Africa Research in Sustainable Intensification for the Next Generation
Ethiopian Highlands project
Technical report, 1 October 2017–30 March 2018

Submitted to:
United States Agency for International Development (USAID)

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April 2018
www.africa-rising.net

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 as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create 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/

This document was made possible with support from the American people delivered through the United States Agency for International Development (USAID) as part of the US Government's Feed the Future Initiative. The contents are the responsibility of the producing organization and do not necessarily reflect the opinion of USAID or the U.S. Government

Contents

Acronyms

Africa RISING	Africa Research in Sustainable Intensification for the Next Generation
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CSVs	Climate smart villages
DM	Dry matter
ICARDA	International Center for Agricultural Research in the Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ILRI	International Livestock Research Institute
MoANR	Ministry of Agriculture and Natural Resources
MOT	Mitigation options tool
N	Nitrogen
NGOs	Non-governmental organizations
NRM	Natural resources management
P	Phosphorus
P_2O_5	Phosphorus pentoxide
PVS	Participatory varietal selection
R^2	Coefficient of determination
R4D	Research for development
s	Second
SARC	Sinana Agricultural Research Center
SNNPR	Southern Nations Nationalities and Peoples region
SWC	Soil and water conservation
USAID	United Stated Agency for International Development
WT	Wheel tractor

Summary

During the 2017 main cropping season, the International Livestock Research Institute- (ILRI)-led livestock research team conducted research for development (R4D) on sweet lupine, faba bean-oat intercropping, alfalfa and fodder beet, and backstopping research on scaling of oat-vetch, tree Lucerne and feeding trough technologies. The average forage biomass yield potentials at 100% flowering for Sanabor and Vitabor sweet varieties were 4.9 and 4.3 t DM (dry matter) ha^{-1}, respectively. Average grain yield at full maturity was 2.61 t ha^{-1} for Sanabor and 2.52 t ha^{-1} for Vitabor. The nutritive value of the forages in terms of crude protein (21.9-22.4%) and in vitro organic matter digestibility (67.4-67.7%) remained similar for the two varieties.

In relation to crops, the International Center for Agricultural Research in the Dry Areas- (ICARDA)-led team conducted research on participatory varietal selection (PVS) on malt barley, faba bean and chickpea. The team also managed community seed production of farmers' preferred varieties of bread wheat, durum wheat, food barley, faba bean, field pea, lentil, chickpea and malt barley in the four Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) sites. Yield of the faba bean varieties ranged from 2.6–4.9 t ha^{-1}. The productivity of selected varieties of chick pea in all locations was about 1.5 t ha^{-1}, which is below the national average. This was due to high disease epidemics and frost damages. Grain yield of malt barely varied from location to location, ranging from 2.4 to 5–6 t ha^{-1}. This yield is higher than the national average. It was possible to produce a total of 328 t of seeds of different faba bean, durum and bread wheat, malt and food barley, faba bean and lentil varieties from the community seed multiplication activities. This seed will contribute in alleviating seed shortages of high yielding varieties for the 2018 cropping season.

The ICRISAT team piloted various fertilizer blends that would suit various soil types and landscape positions of sorghum and teff cropping systems at district and zonal levels for validation. Potassium and sulfur (KS) nutrients were found least yield limiting factors when compared to nitrogen (N) and phosphorous (P) nutrients and farmland landscape position at the experimental sites and similar agro-ecologies for teff production. The overall study findings from this research show that crops fertilizer response is hugely dictated by landscape position, slope and management.

To create climate-smart multifunctional landscapes, the International Center for Tropical Agriculture- (CIAT)-led team developed customized framework that can facilitate matching options with contexts considering site specificities. The research team also managed to generate evidences in treated and non-treated landscapes. Time series (2014, 2015, 2016 and 2017) sediment yield measurements at landscape level showed clear differences between sites with and without soil and water conservation (SWC) practices. Generally, there is decline in sediment yield with integrated land and soil management interventions. The impacts of the interventions vary as time goes-by and it will be possible to note that 'older' year conservation measures have relatively higher sediment yield compared to 'younger' ones highlighting the need for maintenance and follow up.

In 2017 growing season, on-farm demonstrations seeded by two-wheel tractor (WT) drawn planters were established by the International Maize and Wheat Improvement Center (CIMMYT) team to serve the purposes of being learning centres for farmers and awareness/demand creation centres during the course of the year. Crops planted at the demonstration sites using two-WT planters included wheat and teff. Preliminary results show that smallholder farmers are reducing shelling costs by up to 50% by using a two-WT driven sheller compared with the traditional manual procedure.

Africa RISING project organized various training workshops, field visits, field-days, meetings and other events to raise awareness on its innovations and enhance the capacity of farmers, extension

experts and researchers. It has also produced 10 blogs, 7 journal articles, 4 photo reports, 1 poster, 3 reports and 6 presentations, 2 Manuals, 1 Book chapter over the reporting period. The delay for fund releasing has hampered the project operations and allocation of funds for CGIAR centres.

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 as part of the U.S. government's Feed the Future initiative.

In its second phase, the Africa RISING project in the Ethiopian Highlands will seek to elaborate the generic research questions presented in the program umbrella document for issues identified largely during phase I (2011–2016). The research questions addressed by our specific activities will contribute insights from specific sustainable intensification (SI)-related activities and geographic areas within the country.

Trade-offs and synergies

Umbrella research question: What are the environmental, economic, human and social consequences of productivity-enhancing interventions? And what are the productivity-enhancing consequences (according to the SI framework of environmental-, economic-, human- and social-enhancing interventions?

