge of, access to and use of diversity in cultivated crops and their landraces are essential for broadening the genetic base of cultivars to sustain improvement. However, available germplasm in the gene pool of crops is not in a form that most farmers and breeders can easily use. Therefore, a pressing need to radically improve diversity of crop varieties and quality of the characterization and evaluation approaches are crucial to have impacts on agricultural sustainability.

In addition, understanding the dynamics of food availability throughout various seasons is vital in identifying entry points for sustainable diet diversity. Having multiple seasonal food availability data provides a better understanding of the type of foods available in a given area/region. Therefore, a second round of seasonal food availability assessment is conducted in all Africa RISING project sites incorporating the inputs received on the first-round seasonal food availability assessment report presented during the nutrition seminar on 11 May 2021. The objectives of the study include the following:

- Enhancing the diversity, availing adapted varieties through crowdsourcing approach and maintaining and multiplying selected varieties for further trials in unaddressed potential areas.
- Popularizing best varieties selected by farmers through pre-scaling up and training.
- Developing community-based seed system.
- Assessing seasonal food availability.

## Research methodologies/approaches

Data were collected from 5 to 9 October 2021 through Focus Group Discussion (FGD) and Key Informant Interview (KII) carried out to verify the information provided by focus group participants. Both FGD and KII tools were updated to include animal source foods (poultry, meat, milk and eggs). The project site coordinators selected enumerators at their respective areas**.**

The same enumerators were used for the first and second survey, with exception in Lemo district where due to unavoidable circumstance a new set of enumerators had to be recruited. The updated tool was shared with site coordinators and enumerators ahead of data collection period**.** A second training/refresher was given to the enumerators to ensure full understanding of the updates made on the tools (they have been trained during the first-round survey). The same participants who were involved in the first-round survey were interviewed–these included experienced farmers and merchants familiar with seasonal dynamics of foods both men and women with mix of ages, diverse ethnicity and economic status.

A total of 75 participants were involved through 12 FGD and 8 KII in the study. Participants were asked to list all the food items available for consumption in the community and to specify the months that each food item is available. Each food item was categorized to food group. Based on MDD-W methodology guidebooks, the food groups are defined as follows: Grains, white roots and tubers = 1; pulses = 2; nuts and seeds = 3; meat, poultry and fish = 4; eggs = 5; dark green leafy vegetables (DGLV) = 6; other vitamin A rich fruit and = 7; other vegetables = 8; other fruits = 9; milk and other dairy products = 10. The levels of availability each month and each food item were scored by on a scale of 0 to 3 in which 0 represents–no availability; 1 represents low availability; 2 represents moderate availability and 3 for high availability. The average of the availability score across all the focus group was taken to integrate the dataset. The average availability of each species was calculated for each month. A color scale was applied using conditional formatting in Excel: when darkness decreases the availability also decrease; the lighter the color the less availability and white indicates no availability.
For crowdsourcing activity, in total, 400 farmers from 8 villages in North Shewa and Hadiya zones contributed to this study. Farmers' preferences information was gathered and each farmer evaluated three distinct varieties and characterized them in the best and worst criteria

for various traits. In total, 13 faba bean varieties were distributed. The farmers' preferences data were encoded and analysis using Climmob.net using different models.

## Status of planned activities

*Analysis of farmers' preferences on faba bean varieties evaluation*: Among the tested faba bean varieties, Tumisa was found to be resistant to diseases and best in all yield and related traits (earliness, plant height, tillering capacity, number of branches, number of pods per plant, number of seeds per pod, seed size, dry desiccating wind and disease resistance). On the contrary, Jamma local was the worst in all yield and yield related traits; while Jamma Local, Dagim and Ashengie were the most susceptible varieties. Currently, faba bean production is challenged by disease. The area coverage of faba bean production has become less year after year. For this reason, finding a disease resistance variety is an important milestone to continue its production.

*Farmers' reflections on the performance of faba bean varieties:* Farmer's reaction on the faba bean crowdsourcing was impressive (Photo 8). From faba bean crowds, for example farmer Eshetu Niguse said, "I have received and planted three varieties of faba bean (Golla, Dosha and Hachalu), of which my first choice is Hachalu followed by Dosha. Hachalu has a good number of branches per plant with tall plant height, big seed size and it is resistance to dry wind and I have harvested good amount of grain yield. He also implied that non-participant farmers who saw the plots have requested to access seed for the next cropping season. He also promised to share the seeds with other farmers in his area. He stated that the same work must continue on other crops such as wheat and barley (six row malt barley) to realize the benefit of the farming community."

Photo 8. Farmer at Dijo damala, Lemo district, Hadiya zone inside his faba bean field planted from his previous crowdsourcing trial in 2022.



*Impact assessment of faba bean crowdsourcing in Hadiya zone*: In Hadiya zone, it was possible to capture the willingness of farmers to continue planting the accessed faba bean varieties and found that about 36% of the participant farmers have planted at least one of the received faba bean varieties. On the other hand, some farmers indicated that they did not plant faba bean during 2022 cropping season because of reasons related to crop rotation. Framers usually plant faba bean after two years of wheat production on a plot of land. The number of farmers reported seeds damage by weevils was also considerable which show the importance of post-harvest handling of seeds.

*Seasonal food availability*: Data collection included information about diversity, culinary use, source of species and seasonal availability of the different food species considering how they are sourced, consumed and perceived by the local population. In the culinary uses, the major edible parts and the methods of consumption were documented. The possible food sources assessed include a) Own production like from farm, home gardens and local trees; b) Market that includes nearby large market, local wet market, supermarket, shop/kiosk, street hawker; and c) Wild–uncultivated wild fruits and vegetables. In Basona district of north Shewa zone in Amhara region nuts are low throughout the entire year. Moderate availability of meat, poultry and fish are documented from December to February. Dark green leafy vegetables are moderately available for the last six months (July to December). Other vitamin A rich fruits and vegetables are low throughout the year. For most of the year, there are no species of “other fruits” available. Milk and other dairy products are only available for four months a year. In Sinana woreda, Oromia region, cereals and pulses are available from high to moderate level for eight months a year. But, nuts are only available for three months a year and no availability for the rest of the year. Meat, poultry and fish, eggs, other vitamin A rich fruits and vegetables and other fruits are low for most of the year. Other vegetables and milk and other dairy products are moderately available for most of the year from July to January. In Lemo woreda, dark green leafy vegetables are the first highly available foods from all food groups, eight months a year. Followed by other fruits and other vitamin A rich fruits and vegetables. Eggs are low the entire year. Based on the information gathered, a seasonal food availability calendar was developed using a color gradient to represent the availability of food species.

## Capacity development

Second training/refresher was given to the enumerators to ensure full understanding of the updates made on the seasonal food availability tools (they have been trained during the first-round survey). A total of 475 farmers and experts able to engage in the survey and training programs.

## Problems encountered

Due to the election during data collection period, travels were banned and the research team could not be able to travel to the field. However, AR site coordinators played a great role in identifying qualified local experts to collect the data.

### Next plan

- A qualitative study will be conducted in the Upper Gana and Jewe kebeles of Lemo district to capture the potential livelihood benefit of incorporating avocado into the agri-food systems considering the whole value chain.
- Nutritional quality analysis from the tested faba bean and durum wheat varieties will be done.
- Report of the nutritional quality of tested varieties will be done.

## High value fruit trees

### Introduction

The Africa RISING Ethiopian highlands project has been working to sustainably intensify the mixed crop–livestock farming system in the country. The project has validated and demonstrated a range of technologies that have been scaled through national partners. The technologies and production practices have helped thousands of farmers to improve their crop and livestock productivity without affecting the ecosystem negatively. To this end, Africa RISING project had introduced high value tree crops (improved avocado varieties and apple) at project target woredas in its first and second phases of the project to help improve the livelihoods of smallholders.

Increased production, in volume and quality and availability of animal feed has also been among the interventions to enhance the productivity of livestock components in the mixed crop–livestock agriculture domains. The development of legume forage rhizobia inoculants, while enhancing the productivity of the forage crop, help reduce reliance on costly chemical fertilizers through N inputs to the soil via biological N fixation. It is well established that legume forages play essential role in the farming system as a source of high-quality feed supplement and a nitrogen fertilizer, thus contributing to system sustainability. Also, capacity building of local practitioners and farmers, on propagation and management of high value fruit trees and forage crops, marketing and value chain development, is critical for promoting production and sustainability. The objectives of the work reported in this document includes:

- Preparing extension learning manuals based on existing project experiences for further intensification of high value tree production practices in farming
- Organizing and conducting participatory stakeholder's training workshop for capacity development of local partners and learning through a common platform

- Conducting a study on the role of avocado fruit tree production for enhancing household income and nutrition
- Developing rhizobial inoculants for selected forage legumes (tree lucerne, vetch, lupin and alfalfa)

## Research methodologies/approaches

*Preparing extension learning manuals*: Access to appropriate skills and knowledge resources to guide proper management of the trees, harvesting and handling fruits and marketing put important limitation for promoting and scaling production. To prepare and make available field guides and references materials in the form of extension material and/or brochures to local partners the following activities have been conducted:

- Drafting annotated outline of the extension manual, a framework guiding a step-by-step preparation of the content
- Reviewing and collecting materials on the basic principles and practices of the targeted high value fruit trees (avocado)
- Synthesizing the reviewed information, draft and finalize the manual

*Organizing and conducting participatory stakeholder's training workshop*: participatory workshop provides a platform for local partners and communities to share experiences, lessons and discuss challenges and opportunities on introduced technologies.

- Preparing the background and context document (the ToR) for the "participatory training workshop"
- Identifying stakeholders (partners) to invite them for participating in the workshop
- Fixing the workshop date and dispatching the invitation letter to the respective participants

*Studying the role of avocado fruit tree production on household income and nutrition*: to get insight on the role of avocado fruit tree production on the household income and nutrition, management practices and performance of avocado trees

- Preparing survey tool (questionnaire) for data collection and build ODK form built,
- Identifying two enumerators and trained them for data collection,
- Analyzing and summarizing the results

*Developing rhizobial inoculants for forage legumes*: developing legume inoculants requires laboratory as well as field exercises and comprise the following activities:

- Identifying MSc students at university and sign a consultancy agreement to undertake the symbionts isolation work
- Organizing a field expedition for the collection of nodule and soil samples from the target legumes at selected sampling locations

- Carrying out laboratory isolation of the bacteria from nodules and soil samples using established procedures
- Authenticating the isolates (on the respective legume species) and
- Evaluating the symbiotic efficiency of the rhizobial strains on greenhouse and field conditions

## Status of planned activities

*Extending learning manual preparation*: The preparation of an extension learning manual, based on project experiences and materials collected from literature, is underway for guiding and scaling avocado fruit tree production. As part of this effort, annotated outline of the extension manual has been prepared and revised and review of relevant literature underway (Table 7).

*Organizing and conducting participatory stakeholder's workshop:* The context and background document for the envisioned "participatory workshop" has been prepared, along with the objectives, expected outputs and timetable. In addition, the workshop participants identified and tentatively scheduled to be conducted at the end of October or early November 2022.

*Studying the role of avocado fruit tree production on household income and nutrition***:** The survey tool (questionnaire) for data collection prepared (ODK form built) and two enumerators identified and trained for data collection and the survey work is underway on selected samples of smallholders (avocado fruit tree growers, adopters).

*Developing rhizobial inoculants for forage legumes*: A staff at Arba Minch University and two MSc students have been identified, consultancy agreement entered with the staff. Moreover, the collection of nodule and soil samples is underway (from the target legumes and study sites, respectively).

Table 7. Planned activities and summary of progresses during June–August 2022.

| Planned activities | Outputs/accomplishments during the reporting period (June–August 2022) | Expected outcomes* |
|---|---|---|
| Preparing extension learning manual for avocado fruit tree production | • Annotated outline of the extension manual prepared and revised<br>• Collecting information underway (existing project experience and literature) | - Extension learning manual for avocado fruit tree production |
| Organizing and conducting a participatory | • The context and background document for the envisioned | - Conducting the training workshop |

| | | |
|---|---|---|
| stakeholder's training workshop | "participatory workshop" has been prepared and scheduled | - Producing the workshop report |
| Assessing on the role of avocado fruit tree production on household income and nutrition | • Questionnaire prepared and built on ODK form<br>• Enumerators identified, trained and the data collection is underway | - Data will be analyzed, results will be interpreted and presented |
| Developing inoculants for forage legumes | • 2 MSc students, each to work in two forage legumes, identified<br>• Collecting nodules and soil samples from target forage legumes and sites underway | - Isolating rhizobial strains and authentication<br>- Evaluating their N fixing effectiveness |

* Outcomes indicated are expected to be accomplished at end of the consultancy period.