Adaptation and adoptability

Umbrella research question: How are these interventions aiming at increasing productivity and environmental conditions adapted to the endowments of diverse farmer typologies in the target areas?

Livelihoods

Umbrella research question: How do changes in the management of specific activities or 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, diversity) of promising interventions moving towards SI?

Equity

Umbrella RQ: How does social capital affect community productivity, cooperation and wellbeing along with the scaling of SI innovations?

Africa RISING in Ethiopia is led by scientists from the International Livestock Research Institute in partnership with scientists from other CGIAR centres, the Ethiopian national agricultural research system and local communities.

Highlights from the current reporting period

The Africa RISING team introduced newly identified SI interventions that potentially contribute in filling production and associated gaps in 2017 main rainy season in Southern Nations Nationalities and Peoples, Amhara, Tigray and Oromia regions. The following are the research findings of the livestock, crop and natural resources management- (NRM)-related interventions implemented across various Africa RISING sites in 2017 cropping season.

Feed and forage innovations

Introduction

In the 2017 main cropping season R4D activities were implemented for sweet lupine, faba bean oat intercropping, alfalfa and fodder beet and data were generated. The activities on sweet lupine and faba bean- oat intercropping were a continuation of the previous year trial to generate additional evidence on adaptability and productivity, while the trials on alfalfa and fodder beet were new introductions to provide additional forage options for smallholders. On top of the R4D activities, validated forage technologies including oat-vetch mixture, tree Lucerne, sweet lupine (for Lemo site), postharvest feed handling and utilization (feed trough and feed shed) were implemented through development partners.

Research methodologies/ approaches

The R4D/action research interventions were implemented through farmer research groups established in each of the Africa RISING research Kebeles. First, criteria were set for farmer selection for each of the forage technologies to access suitable farm plots and irrigation water for the perennial forage crops. Then, the farmer groups were trained and briefed about the agronomic and management requirements and benefits of the forage technologies and the type of observation required of the trials. Field site assistants were trained and employed to record weekly and monthly data using data collection methods. Mid-season and end of season evaluation and field days were conducted in each of the research sites to get feedback from farmers and share knowledge about the forage technologies.

Two varieties of sweet lupine (Vitabor and Sanabor) were used to conduct on farm evaluations across the four sites. For the Lemo site, adequate information was available on the adaptability of the two varieties to the area, but additional information was needed on planting spaces. On the other three sites (Debre Birhan, Sinana and Endamehoni) additional information was needed regarding the adaptability of the varieties and planting spaces. Therefore, the planting spaces (between plants and rows) were tested through the on-farm trials to determine optimal spacing and seeding rate for the two varieties: a) 7cm x 30cm (control); b) 7cm x 40cm; c) 15cm x 30cm; d) 15cm x 40cm; e) 20cm x 30cm; and f) 20cm x 40cm. Agronomic variables including forage biomass yield at 50% and 100% flowering, grain yield at maturity, straw yield, nutritive value of the forage and grain were determined following standard procedures.

The faba bean-oat intercropping trial was a repetition of the previous years. The experiment aims to build on the existing farmers practice (traditional), which involves leaving wild oats and weeds to grow with faba bean crop for some time and then harvest and use as forage. The recommended practice by the extension system (improved) is frequent removal of weeds so that that there is no competition with the faba bean crop. Despite the advices from the extension offices, several farmers

prefer to use the weeds as forages due to the critical feed shortage during the cropping seasons. In a step wise fashion Africa RISING project evaluated traditional and improved practices of faba bean cultivation and tested intercropping faba bean with improved oats.

Alfalfa adaptation and demonstration trial were conducted in Lemo, Sinana and Endamehoni sites. As alfalfa is a perennial forage of high nutritional quality, it has a potential to supplement the diet of ruminants, and poultry. The adaptation and demonstration trials were initiated to create additional legume forage option for farmers, especially at the backyard for year-round high-quality feed supply. In each of the research sites, the forage was planted on a 10 m × 10 m (100 m^2) plots with supplemental irrigation. The growth, biomass yield at first cut, and short-term response to feeding the forage to lactating cows was conducted.

Fodder beet adaptation trials were conducted in Sinana, Lemo, Endamehoni and Basona sites. Fodder beet is a semi-perennial forage that can produce high biomass tuber feed from a limited plot of land. The forage adaptability to the different sites was tried through direct seeding on a 10 m × 10 m (100 m^2) following recommended seeding rates. The growth and final tuber yield of the forage was observed and evaluated by farmers.

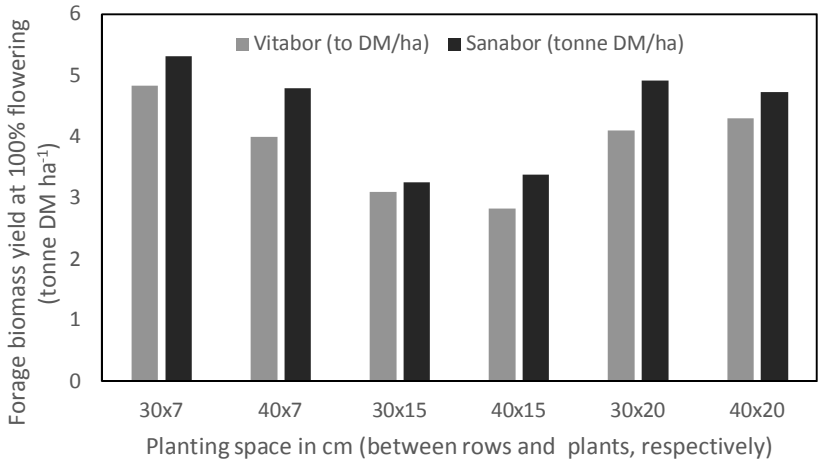
Scaling of farmers' validated technologies were implemented through development partners that included public sector offices, non-governmental organizations (NGOs) and universities. Contact persons, who were assigned by each development partner at district level to facilitate the implementation of scaling efforts, worked together with site coordinators to document and trace the adoption of the technologies in the respective sites.