### Capacity development

Two MSc students are attached to undertake research on the following topics:

a) Rhizobial inoculant development for forage legumes alfalfa (Medicago sativa) and vetch (Vicia villosa)
b) Rhizobial inoculant development for forage legumes lupin (Lupinus albus) and tree lucerne (Chamaecytisus palmensis)

### Problems encountered

Accessing data collected in the previous years on the yield, quality and socio-economic aspects of avocado has been a challenge to respond to requests from local partners.

## Managing soil fertility

### Introduction

Low crop response to fertilizers is a major concern despite the consistent increase in fertilizer supply and usage in the country. The effectiveness of matching fertilizer types to soil fertility problems depends on the ability to identifying limiting factors, characterizing sites and developing appropriate recommendations. To identify nutrient management zones, the collection and interpretation of spatial data, such as yield, elevation, soil nutrient maps and farmers' classification criteria are required. In Ethiopia, government and non-governmental research and development organizations are making a great effort to test and recommend balanced fertilizers for increased yield and quality of crops. Fertilizer trials are in progress using balanced blended fertilizers containing multiple nutrients, such as NP and S (sulfur) and/or zinc (Zn) and boron (B). The basis for the formulation of these fertilizers was an analysis of data

collected under the EthioSIS project, which identified S, Zn and B as deficient nutrients in Ethiopian soils.
Wheat yields significantly responded to landscape positions where wheat yield was increased by 50–300% in foot slope compared to the hillslope positions, depending on location and input level. Significant variations were observed in crop fertilizer response with topo-sequence due to a significant decrease in soil organic carbon, clay content and soil water content (Amede et al. 2020; Desta et al. 2022).

Integrated soil fertility management (ISFM) is an alternative approach for improving crop yields while preserving sustainable and long-term soil health and fertility through the combined application of organic and inorganic nutrient sources. Yield benefits were more when fertilizer application was accompanied by crop rotation, green manuring, application of organic fertilizer, crop residue management, or liming acid soils. For example, the combined application of organic and inorganic fertilizers increased wheat yields by 50–100%, whereas crop rotation with grain legumes increased cereal grain yields by up to 200% (Agegnehu and Amede 2017). Although organic residues are key inputs for soil fertility management, about 85% are used for livestock feed and energy sources. The main incentive for farmers to adopt ISFM practices is economic benefits. The overall aim of this research was to enhance the productivity of wheat in the country in collaboration with national and international research and development institutions and other stakeholders.

The objectives of this research were, therefore, to:

- validating landscape-based site-specific fertilizer recommendations for wheat in selected wheat producing areas of central and south Ethiopia;
- generating information on fertilizer that will help develop fertilizer decision support tool (DST) in the country;
- validating viable ISFM practices for wheat production and generate information on ISFM that could help develop fertilizer DST in the country; and
- improving the capacity of research and development actors, including farmers.

## Research methodologies/approaches

On-farm field trials were conducted to determine the response of wheat to the combination of nutrients–nitrogen (N), phosphorous (P), potassium, sulfur (S) and zinc (Zn) in Basona Worena district of North Shewa zone in Amhara region; Lemo district of Hadiya zone in South region; and Sinana district of Bale zone in Oromia region. Based on the results of previous field trials, promising fertilizer treatments were validated on farmers' fields of Lemo and Basona Worena districts. Six farmers were selected per landscape position (three at hillslope, three at mid-slope and three at foot slope position) for the fertilizer and nine farmers for ISFM validation trials. To characterize each landscape position, slope percentage was used as a key criterion.

Accordingly, landscape positions with < 5°, 5–15° and 15–30° are characterized as foot slope, mid-slope and hillslope positions, respectively. The three treatments were landscape-based

site-specific fertilizer recommendations, landscape-based model-generated rate and the current blanket or extension fertilizer rate applied for wheat across all landscape positions at each implementing district (Table 8). The improved wheat variety (*var*. *Danfe*) was sown in rows in Lemo and *var. Dandaa* as broadcast in Basona Worena district following planting date and seed rate of wheat.

Table 8. Summary of treatments based on landscape position for wheat.

| District (woreda) | Treatments | Foot slope | Mid-slope | Hillslope |
|---|---|---|---|---|
| Lemo | Site-specific fertilizer rate (kg/ha) | | | |
| | Urea | 125 | 75 | 75 |
| | NPS | 180 | 60 | 60 |
| | KCl | 65 | 65 | 35 |
| | Model generated rate (kg/ha) | | | |
| | Urea | 225 | 133 | 75 |
| | NPS | 182 | 195 | 61 |
| | Current extension rate as a control (kg/ha) | | | |
| | Urea | 150 | 150 | 150 |
| | NPSB | 100 | 100 | 100 |
| Basona Worena | Site-specific fertilizer rate (kg/ha) | | | |
| | Urea | 243 | 203 | 150 |
| | NPS | 182 | 158 | 121 |
| | KCl | 0 | 0 | 0 |
| | Model generated rate (kg/ha) | | | |
| | Urea | 225 | 225 | 133 |
| | NPS | 182 | 182 | 195 |
| | Current extension rate as a control (kg/ha) | | | |
| Vertisol | Urea | 150 | 150 | 150 |
| | NPSB | 100 | 100 | 100 |
| Nitisol | Urea | 100 | 100 | 100 |
| | NPSB | 150 | 150 | 150 |

For the ISFM validation trial on wheat in Lemo district, the sites were selected based on the severity of soil fertility depletion, soil acidity and landscape position in collaboration with district agriculture office. Vetch (*Vicia sativa* L.) was grown as a short-term green manure crop during the small rainy season and the shoot and root biomass of the green manure was incorporated into the field. The amount of lime applied per ha was determined based on the

exchangeable acidity of the soil. Lupin was grown as a green manure crop. The treatments included:

i. Green manure + 65% of the recommended N fertilizer rate + the recommended rate of other nutrients (P, S and micronutrients).
ii. 50% of the recommended N fertilizer rate (N) + 50% of the recommended organic fertilizer (compost) as N equivalent + the recommended rate of other nutrients (P, S and micronutrients).
iii. The recommended rate of inorganic fertilizer alone.

The treatments were arranged in a randomized complete block design and replicated four times at each landscape position (hill, mid- and foot slope) on 3 farmers' fields on a plot size of 10 m by 10 m (100 $m^2$). The appropriate wheat variety for each area was sown for both validation trials. Other recommended agronomic practices for wheat production were uniformly applied to all plots. The trials were evaluated by farmers, extension agents and experts during the grain filling stage of the wheat crop. The required agronomic data such as total biomass and grain yield of wheat will be collected.

## Status of planned activities

- The field research and data collection are still going on.
- The decision support tool (DST) for fertilizer recommendations for wheat has been developed and validated.
- In the 2022/23 cropping season, the decision support tool is being demonstrated on farmers' fields in selected districts, including Lemo and Basona Worena districts for wheat production through ICRISAT-excellence in agronomy project.
- One policy brief on "landscape-based site-specific nutrient management for improving farm productivity and sustainability in Ethiopia" has been prepared and submitted to Africa RISING project.
- A module on "site-specific nutrient management and use of decision support tool for fertilizer recommendations in Ethiopia" that can be used as a training extension manual is drafted.
- One research article is under preparation.

## Capacity development

Farmers who have hosted the validation trials, development agents working in the trial sites and experts in Lemo and Basona Worena districts were trained before the implementation of the validation trials. There was a discussion with researchers and technical assistants of Debre Birhan and Areka Agricultural Research Centers on how to select sites, design, apply the treatments under field conditions and collect the necessary agronomic and soil data. Training was also organized for 328 men and women farmers, 53 extension agents and supervisors who could assist them in the implementation of the validation trials (Mulema et al. 2019). About

125 farmers have made field visits during different growth stages of the crop. Field days were also organized for about 167 farmers in both woredas in October 2021 to evaluate the trials under field conditions with farmers, development agents, agricultural officers and other relevant stakeholders in collaboration with the research centers and district agricultural offices. Overall, about 620 farmers participated in the validation of the fertilizer and ISFM field trials in the two districts. So, the direct and indirect beneficiaries of this project were about 5,300 farmers in the 2 districts, of which about 23% were women farmers. It was possible to produce a short video about the field day that was organized in Basona Worena district.

### Problems encountered

- The partnerships that have been created with research and development institutions have played key roles in implementing our research plans and delivering project outputs in this difficult time of 2020–22. The progress made so far has been possible through the joint efforts of our project partners.
- Security problem—the security risks in the country have been a serious problem to plan field trips and execute activities.
- The other activity in this project planned by ICRISAT was to deliver advanced training on data analysis and scientific paper writing accompanied by a Write-shop. However, although it was planned to be delivered in September, we could not achieve it because of overlapping field activities with both in our technical staff and researchers from partner institutions who are expected to take part in this training workshop. If there is an opportunity for an extension for a month or so we are very keen to deliver this training and write-shop.

## Agricultural mechanization

### Introduction

Maize and wheat production systems in the Ethiopian smallholder farming sector are characterized by high drudgery. Farming operations on the farms are predominantly performed by human muscle power leading to high drudgery. Low horsepower two-wheel or walking tractor (2-WT) is an alternative technology that reduces drudgery and can increase crop productivity on smallholder farms. Appropriate mechanization technologies adapted to the smallholder farming conditions are being promoted in different parts of the Ethiopian highlands. The mechanization technologies are value chain focussed, covering crop production, irrigation, harvesting, post-harvest processing (threshing and shelling) as well as transportation services on smallholder farms.

The 2-WT powered technologies that are being promoted in Ethiopia increase opportunities to free up available farm labor to pursue other on-farm and off-farm income generating activities within and outside the rural communities. Activities were implemented in all project sites during the April to September 2022 period. Planned activities during this period included conducting mechanization adoption survey in Amhara, analyzing survey data and developing a survey report, monitoring service provision, establishing on-farm trials and developing this technical project report.

## Research methodologies/approaches

A multi-stage sampling procedure was used to select study districts, sample kebeles and households. In the first stage, Mechakel districts from Amhara region and Gimbichu and Tiyo districts from Oromia region were purposely selected in the project areas as the main study area as these districts are the area where CIMMYT and other partners have been promoting agricultural mechanization technologies in Ethiopian since 2014 under different projects and donors. As the main purpose is to compare adopting and non-adopting farmers, Ada'a, Digelunatijo and Sinana districts were also purposely selected from non-project sites to serve as control districts for Gimbichu, Tiyo and Machakel districts, respectively, as they had similar farming systems.

Information on the kebeles and respondents from the project districts (Machakel, Gimbichu and Tiyo) was collected from the administration. At the same time, we collected information from mechanization service providers and the woreda office of agriculture and hence we identified kebeles where mechanization services were provided. In the second stage of sampling, out of the total kebeles where mechanization service was provided, 17 kebeles were randomly selected from the 3 districts (7 from Machakel, 5 from Gimbich and 5 from Tiyo) using simple random sampling. To proceed with the overall sample selection, a list of farmers engaged in agriculture in each kebele was collected and then identified as beneficiaries and non-beneficiaries of mechanization technology. At the third stage of sampling, in every selected kebele, proportional sampling was used to select sample respondents. Accordingly, a total of 375 sample respondents (244 mechanization service users and 131 non-users) were selected from the 3 treatment districts.

Similarly, 5 kebeles were randomly selected from each of the 3 control districts and 124 households (25 from Ada'a, 25 from Digelunatijo and 74 from Sinana) using simple random sampling technique (Table 9).

Table 9. Zones and districts selected from Oromia and Amhara regions for conducting the adoption survey during November 2021 and March–April 2022

| Region | Zone | Districts | Location type | No. of sample farmers selected | | |
|---|---|---|---|---|---|---|
| | | | | Service users | Non-users | Total |
| Oromia | East Shewa | Gimbichu | Project area | 50 | 25 | 75 |
| | | Ada'a | Control area | – | 25 | 25 |
| | Arsi | Tiyo | Project area | 50 | 23 | 73 |
| | | Digelunatijo | Control area | – | 25 | 25 |
| Amhara | East Gojam | Machakel | Project area | 144 | 81 | 225 |
| | | Sinana | Control area | – | 74 | 74 |
| Total | | | | 244 | 253 | 497 |

Note: Control areas are the kebeles where the mechanization projects were not active during the study period. The Amhara region was conducted in March–April 2022 due to the conflict and results mainly presented within this report.

## Status of planned activities

Highlights of survey findings in Amhara region:

The results of the FGDs and key informant surveys in Debre Markos woreda showed a large interest in the agricultural mechanization with two-wheel tractors and that the established formula with service providers is much appreciated. The farmers indicate that the technology fits their system and the level of intensification that they are moving towards. They increasingly participate in the market from where they obtain cash and they find that the mechanization services are a good investment to reduce drudgery and labor, reduce post-harvest losses and increase income and food security. The services are not used equally by all farmers, but larger, younger and more educated farmers use them more. However, the two-wheel tractors are not suitable for ploughing, for which oxen remain the major source of energy, but are much appreciated for harvesting, threshing and transport.

Mechanization brings substantial changes to the farming systems, in particular a shift to more suitable crops (maize and new wheat varieties, potatoes), a reduction in donkeys replaced by sheep, but no reduction in oxen, as they are still needed for ploughing. Hence, farmers in the FGDs did not expect a reduction in available manure is observed, or any other reduction in input use because of mechanization.

The investment in two-wheel tractors would be too expensive for an individual farmer and even for a small traders or businesses. However, with appropriate credit, the business is very profitable from the start and several providers have been able to purchase a second tractor. The providers are entrepreneurs, purchasing new modules where they see profit and hiring staff and expanding into new activities and supplementary equipment where they see

opportunities. The findings of the household survey showed substantial differences between adopters and non-adopters in project and outside the project areas.

Econometric analysis was used to estimate the impact of mechanization services on household outcomes (income, food security). The findings of the household surveys largely confirm those from the FGDs. The findings show that labor is substantially reduced, for both men and women, that the productivity, at least for wheat, is substantially increased. Further, household income of adopters is higher than that of non-adopter. However, but there was no significant effect on food security, likely because only few households suffered hunger. The econometric model also estimated that there is a decrease in the number of donkeys, but no decrease in the number of oxen and an increase in the number of sheep per household, all confirming the results of the FGDs. However, the econometric findings also estimate that mechanization increases the use of inorganic fertilizer and decreases the use of organic fertilizer. This was not mentioned by farmers in the FGD but is in line with an increased intensification of the farming system. The findings indicate that there is room for expansion to bring mechanization to other areas using the same approach and to look into the opportunities to expand the use of four-wheel tractors.

Agronomy and gross margin results from on-farm trials:

During the reporting period, field trials were established and using two-wheel tractor with Khedut planter. The data related to the established trial farms (Tables 10 and 11) and the crop monitoring are presented below. The crops are developing well in all intervention areas as of end of September 2022 (Photo 9). The gross margin and results from the on-farm trials will be presented in the final report as per this reporting period, the crops are still maturing and not yet harvested.

Table 10. Debre Markos–Machakel woreda site

| No. | Name of farmers | Area of the plot | Planting date | Inputs used | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | NPS | UREA | Wheat seed | Round up | Fuel | Remark |
| 1 | Tefera Tibebu 1 | 0.05 ha | 25/07/2022 | 14 kg | 8.75 kg | 6.25 kg | 0.25 liter | 0.8 liter | Have control farm |
| 2 | Tefera Tibebu 2 | 0.05 ha | 25/07/2022 | 14 kg | 8.75 kg | 6.25 kg | 0.25 liter | 0.8 liter | Have control farm |
| 3 | Yizengawu Tsegaye | 0.05 ha | 25/07/2022 | 14 kg | 8.75 kg | 6.25 kg | 0.25 liter | 0.8 liter | Have control farm |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4 | Leyewu Meretu | 0.05 ha | 22/07/2022 | 14 kg | 8.75 kg | 6.25 kg | 0.25 liter | 0.8 liter | Have control farm |
| Total | | 0.2 ha | | 110 kg | 70 kg | 50 kg | 1 liter | 3.2 liter | |

Table 11. Debre Berhan–Koshebado site.

| No. | Name of farmers | Area of the plot | Planting date | Inputs used | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | NPS | Urea | Wheat seed | Round up | Fuel | Remark |
| 1 | W/Younes Mamo | 0.03 ha | 22/07/2022 | 12 kg | 7.5 kg | 6.25 kg | 0.25 liter | 0.75 liter | Have control farm |
| 2 | Yeshigeta Debebe | 0.03 ha | 22/07/2022 | 12 kg | 7.5 kg | 6.25 kg | 0.25 liter | 0.75 liter | Have control farm |
| 3 | Abebe Mamo | 0.03 ha | 23/07/2022 | 12 kg | 7.5 kg | 6.25 kg | 0.25 liter | 0.75 liter | Have control farm |
| 4 | FTC center farm | 0.03 ha | 23/07/2022 | 12 kg | 7.5 kg | 6.25 kg | 0.25 liter | 0.75 liter | Have control farm |
| Total | | 0.12 ha | | 100 kg | 60 | 50 kg | 1 liter | 3 liter | |

Note**:** All trial farms are established with same size control farm side by side!

Photo 9. Performance of crops planted during the reporting period in wheat-based farming system.





## Capacity development

A total of 497 sample respondents (244 mechanization service users and 253 non-users) were selected actively participated in the mechanization adoption studies. Details of where the studies conducted and number of respondents in the different districts are shown in Table 12.

Table 12. Zones and districts selected from Oromia and Amhara regions for conducting the adoption survey during November 2021 and March–April 2022.

| Region | Zone | Districts | Location type | No. of sample farmers selected | | |
|---|---|---|---|---|---|---|
| | | | | Service users | Non-users | Total |
| Oromia | East Shewa | Gimbichu | Project area | 50 | 25 | 75 |
| | | Ada'a | Control area | – | 25 | 25 |
| | Arsi | Tiyo | Project area | 50 | 23 | 73 |
| | | Digelunatijo | Control area | – | 25 | 25 |
| Amhara | East Gojam | Machakel | Project area | 144 | 81 | 225 |
| | | Sinana | Control area | – | 74 | 74 |

| | | | | |
|---|---|---|---|---|
| Total | | 244 | 253 | 497 |

Note: Control areas are the kebeles where the mechanization projects were not active during the study period. The Amhara region was conducted in March–April 2022 due to the conflict and results mainly presented within this report.

### Problems encountered

- Travel restrictions due to security concerns in some of the project areas–project partners and service providers spearheaded the establishment of trial and planting of field activities.

## Water lifting and delivery

### Introduction

Despite the high potential and urgent need for wider adoption and use of agricultural innovations, many scaling ecosystems are not effective and innovations remain on 'shelves'. Effective and sustainable scaling requires addressing both technical and social aspects, including multi-actor learning and coordinated action to create solutions that fit and are affordable for farmers, value chain actors and the government. Ethiopia has a large potential for expanding its irrigated agriculture, particularly for strengthening and marketing its agro-ecological horticulture and irrigated vegetables.

To foster agricultural innovations in Ethiopia, the International Water Management Institute (IWMI) has co-identified a suitable demand–supply linkage pathway to scaling solar-based irrigation bundles for irrigated fruit and vegetable production by smallholder farmers in Ethiopia. The solar-based irrigation bundle includes pumps and panels, a pay-as-you-go (PAYGO) financing modality as well as pre- and post-sales services. To actualize this pathway for scaling solar-based irrigation bundles, IWMI designed and implemented a series of marker segmentation and demand–supply linkage workshop in Southern Nations, Nationalities and Peoples' Region (SNNPR), Oromia and Amhara regions. These activities aimed at:

- Identifying market demands and segments for solar-based irrigation bundles,
- Creating the engagement and exchange sphere for value chain actors,
- Demonstrating a solar-based irrigation bundle,
- Setting up the sales and service networks.

### Research methodologies/approaches

Qualitative value chain analysis was conducted to map the irrigated value chain structure, including the chain's functions, potential actor roles and relevant knowledge and experience, value addition and distribution and governance to determine how to organize the chain. The

production analysis emphasizes primary resources required for production, environmental consequences of resource exploitation, primary productivity, potential incomes generated for primary producers and factors facilitating and inhibiting production. Specifically, it needs to investigate what and how irrigated products are produced and whether farm size, inputs, services, and resources are required for cultivation. It also needs to examine current irrigation practices, investments, benefits and profits, interest, and willingness to invest, preferences for irrigation equipment and potential financial capital for investment. Finally, it analyzes how irrigated products are marketed by investigating market access, marketing, price and volume of the marketed products.

The in-depth analysis looked at farmers' needs for water for irrigation, their water and land available, their preference for irrigation equipment and their financial capacity to pay for the solar-based irrigation bundle. This was to categorize market segments for the solar-based irrigation bundle by segmenting farmers as potential investors into smaller groups to enable the irrigation equipment suppliers to target them with the right marketing approaches.
With the engagement of various value chain actors and stakeholders, the segmentation data were collected via semi-structured interviews, focus group discussions, stakeholder consultation workshops and field observations in Batu/Ziway town (Oromia region) and Wereta town and Bahir Dar city (Amhara region) from 04–24 September 2022. In both locations, it involved a total of 4 farmer group discussions (103 participants), 42 individual semi-structured interviews, 2 participatory market transaction walks and 2 stakeholder consultation workshops with actors and stakeholders involved in the irrigated vegetable value chain (174 participants). The stakeholder consultation workshops were organized to:

- Identify and characterize farmers' interest to invest in solar-based irrigation.
- Investigate and categorize farmers' land and water resources, farming systems and irrigation practices.
- Understand how farmers manage their incomes and financial potential to invest in solar-based irrigation.
- Understand the existing support for irrigation development in the region.
- Social learning via experience sharing from other farmers using solar irrigation.
- Demonstrate Lorentz PS2-100 solar pump.

Demand–supply linkage workshop has been organized in Lemo (SNNPR) to a) share knowledge about best irrigation practices in Lemo and surrounding areas, b) share new insights on irrigation technologies, products and financial services, c) reflect on the market segments identified from the segmentation, d) develop a plan to establish and facilitate demand–supply linkages for solar-based irrigation and e) network and explore collaboration for business opportunities. Finally, a series of field demonstrations were organized to connect farmers and the relevant value chain actors with actual products and services in the solar-based irrigation bundles.

## Status of planned activities

The market segmentation and demand–supply linkage workshops involve various actors from the irrigated value chains who have benefited from access to insights and knowledge about solar-based irrigation, supply of pay-go solar-powered irrigation pumps, sale and service networks and business and irrigation investment opportunities. The number of beneficiaries is presented in Table 13.

Table 13. Number of beneficiaries

| Target groups | Number of beneficiaries |
|---|---|
| Farmers | 219 |
| Members and representatives from farmer cooperatives and associations (producer, input, water/irrigation) | 66 |
| Agriculture and irrigation officers, development agents, other government support institutions | 83 |
| Non-governmental development actors | 14 |
| Research and academia | 28 |
| Micro-finance institutions | 4 |
| Private sector—tech suppliers | 10 |
| Private sector—agro input suppliers | 2 |
| Private sector—well diggers | 4 |
| Total | 430 |

## Capacity development

Demonstrations of solar pumps (Lorentz PS2-100 pumps and Rainmaker 2S models) were undertaken to introduce and create awareness about the technologies for farmers and other actors in the irrigation value chain in the three regions. These events were attended by a total of 146 beneficiaries. Solar irrigation bundles were also introduced and promoted during the workshop series which 284 persons attended. IWMI conducted one demand–supply linkage workshop for solar-irrigation bundles in Lemo, SNNPR (see methodology section). Together with the private sector partner–Rensys Engineering PLc.–two demonstrations of the solar-based irrigation bundles were organized in Hosanna town and Jawe kebele. During the market segmentation conducted in Ziway, Wereta and Bahir Dar, 5 field demonstrations of Lorentz PS2-100 solar pump were organized during focus group discussions and stakeholder consultation workshops through 08, 14, 20, 21 and 23 September 2022.

IWMI also organized 02 stakeholder consultation workshops on 14 and 23 September 2022 at Ziway and Bahir Dar respectively (see the methodology section). These workshops and field demonstrations in the three regions aimed to raise awareness about solar-based irrigation and

co-learning and co-designing the demand–supply linkages. In total 96 women and 334 men participated in consultation workshops and irrigation pump demonstrations (Photos 10–15).

Photo 10. Demand–supply linkage workshop in Lemo.



Photo 11. Demonstration of Solar pump at Woreta.



Photo 12. Stakeholder consultation workshop in Bahir Dar.



Photo 13. Stakeholder consultation workshop in Woreta.



Photo 14. Farmer group discussion in Bahir Dar.



Photo 15. Focus Group Discussion in Woreta.



## Problems encountered

Key issues that currently hinder broader adoption of the proposed solar-based irrigation bundles in Ethiopia and challenges observed during activities include:

- The limited availability of the pumps and information on the pumps in Lemo, i.e. a lack of experience-based farmer-to-farmer experiences.
- The poor availability and high cost of manual well drilling services for shallow groundwater development, i.e. in many instances a lack of a reliable water base for investing in irrigation equipment.
- The lack of tailored financial services for technology purchases in addition to tight re-payment schedules (e.g. monthly instead of quarterly or annually).
- Periodic floods that destroy farms and homes–annual minor floods that may not cause major damage but major floods every 5–10 years in towns such as Wereta.
- Poor access to inputs like seeds, fertilizers and pesticides due to cost and availability and timely access, limiting production and subsequent migration to improved technologies like solar pumps.
- Low incomes due to low individual and group bargaining power for output, high dependence and cost of labor, increasing cost of motor pumps, increasing cost and access to fuel for irrigation.
- Poor access to skilled repairs and maintenance staff and water conflicts during the dry season.
- Gaps between farmer needs/expectations and the actual performances of solar pumps being promoted as compared to motor pumps (low water discharge, limitations in timing of irrigation, limited mobility) mismatches between size/width of manual tube dug wells and solar pump sizes.