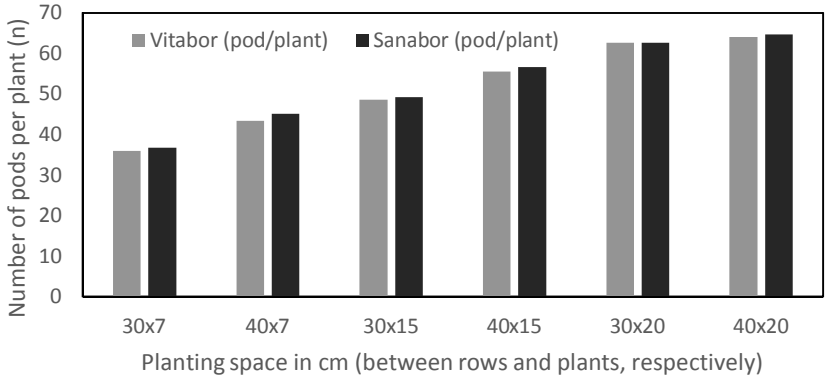
Results/ observations

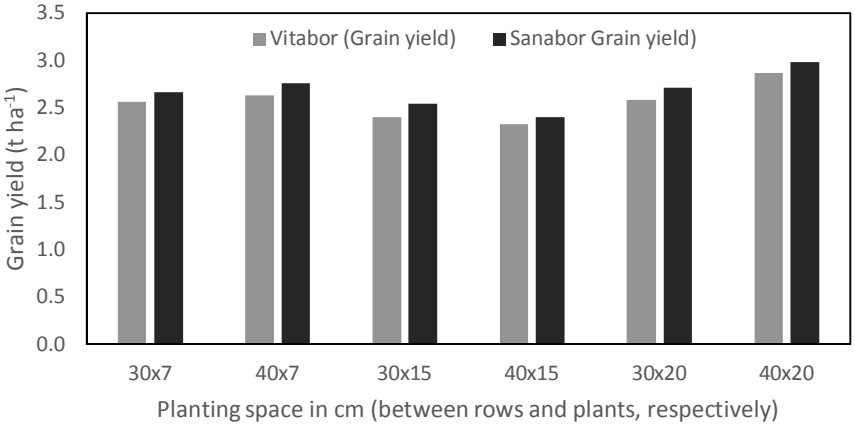
Sweet lupine:

Adaptability of the two varieties to the Debre Birhan field sites was not satisfactory. Although the germination was good, the growth of the crops was poor and in some cases totally failed. Adaptability of these crops to the Endamehoni and Sinana sites appears good, but further evaluation was needed as there was high variability in the performance of the crops in different farmer fields and soil conditions. The observations indicated that there is a need to further investigate the causes of the variability and identify suitable niches for the crop for further scaling. The average forage biomass yield potentials at 100% flowering were recorded as 4.9 t DM ha^{-1} for Sanabor variety and 4.3 t DM ha^{-1} for Vitabor variety. The average grain yield at full maturity was 2.61 t ha^{-1} for Sanabor and 2.52 t ha^{-1} for Vitabor (Figure 1). Although Sanabor variety appeared to be superior both in biomass and grain yields, the differences were not statistically significant. Comparison between spacing treatments indicated no significant difference in grain yield (2.33 to 2.78 t ha^{-1}), although the control treatment (7 cm x 30 cm) produced higher forage biomass yield than other treatments. Wider spacing (such as 20 cm x 40 cm) resulted in higher pod number per plant than narrow spacing treatments, compensating for the lower plant density and producing similar grain yield as the control. This observation indicated that the seeding rate for sweet lupine can be reduced by 20-30% from the current recommendation of 80kg/ha. The nutritive value of the forages in terms of crude protein (21.9-22.4%) and in vitro organic matter digestibility (67.4-67.7%) remained similar for the two varieties.

Figure 1. On-farm performance of two sweet lupine varieties (Vitabor and Sanabor) in terms of forage biomass yield, pods per plant and grain yield as influenced by planting space in the Africa RISING sites.



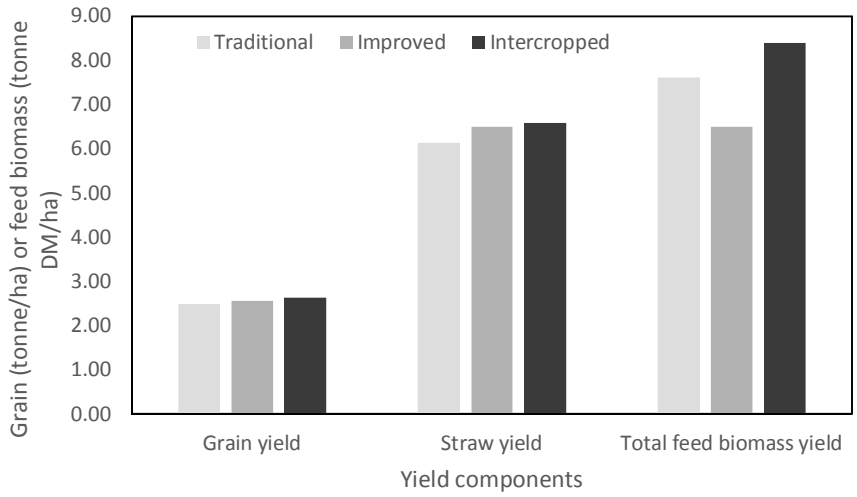




Faba bean oat intercropping:

Figure 2 shows the summary of the last season results. The result is consistent with the previous year observation, in that intercropping faba bean with improved oats can give more forage biomass of good nutritional quality with limited compromise on grain yields. The overall benefit that farmers derive from intercropped plots appeared to be higher than the improved practice and fits well the contexts in the mixed crop livestock smallholder system.

Figure 2. Comparison of traditional, improved and intercropped systems in Lemo Africa RISING site.



Alfalfa forage trial:

The performance of the forage in all sites was found to be very good (Photo 1). Upon establishment, the forage biomass yield at 50% flowering was on average 3.5 t DM ha^{-1}. As a perennial forage, alfalfa can be harvested up to 6 times per year (more than 18 t DM ha^{-1}) with supplemental irrigation and manuring. The forage was mainly used to supplement the diet of dairy cows. In the Sinana site, supplementing 2.5kg day^{-1} $head^{-1}$ of alfalfa forage increased the milk yield of dairy cows by 2.0 litres.

Photo 1. Alfalfa forage field 2.5 months after establishment in southern Ethiopia.

Fodder beet:

The growth performance of fodder beet was generally encouraging (Photo 2), but there was high performance variability between farms and sites. As a semi perennial crop, fodder beet has longer growth period than other cereal and tuber crops. This exposed the crop in some farms (Lemo site) to damages by wild beasts. Lessons have been drawn on where to locate fodder beet plots to get better performance and protect the crop from wild animals' damage.

Photo 2. Fodder beet adaptation and utilization trial.

Scaling activities:

Forage technologies scaled across the different districts were monitored through contact persons, and field visits by site staffs. The overall results showed good performance and acceptance for the forages and feed troughs. Farmers who used oat-vetch forage for lactating cows witnessed improvement both in milk yield and milk quality. The role of feed troughs was described by some farmers as "additional family member", as the technology reduced work load on households in taking care of animals. From the sample data collected on the utilization of the forage, most of the farmers used improved forages (mainly oat-vetch) for dairy cows and ploughing oxen and followed by fattening ruminants (Table 1). The biomass yield recorded in the scaling districts appeared to be encouraging as it was like the results recorded during the R4D trial stage. Strengthening the presence of revolving informal forage seed system and working towards establishing formal seed systems appear important priorities to sustain adoption of the technologies.

Table 1. Average oat-vetch biomass yield and utilization for different classes of animals in sampled scaling districts of Tigray region.

District	% of Female headed households	Oat-vetch yield (t DM ha^{-1})	Proportion of Oat-vetch feed to			
			Lactating cows (%)	Calves (%)	Oxen (%)	Fattening animals (%)
Olfa-Hayalo	40	13.4±1.77	60	-	25	15
Hugumbrida	16	14.1±5.04	80	-	20	-
Endamehoni	55	15.2±3.05	55	15	20	10

Messages/reflections

The R4D trials during the last main cropping season provided valuable evidence to diversify the forage option available for smallholders under different farm contexts and agro-ecologies. With additional adaptation trials and demonstrations in the 2018 cropping season, new forage options will be made available for further scaling and to meet the growing demand for forage solution by farmers.

Scaling of the already evaluated and demonstrated technologies has generally received overwhelming acceptance by farmers. However, for accelerated adoption of the forage technologies easy access to planting materials/forage seeds with affordable price remains to be worked out.

Crop varieties and management

Introduction

The livelihoods of the smallholder farmers relay on the production of barley (food and malt barley), wheat and highland food legumes (faba bean, field pea, chickpea, lentil and grass pea). Wheat, barley and food legumes are important crops for food, nutrition security, animal feed and income generation for poor farmers, especially in women-headed households. The introduction of food legumes improves soil fertility and reduce the demand for nitrogen fertilizer in the succeeding cereal crops. Nutrition of both human and livestock, nevertheless, remains a key challenge to the Government of Ethiopia. This challenge can be mitigated through introduction and scaling of high yielding crop varieties with good production and protection technologies supported by knowledge and skills of farmers and development partners. There are high yield and knowledge gaps in using improved crop technology that make farming not profitable. The objectives of this research work are to: scale validated field crop technologies with partners; identify high yielding, disease resistant and farmer and industry preferred varieties; strengthen informal and formal seed production system for better access to seeds; and improve knowledge and skills of farmers, and development partners in using improved crop technologies.

Research methodologies/ approaches

Participatory varietal selection (PVS) on malt barley, faba bean and chickpea, community seed production of farmer preferred varieties of bread wheat, durum wheat, food barley, faba bean, field pea, lentil, chickpea and malt barley were implemented in the four Africa RISING sites. The PVS were done on 16 farmers (four farmers per Africa RISING site). Male and female farmers were invited and made selections for each crop. Final yield data was taken, and varieties were selected for 2018/19 cropping season. Seeds of selected cultivars were provided to farmers for demonstration and seed production on a revolving seed system approach. Scaling partners were identified: Office of Agriculture, NGOs, Oromia Seed Enterprise, Malt factory and ICARDA United Stated Agency for International Development (USAID)-funded projects were linked to Africa RISING scaling activities.