# Integrated landscape management

## Introduction

Ethiopia is investing a lot in sustainable land management programs to curb land degradation problems and reverse its adverse effects on the ecosystem functions and peoples' livelihood (Adimassu et al. 2018). The landscape team (i.e. Alliance Bioversity–CIAT), as a part of Africa RISING (AR) project, with its local and international partners, have been developing new ideas and approaches towards successful landscape restoration practices thereby supporting and facilitating the implementation of large national programs such as Sustainable land management programs (SLMP) in Ethiopia. To this end, in this reporting period April–September 2022, we have focussed on the following activities: a) continue land restoration efforts and support the national Green Legacy initiative; b) develop scaling strategy using ex-ante and modeling analysis and prepare compendium of technologies for various areas; c) progressing on the development of Landscape Doctor Toolbox–a toolbox that is designed to

facilitate land assessment, technology targeting and impact assessment to be used by researchers and experts in support of restoration activities and (d) provide capacity building of stakeholders.

## Research methodologies/approaches

*Continued support of SLM interventions and aligning to national Green Legacy initiatives*: The land restoration activities are a long-term endeavor, we continued to support our learning and scaling watersheds as much as possible. In addition, the restoration activities are resource intensive and also requires strong partnership between multiple actors and stakeholders. The national Green Legacy initiative has been a good opportunity for collaborating and renewed restoration efforts. Thus, we aligned our technical and financial support in restoring and rehabilitating the learning and scaling watershed with this grand national objective.

*Synthesis of socio-economic impacts of CSA/SLM practices*: In the previous report period, we have focussed on the progress from the biophysical component of the work. Here we will outline the approached followed for ex-ante and scaling of SLM/CSA technologies from socio-economic perspective. Systematic literature review on CSA practice adaptation has been conducted and synthesized. This helps to reduce bias and errors, improves the rigorous review process and helps to organize the literature in specific contents/themes (Tranfeld et al. 2003; Mihalache and Mihalache 2016). Descriptive statistics such as mapping the spatial distribution of studied areas using the GIS and ratios for scaling of adoption status and socio-economic benefits of CSA practices have been used. Adoption rate of each practice was made based on the percentage of adopters out of the total studied sample size (Saguye 2017), i.e. practices with greater than 70, 60–70, 50–59, 40–49 and below 40% of adopters were classified as very high, high, medium, fairly low and very low rates of adoption, respectively. In addition, the main factors responsible for CSA/SLM adoption rate are identified.

*Packaging and developing adaptive learning materials and tools:* Significant efforts have been employed to generate and analyze data from the measurements in learning sites and develop inferences and approaches to create multifunctional landscapes that are both productive, sustainable and resilient elsewhere. This revolves around implementing complementary options and generating evidence in terms of ecosystem services so that we ‘value’ costs and benefits more appropriately. Exploration and discovery research are also undertaken mainly involving understanding the performances of interventions (including bottlenecks) in the ‘new’ areas of interventions. For this, appropriate tool/approach that can guide land management practices with standardized step by step procedures and scaling approach for transfer technologies from AR site to elsewhere is crucial.

With this objective, the landscape team under AR has been working on the: a) customization of landscape performance assessment based on Sustainable Intensifications Assessment

Framework (SIAF), b) development of Landscape Doctor Toolbox–to facilitate land assessment, technology targeting and impact assessment to be used by researchers and experts and c) development of operational guideline for development agents and experts to create multifunctional and resilient landscape and community.

## Status of planned activities

Continued support of SLM interventions and aligning to national Green Legacy initiatives:

As a part of our landscape restoration work, we have been asked by the woreda bureau of agriculture at learning and scaling Africa RISING watersheds to support the Green Legacy initiative that is promoted by the Prime Minster office (PMO). Specifically, the Basona Worena and Borena district/woreda asked for both technical and resource support for effective implementation of the Green Legacy initiative. Discussion on the sustainability problem and addressing existing gaps in landscape restoration has been conducted before the actual intervention. Some of the new opportunities to reinstate our effort are the establishment of watershed use cooperatives, the new declaration to support the watershed use groups bylaws to facilitate enforcing bylaws, the hiring and contracting the community facilitators to mobilize the watershed use group. Discussion and training on the suitable and available seedlings of different grass, forage and none forage trees. For instance, for Borena district, at Wocheche drink water supply and irrigation project site, the primary purpose of the plantation was to cover the project site/watershed areas with vegetation to reduce the sedimentation problem on the Wocheche dam. Alliance–CIAT provides financial supports to facilitate the plantation activities. The local government and district office of agriculture were very happy for the supports and collaboration to implement the watershed development activities. As a part of this effort, a total of 249,100 seedlings (18,249 Juniperus, 131,500 tree lucerne, 99,350 Acacia decurrens) are planted at 29.3 ha of lands. DAs, district agriculture and other sector experts and farmers participated during plantation (Photos 16 and 17). About 723 people participated.

Photo 16. Experts group photo at Wocheche watershed, Borena.



Photo 17. Experts during planting at Wocheche watershed, Borena.

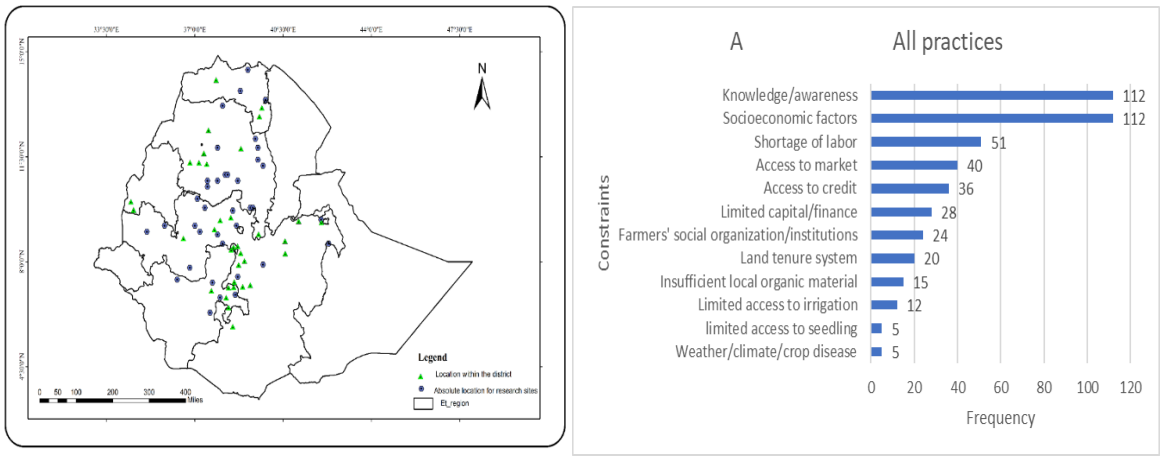


Synthesis of socio-economic impacts of CSA/SLM practices:

Following a systematic literature review procedure, a total of 100 articles published between 2001 and 2021 in Ethiopia were reviewed. Although the publications claimed to be from the highlands of Ethiopia; over 80% was from the regions of Oromia, Amhara and South Nations and Nationalities. The most adopted practice was soil and water conservation (SWC), with a mean adoption rate of 61.5%, followed by integrated soil fertility management and agroforestry with mean adoption rates of 56.5% and 48.8%, respectively. For all aggregated practices, knowledge/awareness and socio-economic factors were the first two constraints, each reported in 112 studied practices (i.e. 68.3%) (Figure 2). In comparison to other constraints such as shortage of labor, limited access to market and limited access to credit with frequencies of 51, 40 and 36, respectively (Figure 2).

A manuscript on detail analysis of adoption studies of climate smart agricultural practices; the status of adoption of practices, gender consideration, socio-economic benefits and constraints of adoptions; and gaps in the current adoption literature and future research and policy directions are submitted for peer-review publication.

Figure 2. The spatial distributions of research sites from which papers have been published with consideration of adoption of CSA practices.

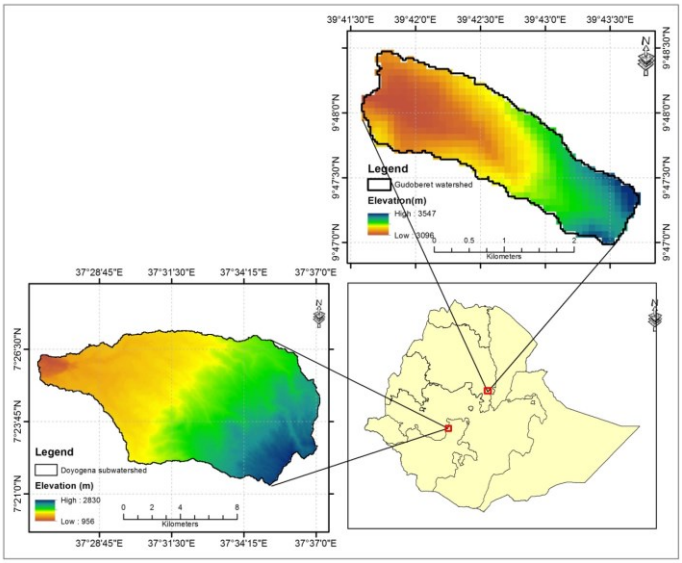



Once the database based on studies from biophysical impact and the adoption studies of CSA/SLM finalized, ex-ante and visualization dashboard will be developed. Once the maps are produced and validated, we will package and develop an interactive dashboard and visualization tool for users to enable them to extract the best-bet technologies at their area of interest. We will work on this in collaboration with federal and regional agricultural offices.

Packaging and developing adaptive learning materials and tools:

*Sustainable Intensifications Assessment Framework (SIAF):* The main objective of the work was to assess the performance of multifunctional landscape management using SIAF. Accordingly, data collection and analysis for various indicators across the five SI domains are started in two multifunctional watersheds (Figure 3), namely, Gudeoberet and Doyogena. We used various data sources including RHoMIS dataset and satellite historical images. GIS and Remote Sensing techniques are used to process and analysis satellite images to generate data on land use/cover types, biomass crop productivity, soil erosion and water productivity at landscape scale.

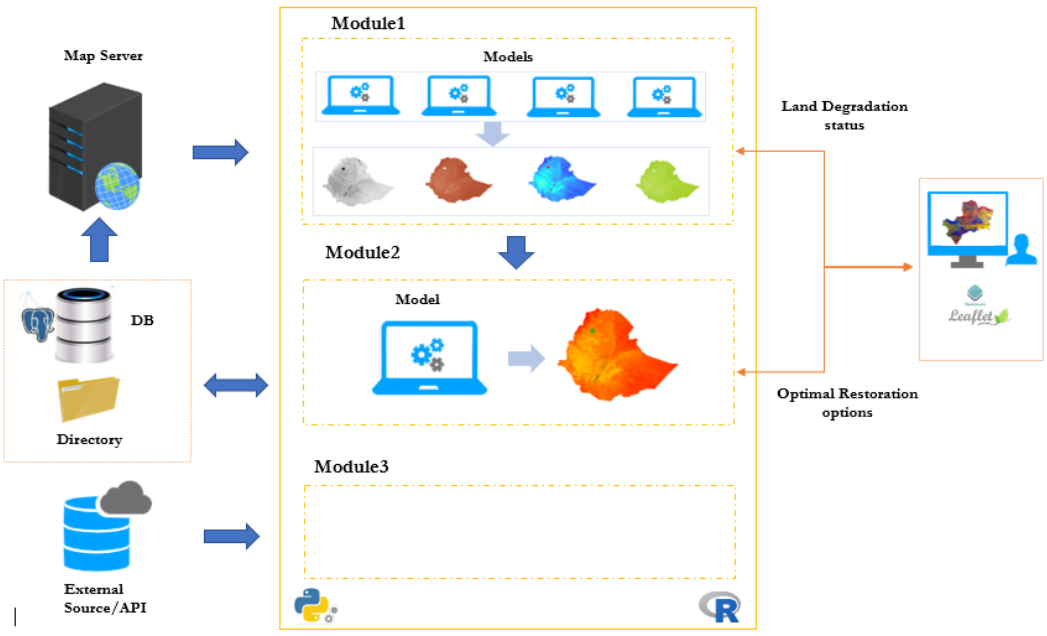
Figure 3. Location of the two landscapes for SIAF studies.



*Developing Landscape Doctor (LandDoc) toolbox:* Our experiences over the last years under the AR program and other projects gave us tremendous lessons about the challenges of land degradation and associated land management options across space and time. We learnt that land degradation is a serious global problem, but the measures taken are not adequate. Because of lack of detailed assessment, the real impacts of land degradation on multiple ecosystem services, livelihoods and resilience are not well quantified. The recent efforts under the land degradation neutrality (LDN) consider very few variables that fail to give clear picture of impact, especially at catchment scales. Evidence also shows that land degradation problems are not properly targeted by diagnosing and prioritizing hotspots. On the other hand, the multiple benefits of restoration on various ecosystem services are not accounted for using near real-time monitoring system.

Harvesting our experiences and available literature, we initiated the development of a toolbox (Figure 4) to facilitate matching 'land and water management' options with specific landscape contexts and characteristics and generate evidence while assessing trade-offs. The Toolbox is consisting of land degradation diagnosis, identifying suit of climate-smart land and water management options, matching solutions (SLM options) to problems (land degradation hotspots), conduct near real-time impact assessment and conducting trade-off analysis. The approach follows a synonymous approach of treating a sick person. As it stands now the 'diagnosis' and 'restoration' steps are being completed. The toolbox can be used by partners and development agents to identify hotspot of land degradation, target appropriate land management technologies, conduct ex-ante impacts of the designed land restoration activities and evaluate remedies for minimizing trade-off and maximizing synergies of co-benefits. It will facilitate the adoption of AR and other land management technologies by wider communities.

Figure 4. System architecture for LandDoc tool that is under development.



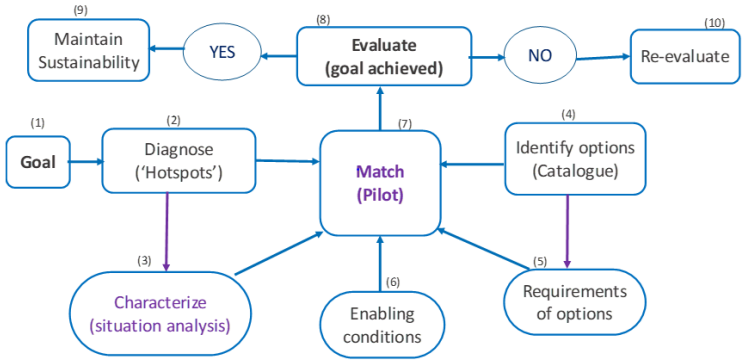
*Creating multifunctional landscapes and climate resilient communities: An operational guideline*: As part of AR exiting strategies, we have prepared a document that provides key steps that need to be undertaken to create multifunctional landscapes and climate resilient communities sustainably. The main objective of the document is to provide an overall guideline that can facilitate the implementation of integrated sustainable land management (SLM), soil and water conservation (SWC) and climate-smart practices to restore degraded landscapes and create resilient communities within those landscapes. The document can be used by development workers and subject matter specialists (SMS) to work with the community and other partners to address land degradation issues and create multifunctional landscapes that can provide multiple services to multiple users.

The examples provided generally relate to the highlands of Ethiopia, which can be applied elsewhere. The main steps related to landscape restoration through land and water management interventions include (Figure 5):

(a) sensitizing local communities about the observed problems and what needs to be done;
(b) co-identifying priority areas of interventions (hotspot areas) and their detailed characterization considering potentials and constraints;
(c) co-identifying suitable and profitable land and water management options including detailed characterization of needs and requirements of those technologies;
(d) implementing the land and water management practices through matching options (identified technologies) with context (landscape characteristics);
(e) generating evidences about the performances of the various land and water conservation practices implemented in the areas under consideration;
(f) developing framework and strategy to guide scaling to other areas and communities.

The guideline is under review by the team and will be available for use shortly.

Figure 5. Framework to guide identification of hotspot areas (diagnose, characterize the areas constraints, potentials), identify SLM options to target the hotspots, characterize the options (requirements, constraints, potentials), match options with context (implement options) and assess impacts including trade-offs.



## Capacity development

There was long-term support for PhD students and there are seven PhD students that have been and are being supported through this project. A total of 722 beneficiaries (326 male farmers, 146 female farmers, 225 male experts and 25 female experts) able to engage in tree planting scheme on degraded landscapes of the Amhara region.

# RHoMIS studies

## Introduction of planned research activities

As the Africa RISING program draws towards the closing stage, it is necessary to evaluate the effects of the promoted agricultural practices in relation to desired system outcomes. The practices have now been used in various combinations and a degree of scaling has occurred, both intentionally via scaling partners and organically via farmer-to-farmer dissemination. This work builds upon the household surveys conducted in 2018, which led to the publication of an evaluation to the degree of "sustainable intensification" achieved in each site (https://cgspace.cgiar.org/handle/10568/115011) and an evaluation of the program return-on-investment in Ethiopia (https://cgspace.cgiar.org/handle/10568/117272).

The proposed study will entail collection of another household survey dataset using the same RHoMIS tool. The content of the survey will cover agricultural practices, production, incomes and consumption; livelihood issues including incomes, market engagement and non-farm incomes; food security indicators including potential calorie availability, food insecurity experience, food group consumption and household dietary diversity; gender related issues such as female and male decision-making over income streams and farm produce, gendered decision-making over agricultural planning and gendered labor breakdowns. Importantly, the survey will also cover adoption and dissemination dynamics of the promoted technologies. The populations sampled will be drawn from the phase 1 research kebeles (exuding those in Tigray due to the ongoing conflict). Additionally, a reduced-length survey will be conducted within the Phase 2 scaling kebeles (excluding Tigray). This reduced-length surveys will contain only basic information on household demographics, land and livestock assets and non-farm income (sufficient for classification of respondents into a resource-typology) and will contain the complete information on technology adoption and dissemination.

An additional complicating factor in sample design is the intention to link the interviewees with previously collected rounds of survey data. The IFPRI-led ARBES survey as conducted in 2014 in Ethiopia and the RHoMIS survey was conducted in 2018. Despite best efforts, there were few (approximately 80) households who had been interviewed in both 2014 and 2018. Those respondents were prioritized for the 2022 survey. There were also households who had been

interviewed in either 2018 or 2014, but not both and who remained engaged with the Africa RISING project. Those households were identified as a second priority tier. Households who had been interviewed in 2014 but were not subsequently engaged in the program activities were also prioritized with the intention to be used as a counterfactual, in the absence of a control-group experimental design. The remainder of households required to make up the sample were drawn from the pool of respondents within the communities who were engaged in program activities but had not been previously surveyed. The respondent IDs and correspondence to previous survey datasets have been recorded.

There are multiple intended analyzes of these data. Firstly, the trial, adoption and dissemination of the various technologies (individually and in combination) will be assessed, both in the phase 1 and phase 2 locations. A resource typology will be explored as an explanatory factor in adoption rates. The observed adoption rates can then be scaled up across the full population of the phase 1 and phase 2 regions, using the resource typology to nuance the predicted adoption rates. The dissemination information can also be used to estimate the organic spillover rates of farmer-to-farmer knowledge exchange (this also related to the proposed study of scaling processes; and the study designs have been coordinated). Secondly, we will evaluate the effects of technologies, in terms of direct impacts (e.g. wheat production increased), secondary impacts (e.g. increased wheat sales and income gain) and indirect impacts / outcomes (e.g. improved food security). The research design will not allow for water-tight evaluation of such issues, rather we will construct and patchwork of evidence for these various issues. The starting point will be the reported direct impacts from experimental data conducted by the scientists conducting the component research. We will then validate or modify these based on evidence from within the survey datasets (both by comparing within the 2022 survey and by comparing between the survey datasets from different years).

Production gains will be valued where sold or valued as calories where consumed at local market prices. The outcomes are the most difficult to accurately assess, these will need to be done on a portfolio basis–i.e. the net effect of combined packages of innovations on different wealth classes of respondents in each of the three study regions. The outcome issues will be assessed using by reference to the 2014, 2018 and counterfactual datasets. Outcome issues include (but are not limited to) food security, sustainable natural resource management, investment in human and agricultural capacity, gender equity and innovation capacity. Thirdly, the work on adoption rates and the impacts of technology bundles will be combined to produce an updated return on investment calculation. This will contain tiered scenarios of certainty and differing timelines for benefit estimation.

Fourthly, the longitudinal datasets will be analyzed from a “change over time” perspective, to be led by colleagues from IFPRI. This will entail comparison of the various subsample groups. It will look at farming behaviour changes, livelihood and welfare indicators and compare site

conditions between the time points. The typology and needs assessment which was carried out during the initial phases of Africa RISING may be revisited and re-evaluated as a means to assess change.

The fifth intended analysis of the dataset is to provide intelligence for further work within the study regions. The OneCGIAR initiative "Sustainable Intensification of Mixed Farming Systems" will work in similar locations and with a similar mandate. Building on the progress made in Africa RISING and the knowledge gained, will be essential to ensure the best outcomes of the initiative in Ethiopia. Analyzes can include a new needs assessment and typology for targeting of technology bundles; a positive deviant analysis to assess feasible but inspirational achievements; and a farm level modeling and design exercise to inform future activities.

## Objectives of the planned activities

- Deliver another RHoMIS household survey and dataset [Achieved]
- Updated and improved assessment of adoption of interventions and intervention bundles [In progress]
- Assessment of direct and indirect outcomes due to interventions and intervention bundles [In progress]
- Develop improved Return on Investment assessment study [In progress]
- Contribute to scaling study [In progress]
- Contribute to study on Gendered Impacts of Technologies [In progress]
- Contribute to longitudinal assessment of farm- and site-level changes [In progress]
- Contribute to situation analysis for follow-on work [In progress]

## Methods used to undertake planned activities

The survey design was completed using the RHoMIS toolkit. Sampling was carried out using the same method as the 2018 survey, intended to give representative information for all program participants, along with the full range of engagement profiles. Sampling of phase 2 locations followed the same approach, however, not all woredas could be included due to the sheer numbers, therefore more recently engaged woredas were prioritized. Survey implementation was via an Ethiopian consultancy service who specialize in data collection for development oriented research and implementation organizations. Data collection was conducted in May 20222. Implementation reports are available. Data were cleaned and processed using the R software environment and using standard protocols for this type of survey data (e.g. https://github.com/l-gorman/rhomis-R-package). Analyzes will be conducted using a variety of desk based methods, including statistical analyzes and the farm design model. Integrating analyzes with other program activities is planned and will include drawing on experimental data as well as drawing on other studies during the current round of work–on the dynamics of

scaling and diffusion of planting materials and on the gendered implications of the promoted technologies.

### Beneficiaries / people engaged in the study and training

People conducting/conducted the study
One mid career M&E consultant (Ethiopian, male). Capacity building achieved–sensitization to digital survey tools, sample design, reporting requirements.
Fifteen early career data collectors (some recent graduates, some from government and national research institution staff). All Ethiopian, 14 male, 1 female (an unfortunate gender balance, which was justified by the consultant in charge of recruitment that due to the various conflicts during the time of the data collection, few women were willing to travel to rural areas.) Capacity building achieved–sensitization to ODK surveys, development program strategy and evaluation methods.
One MSc student to analyze dataset (Dutch, male).
CGIAR staff engaged: Three scientific staff (ILRI, IFPRI), one post doc (ILRI).
Beneficiaries engaged in study
Seven hundred fifty one respondents interviewed in the Phase 1 research kebeles; 503 respondents interviewed in the Phase 2 scaling kebeles.

### Lessons/messages

As yet no lessons or messages are coming from this work, as the data collection and preparation phases have been completed but the analyzes have not.

### Challenges

No major challenges have yet been encountered. There were some minor challenges with identifying the required households to construct the various subsamples, but from initial inspection it appears that there are sufficient numbers for the planned analyzes to be performed.

## Gender studies

### Introduction of your planned research activities

Sustainable intensification is an important development goal and may be achieved through improvements in productivity, economic performance, environmental compatibility and human and social capital. Sustainable intensification can also support household and communities' abilities to adapt to climate change. In Ethiopia, gender inequalities in the areas of labor

division, decision-making over productive resources, technologies and access to credit and extensions services often exist. Women tend to be marginalized or altogether excluded from important processes such as deciding whether to adopt a new labor saving technology. Additionally, women's unpaid labor may be used when technology adoption incurs additional labor. Such circumstances and their implications for sustainable intensification, particularly in the areas of human and social capital, require a critical research lens to understand the gendered effects of technology uptake and scaling to support sustainable intensification. Women's participation and decision-making ability is critical to support agricultural sustainability; however, women often exercise limited decision-making in households and communities. Women's relatively lower levels of control over household resources, relative to men, were frequently cited by men and women in the FGDs as a factor that hampers women from participating in agricultural research. Also, women who have small plots located further from the main road often do not participate in testing technologies.

Gendered divisions of labor commonly influence women and men's labor distribution in productive and domestic tasks. Women carry most of the burdens of domestic tasks and additional labor associated with technologies to improve production often results in gender specific effects that increase women's time poverty. These outcomes are often linked to women's position in the household and gender roles about specific tasks.

Africa RISING's mandate is to implement sustainable intensification and to scale up successful agricultural intensification practices that have positive impacts, including supporting gender equity and enhancing women's access to and control over productive outputs, income and assets. Africa RISING is in its second phase and is scaling successfully trialled technologies that include animal feeds, crops, soil and water and mechanization. The proposed research will provide a socially differentiated and relational understanding of adoption of technologies and implications for scaling in households and communities.