Results/ observations

Participatory varietal selection

Faba bean:

The PVS was conducted at the four Africa RISING sites using six released faba bean varieties (Didea, Gora, Moti, Tumsa, Gebelcho and Hachalu) on 16 m^2 plot of land per variety. The varieties were evaluated by male and female farmers at physiological maturity. All the six evaluated varieties were selected by male and female farmers in different locations (Table 2). The varieties Didea was selected both by male and female famers in Maichew, Basona and Sinana sites followed by varieties Gebelcho and Tumsa.

Table 2. Faba bean varieties selected by male and female farmers in the four Africa RISING sites, 2017/18 cropping season.

Site	Kebele	Variety selected	Male farmers	Female farmers
Sinana	Ilu- Sanbitu	Didea	X	X
Sinana	Ilu- Sanbitu	Hachalu		X
Sinana	Selka	Gebelcho	X	X
Sinana	Selka	Didea	X	X
Endamehoni	Emba Hasti	Gora		X
Endamehoni	Emba Hasti	Moti		X
Endamehoni	Emba Hasti	Tumsa	X	X
Endamehoni	Emba Hasti	Didea	X	X
Basona	Gudo Beret	Gebelcho	X	X
Basona	Gudo Beret	Moti	X	X
Basona	Goshe Bado	Moti	X	X
Basona	Goshe Bado	Didea	X	X
Lemo	Upper Gana	Tumsa	X	X
Lemo	Upper Gana	Didea		X

The productivity of the selected varieties ranged from 2.6–4.9 t ha^{-1}. Except Selka research kebele, the highest productivity (average of 4 t ha^{-1}) was recorded from varieties Didea, Hachalu, Tumsa and Moti (Table 3).

Table 3. Average productivity of selected faba bean varieties from the four Africa RISING sites, 2017/18 cropping season.

Research kebele	Variety	Yield (t ha^{-1})
Emba Hasti	Moti	4.8
Upper Gana	Hachalu	4.9
Ilu-Sanbitu	Hachalu	4.7
Ilu-Sanbitu	Didea	4.8
Selka	Gora	2.6
Selka	Didea	2.6
Jawe	Tumsa	4.5

Chickpea:

Chickpea PVS was conducted at the four Africa RISING sites on four farmers' field per site. Six chickpea varieties (DZ-10-4, Hora, Habru, Arerti, Ejere and Local at Endamehoni) were planted on 25 m^2 plot of land per variety. The genotype evaluated by male and female farmers at physiological maturity and yield was measured for final varietal selections. The major constraint on early planting of the varieties was Ascochyta blight. Some of the varieties were susceptible to the diseases, and unable to withstand the disease and failed before harvesting. The varieties DZ-10-4 was not selected in all sites (Table 4).

Table 4. Chickpea cultivars selected by male and female farmers in the four Africa RISING sites, 2017/18 cropping season.

Site	Kebele	Variety selected	Male farmers	Female farmers
Sinana	Ilu- Sanbitu	Arerti		X
Endamehoni	Tekelhaymanot	Ejere		X
Endamehoni	Tekelhaymanot	Hora	X	X
Endamehoni	Tekelhaymanot	Arerti		X
Lemo	Jawe	Habru	X	X
Lemo	Jawe	Ejere	X	X
Lemo	Upper Gana	Habru	X	X
Sinana	Ilu- Sanbitu	Arerti		X

The productivity of the selected varieties at all locations was about 1.5 t ha^{-1} which is below the national average. This was due to high disease epidemics and frost damages (Photo 3). The selected varieties will be demonstrated in 2018/19 cropping season.

Photo 3. Chick pea varieties evaluated with farmers in the different Africa RISING sites.

Malt barley:

Malt barley PVS was conducted at the three Africa RISING sites (Lemo, Sinana and Endamehoni) on four farmers' field per site. The six malt barley varieties (Bekoji 1, Holker, IBON174, Bahati, HB1964 and HB1963) were planted on 25 m^2 plots of land per variety. The varieties were evaluated by male and female farmers at physiological maturity. Yield was measured for final selections. Recently released varieties HB1963 and HB1964 were selected by male and female farmers (Table 5). The variety IBON174 was found to be early maturing type that can be recommended for drought prone highlands.

Table 5. Malt barley cultivars selected by male and female farmers in the four Africa RISING sites, 2017/18 cropping season.

Site	Kebele	Variety selected	Male farmers	Female farmers
Sinana	Ilu- Sanbitu	HB1963	X	X
Sinana	Illu- Sanbitu	HB1964	X	X
Sinana	Selka	HB1964	X	X
Lemo	Jawe	HB1963	X	X

The productivity of the varieties varied from location to location, ranging from 2.4 t ha^{-1} for varieties Bahati in Upper Gana to 5–6 t ha^{-1} for varieties HB1963 in Ilu-Sanbitu and Endamahoni (Photo 4). All varieties gave more than 2 t ha^{-1}, which is higher than the national average. The newly released varieties gave double yield over the widely grown malt barley variety Holker.

Photo 4. Performance of malt barley varieties in Africa RISING sites.