## Objectives of the planned activities

The main objectives were to understand:

- Context: site characteristics, e.g. markets and gender roles and practices in farming
- Technologies: dissemination and mechanisms of access
- Technology performance: uptake, reasons for uptake, lack of uptake and explanations for lack of uptake
- Technical and social interactions: social factors influence uptake and technology uptake influences social roles and practices in the household

## Methods used to undertake planned activities

Study sites were selected in close collaboration with Africa RISING field coordinators in North Shewa and Hadiya zones. Criteria of selected sites included both research sites and scaling sites, promotion of diverse Africa RISING technologies and sites with both adopters and non-adopters (Table 14).

Table 14. List of study sites for the qualitative study

| Regional state | Zone | Kebele | AR site | Distance from zonal town (in kms) |
|---|---|---|---|---|
| Amhara | North Shewa | Gudo Beret | Research | 27 |
| Amhara | North Shewa | Angolela | Research | 10 |
| Amhara | North Shewa | Gerba | Scaling | 65 |
| Amhara | North Shewa | Wole | Scaling | 47 |
| SNNPR | Hadiya | Jawe | Research | 8 |
| SNNPR | Hadiya | Upper Gana | Research | 13 |
| SNNPR | Hadiya | Morsuito | Scaling | 18 |
| SNNPR | Hadiya | Dubanicho | Scaling | 11 |

Qualitative data were collected through key informant interviews and FGDs. Purposive sampling techniques were used to identify key informants and participants of FGDs. Participants of the key informant interviews included the Africa RISING field coordinators, experts from the Office of Agriculture and progressive farmers in the selected sites. Participants of FGDs were men and women farmers, both adopters and non-adopters of the technologies promoted by the Africa RISING program.

## Beneficiaries / people engaged in the study and training

Data were collected in May and June 2022 in North Shewa sites in Amhara and Hadiya sites in SNNPR regional states using key informant interviews and FGDs as detailed in Table 15. Key informant interviews were conducted with Africa RISING field coordinators, experts from the Office of Agriculture and progressive farmers. FGDs were conducted using a semistructured interview guide.

Table 15. Fieldwork schedule

| Timeline | Activity | Location |
|---|---|---|
| 23–24 May | Enumerator training | Addis Ababa |

| | | |
|---|---|---|
| 26–30 May | Fieldwork in 2 scaling and 2 piloting sites in North Shewa | Basona Worena woreda (district), North Shewa |
| 09–13 June | Fieldwork in 2 scaling and 2 piloting sites in Hadiya | Lemo woreda, Hadiya |

FGDs were sex disaggregated and each FGD comprised of 9 participants on average. In total, 9 key informant interviews and 16 sex disaggregated FGDs were conducted (Table 16). Questions in the key informant interviews focussed on understanding the social context including gender roles and responsibilities and access to agricultural information and services, technological practices, decision-making around technologies and impact of technologies. Key informant interviews and FGDs were held in Amharic and Hadiyisa languages. All the data were transcribed and then translated into English.

Table 16. Men and women participants of FGDs

| Kebele | Women | Men | Total |
|---|---|---|---|
| Gudo Beret | 10 | 10 | 20 |
| Angolela | 10 | 10 | 20 |
| Gerba | 7 | 10 | 17 |
| Wole | 10 | 9 | 19 |
| Jawe | 9 | 10 | 19 |
| Upper Gana | 10 | 8 | 18 |
| Morsuito | 10 | 10 | 20 |
| Dubanicho | 10 | 10 | 20 |
| Total | 76 | 77 | 153 |

## Lessons/messages

- Gender norms constrain women's movement within the community. Restricting movements was more pronounced in Hadiya sites compared to North Shewa sites.
- Decisions on adoption of new technologies and innovations were made first at community level followed by the household level. FGD participants explained that community members, represented by the household heads, learn about the new technologies and innovations available in the kebele from the agricultural extension personnel.
- Decision-making processes on adoption of new crop varieties began with the office of agriculture. The agriculture extension personnel provide trainings to progressive farmers who play important roles in field trials and demonstration activities. Progressive farmers then demonstrate the new varieties to other framers. The progressive farmers engage in scaling up of the technologies to other farmers with trainings and demonstration activities.

- Men and women make joint decisions on trying and adopting new varieties at the household level. However, it was observed that women were often not included as progressive farmers because of low literacy level, limited access to resources and information compared to men.
- The AR interventions had positive impacts on improvement of practices and efficient use of improved technologies and resources.
- Technologies and innovations in livestock fodder and feeds have gendered impacts as they reduced the time and labor men spend in search of grass or other feeds.
- Capacity development of farmers through trainings, demonstration activities and awareness development on relevant technologies and innovations increased motivation, awareness, and skills.
- Availability of improved technologies through AR and technical support from agricultural experts at kebele levels played a key role in uptake of technologies by men and women.
- Distributing benefits from adopting new technologies were often made jointly. Income generated from adopting new technology was often spent on household needs, such as covering expenses of school, clothing for children or investing in livestock.
- Women invest significant time and labor working on the farm and underestimations of their contribution aggravates existing gender inequalities. More gender responsive technology approaches are recommended.

## Challenges

- Gender norms and cultural constraints restricted women's movement out of their homesteads, thereby excluding them from opportunities in interacting, learning and exchanging with others and from taking up leadership roles in their community.
- Men and women reported that they needed more agricultural equipment, like potato storage facilities, threshing machines, combine harvesters, mowing and sowing machines to assist them in lowering the cost of production.
- There is an inadequate supply of improved technologies like improved seed varieties and improved cattle breeds.
- Women's poor access to water for irrigation incurs additional labor for women because they fetch water. In addition, the high demand for time and labor in avocado production increased the workload of women but not men. This situation highlights the importance of considering gendered workloads and increased access to productive resources to improve women's potential to benefit.
- Women in Hadiya reported several challenges:
  - extension agents do not consult women unless they are the household head
  - women are not normally called for kebele meetings
  - agents do not train women through home visits and at the FTC

- It was observed that women were not represented well as progressive farmers attributed to low literacy level, limited access to resources and information compared to men.
- Men dominate discussions at the community level. Women's participation in the discussion was limited to women in female headed households. Married women and youth seldom participate in community meetings where major decisions on the prioritization and choice of technologies are made. However, they participated in the decision-making processes about whether to adopt technologies at the household level.

# Spillover assessment of crop and forage innovations

## Introduction of your planned research activities

Africa RISING is now at stage of wrapping up its activities and generating legacy products. The main scaling model identified in the project document were recruiting development partners, capacity building of development partners through technical training on innovations ready to scale and provide supporting research for development partners as they scale the innovations. Practical testing of the model in the initial years showed mixed results. On the one hand, there was huge interest, especially from public extension and farmers' side on AR validated innovations.

On the other hand, there was limitations in planting materials, especially for crop and forage innovations. Hence, in subsequent years, AR started providing critical support in supplying initial planting materials in the form of early generation seeds. This arrangement introduced concepts of direct and spillover beneficiaries. The direct beneficiaries are those farmers who get crop and forage seeds directly from AR. Spillover beneficiaries are those farmers who receive seeds from the direct beneficiaries in subsequent years, either through purchase, loan or gift arrangements. A full understanding of the extent of diffusion of AR innovations, hence, require in-depth knowledge of the diffusion of innovations with various forms of farmer-to-farmers seed exchange mechanisms. This study aims at mapping the farmer-to-farmer exchange of AR introduced cereal, pulse and forage seed among farmers in three of the AR operating areas.

There are various rationales in undertaking this study. First, capturing the direct and spillover diffusion of innovations is an essential first step in undertaking a sound return on investment study. Second, the study would shade light on the difference among social groups in benefiting from AR innovations. Third, the study would also help in deepening our understanding of differences in seed exchange mechanisms for different crops and forage innovations.

## Objectives/research questions of the planned activities

This study aimed at addressing the following research questions:

- How many farmers were reached by AR technologies with seeds shared from the direct beneficiaries?
- What are the main modes of diffusion of AR technologies?
- What are the existing partners of AR and their contribution in scaling improved crop and forage varieties?

## Methods used to undertake planned activities

The study was conducted in AR's operation regions, particularly in Amhara, Oromia and Southern Nation, Nationality and People (SNNP) regions. North Shewa, Bale and Hadia zones were the operation area of the study. All these zones were categorized among highland area in Ethiopia.

A cross-sectional survey research design was deployed to collect primary information from beneficiary farmers and supportive institutions in the study regions. Both quantitative and qualitative research approaches were used to collect the information. The former was used to quantify the level of improved seed diffusion; while the later was used to understand how the improved seed diffused among the farming community.

Kilwinger and Buddenhagen (2021) suggested purposive, snowball sampling to select sample respondents to trace and map seed diffusion. The justification is the difficulty of tracing the second and above generations of seed transfers. In AR project operations, direct seed supply started in 2017/18 and continued through in 2018/19, 2019/2020, 2020/21 production years. The first-round sampling was done on the direct beneficiaries of the four production years. The rest of the sample respondents was selected from next generation beneficiaries using snowballing technique. Each of the first-generation beneficiaries was asked to connect us with one beneficiary they shared seeds with. This was continued to the last generations. If all the direct beneficiaries shared seeds to first generation beneficiaries, a one-to-one snowballing technique was used, whereby each of the direct beneficiaries was asked for a link to one other first-generation beneficiary. If some of the direct beneficiaries did not share seeds to others, the number of snowballed samples was increased for those who shared seeds. The same strategy was used for second and third generation beneficiaries. Accordingly, 115 to 120 HHs were sampled from each study sites. In total, 351 HHs were interviewed for the survey. In addition, 13 different partners were interviewed.

The data were collected ODK and paper questionnaire. ODK was used to collect information from farmers, while the later was deployed to collect information from key partners of AR. The data were managed and analyzed using SPSS (Version-21) and excel spread sheet. The results were presented with table and graphs.

## Beneficiaries / people engaged in the study and training

Target beneficiaries: A total of 351 farmer respondents were interviewed, of which 37 of them were female respondents. In addition, 13 expert interviews were made representing various partner organizations.

## Lessons/messages

The result revealed that from direct beneficiary farmers, the overall spillover effect of AR went up to 2nd generation though it was expected to extend up to 3rd generation. The up taking of improved varieties increases from year to year. However, the percentage of the farmers using an improved variety in the subsequent years decrease because most improved varieties of the crops were easily affected by disease and pest. After the 2nd production year, most improved varieties, particularly wheat (bread and durum wheat), get out of production. Across the three regions, level of up taking of improved varieties varied. In bread wheat, for example, Wane, Tsehay and Dendea were popular in Amhara region; while Hidase and Huluka were popular in Oromia region; and Limu was popular in SNNP region.

Farmers obtain improved seeds from different sources, majorly from their neighbors, cooperative, Africa RISING project and agriculture offices. In Oromia region, FTCs played a significant role in serving as source of improved forage seeds as AR used FTCs to multiply and deliver forage seed to the farming community. In scaling improved varieties, farmers share improve seed to other farmers. Bread wheat is the prominent shared crop followed by faba bean crop in all regions.

On average, a farmer in Amhara region shared improved seed from one to five farmers depending on the crop types. In Oromia region, a farmer shared improved seed to two to six farmers, while in SNNP region, it varies from 2 to 12 farmers depending on the crop types. The study also revealed that AR had various partners to scale improved varieties of different crop and forages. Agriculture office, universities, agricultural research centers, agricultural cooperatives and unions are the key stakeholders in all regions. They collaborate in generating, multiplying, promoting and marketing improved agricultural technologies. For some technologies such as integrated faba bean technologies AR appeared to be the sole research-based player in introducing and promoting technologies; whereas, in other crops, such as improved wheat varieties, AR serves as a catalyst to accelerate the level of uptake of innovations by smallholder farmers through identifying appropriate varieties, facilitating supply of early generation seeds and capacity development of farmers and farmer organizations.
As AR is approaching to an end, the following point should be taken into account to sustain AR efforts after the project phase out period.

- The success stories and challenges of AR operations should be properly documented for future use

- Agricultural office and potential NGOs in AR operation areas need to capitalize on and take over the achievements of AR for a wider scaling of AR prompted innovations
- Sustained efforts are needed for a continuous supply improved varieties for wheat (bread and durum) and faba bean production to overcome disease and pest problems
- Business enterprise development should be the focus of next generation oat and vetch R4D interventions to create business cases along oat and vetch value chains
- Existing local partnership needs to be inclusive of finance and business partners to accelerate the scaling of AR's improved technologies in the study areas

# Assessing opportunities and constraints in scaling some promoted crop and feed and forage innovations.

## Introducing your planned research activities

The second phase of Africa RISING in Ethiopian highlands project focussed on scaling of research results and innovations generated during the first phase of the project. The scaling approaches followed by the project were both heuristic and emergent, which includes scaling targets set by the project team, recruiting potential scaling development partners by CG partners, training of trainers for development partners to create awareness and interest in taking up innovations, multi-stakeholder engagement meetings for annual planning and evaluating scaling targets with development partners, tailored capacity building for development partners and strategic material support to tackle critical constraints.
After almost four years into the scaling work, it is time to assess what worked and what does not work. Our practical observations showed us our success factors and critical constraints. One paper was also published, documenting the scaling processes followed and the results achieved. However, the data for the last paper published was already over two years old. The theoretical direction and empirical data collection methods used were also not aligned with current scaling assessment frameworks adopted by the CGIAR system in general and ILRI. Project level scaling scan assessment workshops using ILRI's impact at scale framework were held, however, they remain only light assessments. The rich practical experiences of AR on scaling of agricultural innovations warrant a rigorous assessment of the processes followed, the results achieved and the limitations observed.