Community-based seed production

In the community seed production, it was possible to produce over 328 t of seeds of the different faba bean, durum and bread wheat, malt and food barley, faba bean and lentil varieties. This seed will contribute in alleviating seed shortages of high yielding varieties (Table 6 and Photo 5).

Table 6. Amount of seeds of farmer and industry preferred varieties produced by participating farmers in the four Africa RISING sites, 2018/19 cropping season.

Crop	Variety	Location	Quantity (t)	Seed class	Estimated area to be covered (ha)
Durum wheat	Utuba	Bale	15.8	Basic	126.4
Durum wheat	Hidase	Bale	34.7	Basic	277.6
Durum wheat	HB1307	Bale	16.1	C-3	161.0
Durum wheat	Bahati	Bale	8.0	C-1	80.0
Durum wheat	Dosha	Bale	8.2	C-1	46.9
Durum wheat	Bilalo	Bale	2.0	C-2	16.0
Durum wheat	Habru	Bale	3.5	Basic	31.8
Durum wheat	Derash	Bale	4.0	Basic	43.5
Faba bean	Dosha	North Shoa	29.5	C-1	168.5
Food barley	HB1307	North Shoa	10.8	C-3	86.1
Malt barley	Bekoji-1	North Shoa	19.9	C-1	158.9
Bread wheat	Tsehay	North Shoa	50.0	Basic	400.2
Durum wheat	Utuba	North Shoa	31.5	Basic	252.0
Fab bean	Dosha	Lemo	1.3	C-1	7.1
Food barley	HB1307	Lemo	2.3	C-3	23.0
Bread wheat	Hidase		28.0	basic	223.6
Lentil	Alemaya	Maichew	2.9	basic	31.0
Lentil	Derash	Maichew	1.0	basic	10.3
Durum wheat	Utuba	Maichew	0.7	Basic	5.6
Durum wheat	Mangudo	Maichew	0.3	Basic	2.4
Bread wheat	Mekel-4	Maichew	3.3	Basic	26.4
Bread wheat	Hidase	Maichew	32.1	Basic	256.0
Faba bean	Dosha	Maichew	3.4	C-1	19.7
Field pea	Bilalo	Maichew	18.8	C-2	150.0

Photo 5. Different crop varieties considered for seed production.

Seed production and scaling of technologies with partners

The Oromia Seed Enterprise produced 126.5 t C1 seeds of variety Utuba supplied by the project. Moreover, the enterprise also produced 65.53 t basic seed to be sold for 2018/19 cropping season. A total of 31391 farmers (Bale zone 12,071, North Shoa zone 11,783, South Tigray 6,767 and Lemo 770) were involved in scaling of cereal and food legume technologies through Zone Office of Agriculture. Gondar malt factory and Raya Brewery indicated their interest to continue working with the scaling activities.

Messages/ reflections

- Diversification and genetic intensification of cereal and food legumes increased incomes through high productivity;
- High yielding food legume and cereal varieties were identified by both male and female farmers and seed produced for further scaling to bring greater impact;
- Many varieties of cereals and food legumes with wide and specific adaptations were identified;
- Introduction of food legumes improves soil health and reduce cost of production used for pest management and reduced application of nitrogen fertilizers;
- Community seed production is one of the key approaches to make high yielding varieties with quality seeds available for large number of farmers; and
- Linkages with different partners helps to address many farmers to improve their productivity and easy access to markets (mainly malt barley and durum wheat).

Niche- and crop-specific fertilizer studies

Introduction

This work has capitalized on the earlier outputs of Africa RISING project on developing soil fertility management decision guides, which has generated tools and methods to understand landscape dynamics for targeted input supplies and assessed its implication on crop productivity, fertilizer use efficiency and economic returns to investments. Africa RISING and ICRISAT's successful approach in the wheat systems of Ethiopia on landscape -based nutrient management served as an entry point to scale-up these decision guides in sorghum-based and teff-based farming systems in Ethiopia. The approach was the adoption of soil-test based nutrient management recommendations of key nutrients along with quality seeds of high-yielding varieties in differing landscape positions and socio-economic categories, particularly women.

Methodologies/ approaches

We piloted differing fertilizer blends that would suit various soil types and landscape positions of sorghum and teff cropping systems at district and zonal levels for validation. We also created country-wide influence by institutionalizing our decision guides and targeting tools for fertilizer recommendation at regional and national scales. The revised Ethiopian soil strategy, which hugely builds on the approaches and methods of the Africa RISING project has been developed, at least three stakeholder validation workshops conducted, and the strategy is published by the Ministry of Agriculture and Natural Resources in Amharic language. There is currently an ongoing effort to translate it to English. The strategy will be officially launched on 28–29 May 2018 by the Ministry of Agriculture in Adama town (central Ethiopia).

Results/ observations

The results of the decision guides validated in the two cropping systems (sorghum-based and teff-based) is presented as follow.