## Objectives of the planned activities

- to document scaling practices of AR Ethiopian highlands (if needed it can also be made for the whole of AR)
- to identify critical areas of support that would amplify our scaling effort in the remaining period of the project
- to develop an exit strategy that would ensure a continuity of scaling of AR innovations

## Methods used to undertake planned activities

Qualitative research was used as research approach to understand in depth enabling environment to scale AR's innovation. As a tool, scaling scan framework was used to identify the potential challenges and opportunities on selected innovations in the study zone. To do so, a series of workshops were held with scaling champion and concerned stakeholders. The first workshop was organized to give briefings on the concept of scaling scan; and to select the prior innovations to scale in wider. This was done by scaling champion, which included crop, livestock and horticulture experts from agriculture offices. Finally, scaling ambitions were set to the selected innovations by respective experts.

In the second workshops, all concerned stakeholders were invited. The participants were from different public, private and civic institutions. In North Shewa zone, the participants were zone office of agriculture, zone livestock agency, zone cooperative and expansion agency, ATA, Tegulet seed multiplication union, woreda seed multiplication cooperative, Debre Birhan Agricultural Research Center, Debre Birhan University and zone seed inspection agency. While in Hadia zone, the participants were from Wachemo University, Areka agriculture research center, Hadiya zone department of agriculture, Licha union and Lemo woreda office of agriculture.

The scaling ingredients for the scaling scan assessment were technology/practice, awareness and demand, business cases, value chain, finance, knowledge and skills, collaboration, evidence and learning, leadership and management and public sector and governance. Scales of the Likert scale included no, this is very uncertain or not enough information to answer, serious doubts, some doubts/unsure, quite confident and yes, this is not an issue for my scaling case.

## Beneficiaries / people engaged in the study and training

A total of 49 beneficiaries, 41 men and 8 women participated in the 4 workshops organized in 2 rounds in the 2 zones.

## Lessons and challenges

Based the results of scaling ingredients assessment, the following potentials opportunities and constraints are determined.

*Opportunities for:*

- faba bean scaling are availability of the technology, adequate knowledge and skill and better awareness and demand on the innovation.
- feeding trough scaling are adequacy of the technology, knowledge and skill and public sector governance supports.
- wheat scaling are adequacy of the technology, awareness and demand and public sector governance supports.

- avocado scaling is adequacy of the technology, attractive business cases and better awareness level on the technology.
- oat scaling are collaboration, knowledge and skill and technology had the highest scoring value in assessing oat scaling in Hadia zone.

*Constraints for:*

- feeding trough scaling are less organized value chain, poor leadership and management and weak collaboration.
- faba bean scaling are absent of functional value chain and financial constraints.
- wheat scaling are less incentive business cases and unstructured value chain.
- avocado scaling are lack of evidence and learning, value chain and financial constraints.
- oat scaling are less structured value chain, lack of evidence and learning and less incentive business cases.

*Recommendations:*

*Faba bean*

- Scale faba bean production through establishing functional value chain to deliver quality seed at the right time and place. This could do through creation of dedicated faba bean scaling stakeholders' platform.
- Financing is a major constraint and there is a need to work with local micro-finance and other financial institutions to reconsider their lending mechanism.

*Feeding trough*

- Feeding trough has a potential to scale even better in North Showa. Hence creating a functional value chain needs to be a priority.
- Stakeholders' platforms need to be established and effectively facilitated to tackle weak collaboration among stakeholders.
- Policy advocacy among local political leaders is essential to fill leadership gap in promoting feeding trough.

*Bread wheat*

- Strengthening functional value chain for scaling bread wheat, through establishing and facilitating focussed bread wheat innovation platforms
- Developing bread wheat information system to address information related constraints and asymmetries in wheat production such as improved seeds and wheat market prices
- Developing affordable wheat financing schemes for inputs purchase such as improved seeds and chemicals

*Avocado*

- Developing an alternative financing system to finance avocado production
- Developing the capacity of farmers to graft seedlings at the farmer level
- Developing an avocado value chain, through establishing input–output marketing cooperatives

*Oat forage*

- Establishing and strengthening oat value chain to foster oat seed production system and to make the sector economically important
- Developing an evidence based on oat forage and seed production in Hadia zone to assist evidence-based decision by zonal actors
- Creating business cases for oat production for different actors along the value chain

# Establishing feed and forage innovations technology parks

## Introducing your planned research activities

The Ethiopian highlands project of Africa RISING program led by the International Livestock Research Institute (ILRI) has been doing successive research for development activities around various feeds and forage varieties and their use at its research sites in Ethiopia. Some of the feeds and forage technologies validated through the on-farm participatory research has already gone to the scaling level at the different zones and woredas in SNNPR, Tigray, Amhara and Oromia regions through government extension systems and other development partners. The project has been providing basic planting materials and attempting to establish local seed production and dissemination systems for forages using different modalities including FTCs, model farmers, cooperatives and seed enterprises. Though there are some promising results in terms of producing forage seeds locally, these efforts need to be couched and nurtured by a local institution especially after the project's lifespan.

The feeds and forage technologies which are in the scaling channel are distributed to the different zones, woredas, kebeles and individual farms at different levels. Practical trainings are provided to the users of these technologies through training of trainers (ToT) and preparing user manuals or fact sheets. As the project is short lived and may not continue providing these services in the long run, local institutions must take over these responsibilities and continue providing technical support and research support to the famers who are planting and using these technologies.

## Objectives of the planned activities

- To create a learning platform or exposure for university student, farms, extension workers and experts who are interested to learn and use the feeds and forage technologies
- To use the forage plots as a source of basic planting material for future seed multiplication and dissemination for different research or development purposes
- To provide options to researchers in universities and local research systems using these validated feeds and *forage technologies*

## Methods used to undertake planned activities

Activities

- Conduct preliminary discussion with selected partners relevant to meet the objectives at three of the sites (Oromia, Amhara and SNNPR)–ILRI to initiate
- Identify suitable location/s with the selected and agreed partners–ILRI and partners
- Develop the list of technologies and the layout of plots to be established at each site–ILRI
- Procure the planting materials for the selected technologies–ILRI
- Plot preparation and fencing–partner
- Planting–partner with the guidance of ILRI
- Field management (weeding, pest management, watering and harvesting)–partner

Roles and responsibilities

**ILRI**

- Develop the list of candidate forage varieties and feed conservation technologies relevant to each project site
- Initiate discussions in assessing interest and willingness of partners to take part in establishing the technology parks. This may require traveling of the project team to the sites and hold face to face discussion and site selection
- Procure planting materials of listed technologies (Table 17)
- Prepare plot layout and guide planting and field management of the planted materials (Photos 18 and 19)
- Bear cost of initial establishment including fencing, planting and weeding for the establishment season
- Provide fact sheets for each technology to be used for training purposes

**Partners**

- Allocate plot of land (400–500 $m^2$) required to accommodate the technologies to be established
- Provide labor (cost to be covered by ILRI) for establishing the forages
- Ensure fences and planted materials are protected from people and animal disturbance
- Avail water and irrigation system to irrigate the forages during pick dry season
- Takeover the responsibility of managing and maintaining the park after the establishment season and ensure it is used for the intended purposes
- Provide access to farmers, extension workers and other partners who want to visit the plots and share experience

Table 17. List of technologies and area of land required

| Species | No. of accessions/ plots | Plot size/accession ($m^2$) | Total area ($m^2$) |
|---|---|---|---|
| Napier grass | 3 | 12 | 36 |
| Panicum | 2 | 12 | 24 |
| Brachiaria | 2 | 12 | 24 |
| Desho | 1 | 12 | 12 |
| Alfalfa | 1 | 12 | 12 |
| Desmodium | 1 | 12 | 12 |
| Oats | 1 | 12 | 12 |
| Vetch | 1 | 12 | 12 |
| Fodder beets | 1 | 12 | 12 |
| Tree lucerne | 1 | 12 | 12 |
| Sweet lupin | 2 | 12 | 24 |
| Feeding trough | 1 | 24 | 24 |
| Napier grass | 3 | 12 | 36 |
| Desho vetch intercrop | 1 | 12 | 12 |
| Napier desmodium intercrop | 1 | 12 | 12 |
| Oats vetch intercrop | 1 | 12 | 12 |
| Feed shade | 1 | 24 | 24 |
| Total area (excluding pathways) | | | 312 |

## Beneficiaries / people engaged in the study and training

Local university (students and instructors), research institutions and extension experts can benefit from feed and forage technology parks. It is too early to report the number of beneficiaries at this early stage of establishing the technology parks.

## Lessons/messages

- The project has been providing basic planting materials and attempting to establish local seed production and dissemination systems for forages using different modalities including farmer training centers, model farmers, cooperatives and seed enterprises. Though there are some promising experiences in terms of producing forage seeds locally, these efforts need to be couched and nurtured by a local institution especially after the project's lifespan.
- As the project is short lived and may not continue providing training and forage planting material seed delivery services in the long run, local institutions must take over these responsibilities and continue to provide technical support and research support to the famers who are planting and using these technologies.

Photo 18. On-farm forages technology park at ILSSI/Africa RISING site, Kambata, SNNPR.



Photo 19. Feeds and forages technology park under establishment at Wachemo University, Lemo Africa RISING site.



## Challenges

- The park at Wachemo University has been planted earlier than that of Sinana site and is already catching eyes of the students and instructors in the animal production department.
- Some staff visiting the park expect this is again another project coming with resources to hire them and create unnecessary expectations though ILRI staff and the management of the institute continue to explain the objective of the park.
- Attempt was made earlier to establish such parks in a form of mother–baby plots at individual farmers' sites, but it could not be successful as farmers needed their land for planting other crops on subsequent growing seasons.

# Capacity development at the project level

The Africa RISING project in the Ethiopian highlands managed to conduct different capacity development programs including training, field visits, field days, workshops and meetings and reached over 4,989 beneficiaries in the current reporting period (Table 18). Two MSc new students were attached to the project during this reporting period, while three students (one PhD and two MSc) graduated. The project has currently 14 students (Table 19).

Table 18. Africa RISING capacity development for 2022 (01 April–30 September 2022)

| AR site name | Activity | Farmers (M) | Farmers (F) | Experts (M) | Experts (F) | Others (M) | Others (F) | Total |
|---|---|---|---|---|---|---|---|---|
| Basona | Field days | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Meetings | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surveys | 410 | 90 | 12 | 2 | 7 | 4 | 525 |
| | Training | 376 | 67 | 32 | 11 | 4 | 0 | 490 |
| | Visits | 16 | 2 | 11 | 1 | 33 | 5 | 68 |
| | Workshop | 0 | 0 | 10 | 0 | 5 | 1 | 16 |
| *Basona total* | | 802 | 159 | 65 | 14 | 49 | 10 | 1,099 |
| Lemo | Field days | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Meetings | 0 | 0 | 9 | 1 | 0 | 0 | 10 |
| | Surveys | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Training | 410 | 57 | 20 | 4 | 0 | 0 | 491 |
| | Visits | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Workshop | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Lemo total* | | 410 | 57 | 29 | 5 | 0 | 0 | 501 |
| Sinana | Field days | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Meetings | 0 | 0 | 8 | 0 | 1 | 0 | 9 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Surveys | 459 | 55 | 38 | 9 | 11 | 0 | 572 |
| | Training | 340 | 44 | 52 | 16 | 15 | 0 | 467 |
| | Visits | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Workshop | 20 | 16 | 80 | 48 | 24 | 5 | 193 |
| *Sinana total* | | 819 | 115 | 178 | 73 | 51 | 5 | 1,241 |
| *Various* | | | | | | | | *2,148* |
| *Various total* | | | | | | | | *2,148* |
| *Grand total* | | | | | | | | *4,989* |