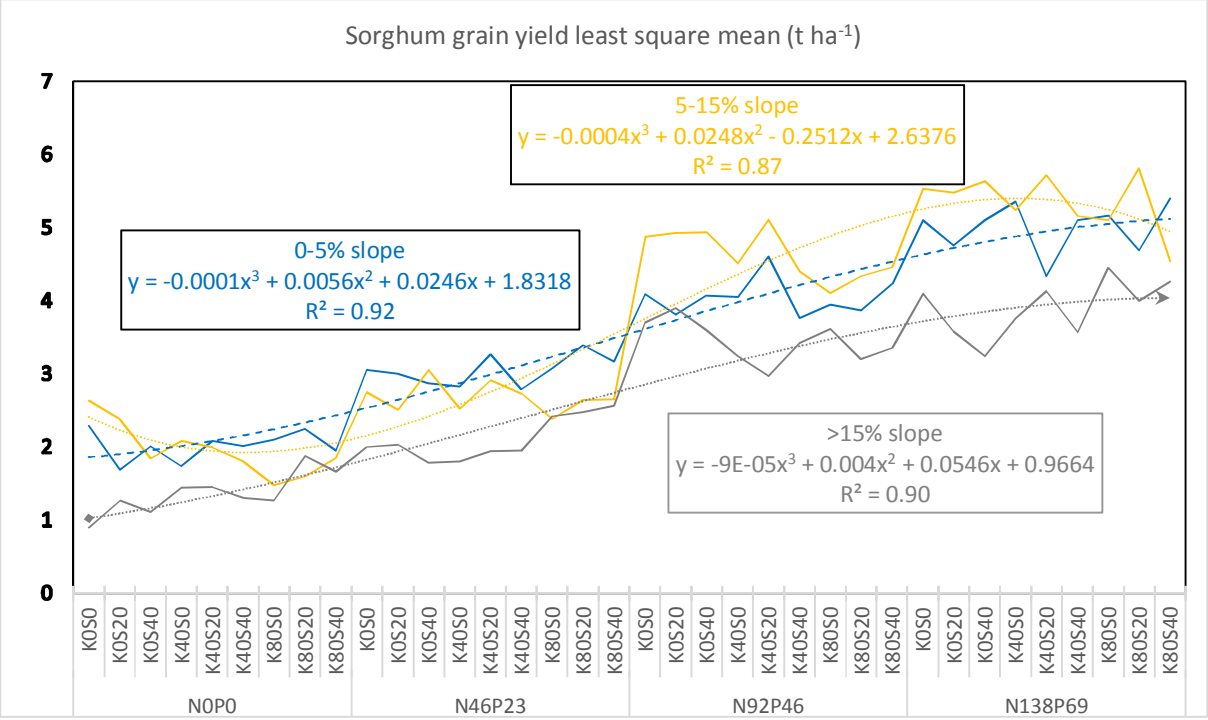
Sorghum yield response in respect to combined levels of nitrogen and phosphorus application with landscape position:

Application of combined levels of nitrogen and phosphorus nutrients had a statistically significant positive effect on straw as well as head weight of sorghum in all landscape positions whereby the optimum nitrogen and phosphorus nutrients could be between 92–138 kg ha^{-1} N and 46–69 kg ha^{-1} P_2O_5. The yield gap of straw and head weight was in a range of 3-4 t ha^{-1} which could be filled by proper management of nitrogen and phosphorus nutrients in all landscape positions. Straw yield had a trend of decrease when moving from flat to rolling landscapes which indicated landscape was one of straw yield limiting factor in the research area and similar agro-ecologies. And on the other hand, head weight performance was similar in farmlands located at slopes below 5% and 5–15%. One to two t ha^{-1} head weight reduction was evident in farmlands located at slopes above 15% when compared to the other landscape categories whereby other yield limiting factors could be associated to sorghum productivity in rolling landscapes that need a thorough investigation to maximize productivity.

Sorghum grain yield was significantly affected by application of combined levels of nitrogen and phosphorus nutrients in all landscape positions (Figure 3). The optimum NP levels for sorghum grain yield could about 138/69 N/P2O5 kg ha^{-1} for farmlands. More than three t ha^{-1} sorghum grain yield gap could be filled by proper management of NP nutrients in farmlands located at 0–5% and 5–15% slopes whereas, two t ha^{-1} sorghum grain yield could be obtained by proper management of NP nutrients in farmlands located at slopes above 15% slope. Hence, NP nutrients could be the leading yield limiting factors for sorghum grain production in all landscape categories and an in–depth study could lead to precise recommendation in environmental, production, social and economic optimum levels of NP.

Farmlands with slopes 0–15% were found to be the most suitable categories for sorghum productivity and had the maximum return for input used.

Figure 3. Least square mean of sorghum grain yield by landscape strata with curve fitting (blue line = 0–5% slope, Deep yellow = 5–15% slope, Grey = >15% slope).



Application of potassium and sulphur had a statistically significant effect over straw yield and head weight (except at below 5% slope) of sorghum at all landscape positions. Potassium had a positive effect on straw yield of sorghum in farmlands with slope below 5% and had a negative effect in farmlands located in slopes 5–15% and above 15%. On the other hand, sulphur application had no visible association for both straw and head weight across the landscape position indicating that potassium was yield limiting nutrient than sulphur. A one tonne per hectare yield gap in head weight and one and half tonne per hectare yield gap of straw were observed through management of potassium and sulphur nutrients in farmlands located at slopes 5–15% and above 15% that could be filled by applying these nutrients.