Table 19. List of students attached to the Africa RISING project in the Ethiopian highlands

| Name | University | Affiliation/ program | Thesis title | Duration and status |
|---|---|---|---|---|
| Mekonnen Misganaw | Haramaya University | ICARDA/PhD | Genetic analysis and biochemical profiling of faba bean (*Vicia faba* L.) genotypes resistance *Orobanche crenata* | 2018–22 / data collection and writing |
| Anteneh Ademe | Addis Ababa University | ICARDA/PhD | Genetic diversity of pea seed borne mosaic virus and identification of sources resistance from lentil genetic resources | 2018–22 / data collection |
| Beyene Bitew | Haramaya | ICARDA/PhD | Genetic identity, epidemiology and management of faba bean gall disease in Ethiopia | Writing thesis |
| Getachew Kiros Gebremariam | Raya University | ILRI/MSc | The impact of Insosila production on household income and asset accumulation: The case of Endamehoni Woreda, Tigray region | 2020–22 / Finalized writing the thesis |
| Beletew Bekele | Debre Birhan University | ILRI/MSc | The effect of cutting height and frequency on biomass yield and foliage nutritional quality of tree lucerne | 01 June–30 November 2021 |
| Melkamu Berhan | Wachemo University | ILRI/MSc | The effect of intercropping Desho grass with vetch on biomass yield, nutritional quality and soil nutrient dynamics | 1 June–30 November 2021 (Completed) |
| Amisalech Martsa | Arba Minch University | ILRI–ICRAF/MSc | Rhizobial inoculant development for forage legumes alfalfa (*Medicago sativa*) and vetch (Vicia villosa) | 2022/23–Soil samples collections |

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|---|---|---|---|---|
| Hussen Dawud | Arba Minch University | ILRI–ICRAF/MSc | Rhizobial inoculant development for forage legumes lupin (*Lupinus albus*) and tree lucerne (*Chamaecytisus palmensis*) | 2022/23–Soil samples collection |
| Yonas Getaneh | Addis Ababa University | CIAT/PhD | Analyzing risks of the Ethiopian Rift Valley lakes and proposing suitable management options | 2019–22/data collection and writing |
| Berhan Mohammed | Addis Ababa University | CIAT/PhD (partial support) | The effect of water hyacinth on fish and fisheries in Lake Tana under natural and experimental conditions | 2018–21 |
| Ashenafi Ali | Addis Ababa University | CIAT/PhD (partial support) | Soil resources mapping using machine learning techniques | 2021–24 / proposal writing |
| Habtamu Sewnet | Addis Ababa University | CIAT/PhD (partial support) | Spatially explicit land use and land management optimization to facilitate informed decision-making | 2021–24 / proposal writing |
| Meseret Dawit | University of Johannesburg | CIAT/PhD | Optimizing irrigation efficiency of surface–groundwater with respect to climate change and gender sensitivity | 2017–22 |
| Abera Assefa | Haramaya University | CIAT/PhD | Hydrological processes and ecosystem services under different land use/cover and management practices in the changing climate of central Rift Valley, Ethiopia | 2018–22 |
| Konjit Abreham | Hawassa University | ICRISAT/MSc | Effects of topography and different land use systems on selected soil properties and phosphorus absorption characteristics at upper Gana sub-watershed, Hadiya zone, Southern Ethiopia | 2019–21 writing thesis |

## Communications and knowledge sharing

The main communication channels supported are:

- Wiki internal workspace: http://africa-rising-wiki.net/Home
- Project updates on the program website: africa-rising.net/category/countries/ethiopia/
- A Yammer network with internal updates
- Photos: https://www.flickr.com/photos/africa-rising/sets
- Repository: https://cgspace.cgiar.org/handle/10568/16500

# Events from our sites, coordination office and CGIAR partners

## CGIAR centers

**16–18 May 2022:** Climate smart livestock feed and forage innovations, training workshop, Bahir Dar.
**24–25 May 2022**: Forage seeds production as a business: Learning workshop. ILRI campus, Addis Ababa and Bishoftu.
**07–08 June 2022:** Media training workshop on climate smart feed and forage innovations. ILRI campus, Addis Ababa and Debre Birhan.
**19 July 2022**: Africa RISING project in the Ethiopian highlands project coordination, ICRAF CGIAR partners and Lemo site coordinator discussed how to document some important stories of avocado in the project site and beyond–Virtual.
**25 July 2022**: Africa RISING project in Ethiopian highlands project coordination team and site coordinators discussed project activities and field updates.

## Coordination office

**06 April 2022:** Africa RISING project coordination team, ILRI-feed and forage research team and site coordinators discussed the feed and forage technology parks progress update–Virtual.
**26 July 2022:** Africa RISING project in the Ethiopian highlands discussed the extension manual preparation with CGIAR partners–Virtual.
**28 July 2022**: Africa RISING project in the Ethiopian highlands discussed the way forward: Policy brief preparation with CGIAR partners–Virtual.

## Africa RISING sites

**Amhara**
**June 2022**: Africa RISING Basona site effectively organized 'Training on forage production and management' for farmers and development agents (DAs) in the month of June 2022. The training was conducted at three woredas and six kebeles in Basona Worena woreda Gudo Beret and Angolela kebeles, Moretina Jiru woreda Gerba and Bollo kebeles and Hager Mariam woreda Debre Tsige and Kume Dingay kebeles were addressed. The training focussed on cultivated forage production options for the highland and mid-altitude of the North Shewa zone, integrated forage production methods, forage seed production, crop residue management and nutritional improvement and post-harvest feed management. The issues of inputs for forage seeds, effective microbe (EM), molasses and AI service were the major discussion points in all the kebeles. A total of 443 farmers, 29 kebele DAs, 8 woreda experts, 2 woreda livestock heads and one zone expert were part of the training.

**Oromia**

**30 March to 08 April 2022:** Africa RISING technology spillover survey was conducted in Sinana. The objective was to assess how agricultural innovations diffuses through farmer networks between 2017–20. The survey work covered AR technology dissemination from 2017 to 2020 in AR target woreda and scaling woredas. A total of 114 farm hhs (17 Females) direct beneficiary farmers, first generation (farmers who benefited from direct beneficiary farmers) and second-generation farmers were interviewed from Sinana, Goba and Dinsho districts. Key informant interview from institutions was zonal level extension office, target woreda extension office, DAs from selected kebeles, primary cooperative heads, Oromia seed enterprise and Madda Walabu University were included.

**14–19 April 2022:** Sinana research site successfully facilitated the purchase, transportation and delivery of livestock feed support for drought-affected pastoralists of Bale zone. The objective was to deliver emergency support for pastoralists who were severely affected by drought in the lowlands of Bale zone. Based on the assessment result of Bale zone disaster risk reduction management office and Bale zone agriculture and NRM office, Madda Walabu district was identified as the first in its severity. Crop residue was purchased from Oromia seed enterprise. Five big trucks with a carrying capacity of 400 bells each and a total of 2,000 bells (50 t) were transported. Distribution was done directly to farmers in five kebeles of Madda Walabu district. The purchased feed able to support 1,000–1,500 hhs. Bale zone administration vice head was grateful to Africa RISING project for the timely support delivered to severely drought-affected pastoralists in Madda Walabu district. The beneficiary farmers were also thankful for the project.

**30 May–14 June 2022:** Sinana research site facilitated RHoMIS survey. The objective of the survey was to collect diverse information from randomly selected farm hhs and to quantify on- and off-farm pathways to food security, diverse diets and reduced poverty of rural smallholder farm households. A total of 400 hhs were addressed from three districts (Sinana, Goba and Agarfa) and eight kebeles.

**30 June–01 July 2022:** The site coordinator in Sinana successfully facilitated the delivery of cultivated forage management and use of training in AR Sinana site for experts and DAs organized at zonal level. The objectives were to refresh experts and kebele DAs on animal feed management and use, to enable experts and DAs to use ILRI's on farm feed advisor tool (software) so that they can support farmers in ration formulation. A total of 30 experts and DAs from 3 districts engaged in the training. Experts from woredas, DAs and zonal as well as woreda higher officials were motivated by the training and decided to implement the experience and knowledge acquired through the two days training. The woreda agriculture heads/vice heads expressed their full commitment to support and facilitate the training delivery in each kebele.

**02–19 July 2022:** Cultivated forage management and use training was organized for DAs and farmers in the three target woredas. This training was delivered immediately after the training was delivered for experts and DAs at zonal level. The objective was to equip farmers and kebele DAs with knowledge and skills of cultivated fodder production, management and use; to train farmers and DAs on post-harvest feed management and use. Africa RISING contact persons who trained on the cultivated forage management and use in Bahir Dar translated the training materials into local language and contextualized before the training delivery. Zonal contact person and the site coordinator supported them in translating the contents. The translation made better understanding among farmers and DAs during the training delivery. It was engaging and followed by field visit and practical works like crop residue treatment using EM. Farmers were very happy by the training and motivated to apply the experience and knowledge they grasped through the training. Farmers and DAs were thankful to the AICCRA/Africa RISING projects. We were able to address above 460 participants including farmers, DAs and experts.

**27 August 2022**: Sinana district agriculture and NRM office organized a warm ceremony to celebrate their annual success. The objective was to celebrate their success and to acknowledge the key stakeholders who take part in this achievement. In competing with all sectors within the district as well as all districts of Bale zone, the woreda ranked first in agricultural production and productivity, irrigation activities, livestock and NRM aspects in July 2021 and June 2022. The woreda was awarded cup and certificate for its best achievement. On this ceremony, AR site coordinator was invited to represent ILRI/Africa RISING as one of the key stakeholders. All Africa RISING project activities were mentioned and AR awarded certificate for having highest share/contribution for the impacts within the woreda. The woreda was grateful to the project for having significant involvement in agriculture sector within the woreda and within the zone in general.

**SNNPR**

**24 April 2022:** Africa RISING Lemo research site in collaboration with Wachemo University held a technology park establishment meeting. The meeting was aimed to discuss possible ways to establish technology parks in Lemo Africa RISING site.

**03 June 2022:** Africa RISING Lemo research site organized training on avocado nursery establishment and management for farmers and development agents from Jewe, Shurmo and Upper Gana kebeles. The training supported participants to acquire basic skills in proper seedling beds, sawing and pot preparations.

Africa RISING Ethiopia highlands outputs by type

## Journal articles

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Mekonnen, K., Bezabih, M., Assefa, G., Adie, A. and Gebreyes, M. 2022. Fodder trees and shrubs in the Ethiopian highlands: Service and product functions. Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA). https://hdl.handle.net/10568/119884

Mekonnen, K. 2022. Planned and ongoing Africa RISING activities and studies for 2022 in the Ethiopian highlands. Presented at PCT (Program Coordination Team) and Chief Scientists Meeting, 30 August 2022. Nairobi, Kenya: ILRI. https://hdl.handle.net/10568/121093

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Blogs

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https://africa-rising.net/podcast-optimizing-food-feed-production-in-smallholder-systems/

**Improved troughs are reducing feed wastage in Ethiopia**
https://africa-rising.net/improved-troughs-are-reducing-feed-wastage-in-ethiopia/

**Africa RISING contributes to sustainable agricultural intensification in the Ethiopian highlands**
https://africa-rising.net/africa-rising-contributes-to-sustainable-agricultural-intensification-in-the-ethiopian-highlands/

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## Opportunities and challenges

Opportunities

- Increasing demand for the Africa RISING validated technologies/innovations.
- Alignment of most Africa RISING validated technologies/innovations with development priorities Ethiopian government.

- Strong partnership with CGIAR Centers, local universities, research institutions, extension services, NGOs, communities, private entrepreneurs and development partners.

Challenge

- The conflict in the northern parts of Ethiopia stopped the AR project not to operate in its Endamehoni site.

## Project partners

Table 20. Africa RISING partners in the different regions and sites in 2020

| Partner | Region and site | Organization type |
|---|---|---|
| Inter Aide France | SNNPR/Lemo | NGO |
| Send-a-Cow | SNNPR/Lemo | NGO |
| World Vision | SNNPR/Lemo | NGO |
| Cooperazione Internationale Ethiopia (COOPI)-Ethiopia | Oromia/Sinana | NGO |
| Livestock and fishery development offices and agriculture and natural resources development offices | SNNPR, Amhara, Oromia and Tigray | Government |
| Graduation with resilience to achieve sustainable development/Relief Society of Tigray (GRAD/REST) | Endamehoni in Tigray | NGO |
| Raya Brewery | Endamehoni in Tigray | PLC |
| Oromia Seed Enterprise | Bale Robe in Oromia | Government |
| Local universities | Madda Walabu, Wachemo, Debere Birhan, Mekele and Raya universities | Government |
| Farmers Training Centers (FTCs) | Bale in Oromia, Lemo in SNNPR and Basona in Amhara region | Government |
| Saint Mary and Maichew ATEVT colleges | Tigray | Government |
| Regional research institutions | ARARI, SARI, IQQO, TARI | Government |
| Mass Media | OBN FM and FANA FM | Government |
| Federal research centers | EIAR | Government |
| Cooperatives and unions | Amhara, Tigray, Oromia and SNNPR | Government and communities |

| | | |
|---|---|---|
| Projects | TAAT, ILSSI, Grass2cash | Collaborative |
| Private entrepreneurs | Faji integrated farm, Eden Field seed company | Private farm |
| International research organizations | ILRI, ICARDA, CIAT, CIMMYT, ICRISAT, IWMI, ICRAF, Bioversity International, IFPRI | CGIAR centers |
| Fruit tree multiplication and training centers | Butajira | Government and communities |

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