Teff yield response to nutrient application in respect to landscape position:

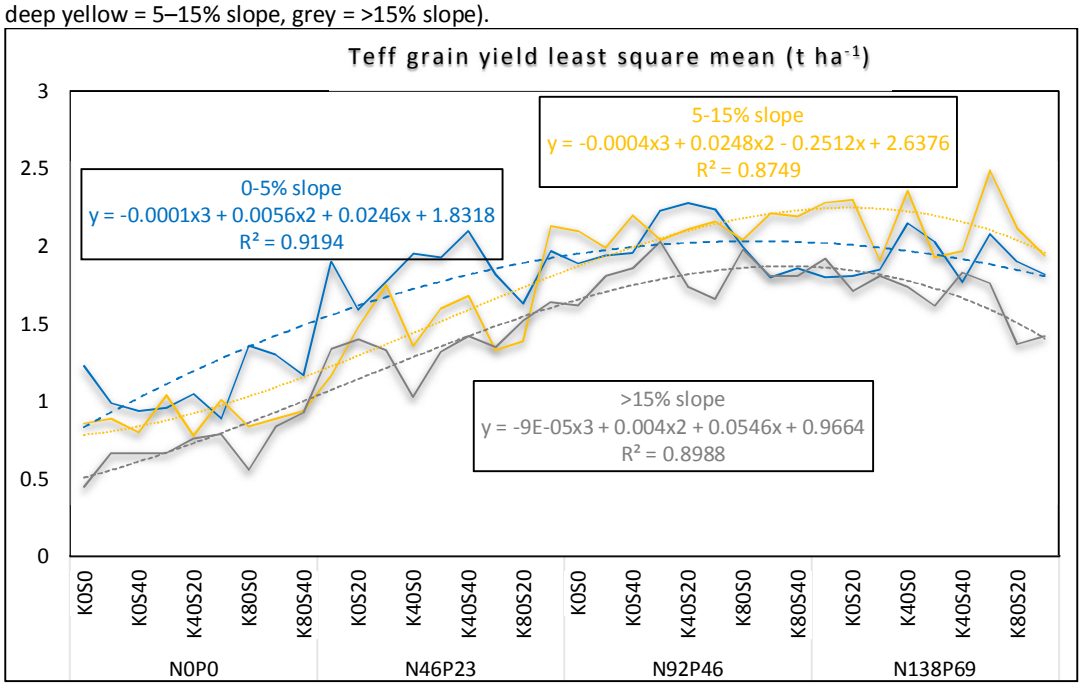
A significant biomass yield difference among the levels of potassium and sulphur nutrient application was observed at farm lands located in 0–5% and above 15% slopes. Application of higher rates of potassium has showed a better biomass yield across the landscapes, even though there was no statistically significant difference observed in farmlands with slope >5%.

Overall yield performance was similar in those landscape categories with slopes below 15%. Meanwhile, the productivity of teff was very low, almost half of the other slope categories, in slopes above 15%. This might be an indication where farmlands with slope below 15% could be productive and above these slopes, teff should not be grown with current land management.

A significant biomass and grain yield of teff were observed for the application of combined levels of nitrogen and phosphorus nutrients across the landscapes with more than twofold yield increment in all landscapes. The optimum nitrogen and phosphorus levels in all landscapes could be about 92/46 kg ha^{-1} N/P2O5 as there was no statistically significant yield increment beyond these levels. N and P at all landscapes were found to be yield limiting factors which need a thorough study and follow up to narrow yield gap of teff production at Haike, Sirinka and similar agro-ecologies.

Landscapes were found determinants of teff yield whereby the rolling landscapes showed lower yield at all nutrient levels signifying that yield was limited from a stress factor other than the tested nutrient types and rates. A steady 'S' response curve (Figure 4) for the NP nutrient increments for teff grain yield was observed in all the landscape strata where NP were the dominant yield limiting factors, from nutrient perspective, for teff grain yield production.

Figure 4. Least square mean of Teff grain yield by landscape strata with curve fitting (blue line = 0–5% slope, deep yellow = 5–15% slope, grey = >15% slope).



From both grain and biomass yield response graphs for nutrient and landscapes, it could be possible to conclude that KS nutrients had little effect on teff productivity at all landscape positions. This could lead us to judge that KS nutrient were least yield limiting factors when compared to NP nutrients and farmland landscape position at the experimental sites and similar agro-ecologies for teff production.

Message/ reflections

Although there is difference between crop species in nutrient recovery, the major outcome is that fertilizer response is hugely dictated by landscape position, slope and management.

Integrated watershed management

Introduction

Ethiopia aspires to achieve middle income status by 2025. To achieve this ambitious goal, various policies and implementation processes have been designed under its successive medium-term Growth and Transformation Plan. Ethiopia recognizes that, transformation of its agricultural sector is the basis for its industrialization. For agriculture to sustainably support the country's industrialization, agricultural productivity should be significantly improved, and the sector must benefit from modern organization and farm management solutions. Sustainable intensification and niche-based diversification must be coupled with integrated landscape management to enhance overall system productivity and livelihoods.

However, achieving these will not be straight forward due to various complex anthropogenic and natural factors. For instance, population pressure, land degradation, and climate change are seriously undermining the food security and growth and transformation plan of the country. The country's policy makers are also aware that agricultural transformation can only be achieved if degradation is tackled and degraded areas are restored. Because of this, great deals of efforts have been and are being implemented—the most important of which is the Sustainable land management program(SLMP). Despite the long-term effort to restore degraded areas and some success stories, results are not as expected due to dominantly top-down approach, miss-match between options and context, lack of sectoral and disciplinary integration, focus on predominantly physical-based options, and low technology adoption rate by smallholder farmers. These hugely call for promotion of multifunctional landscapes through implementation of complementary climate-smart options.

Methodologies/ approaches

To create climate-smart multifunctional landscapes, we developed customized framework that can facilitate matching options with contexts considering site specificities. Next, we developed approaches to generate evidences of interventions for planners, decision makers and land users. Key results are presented below.

Results/ observations

Soil health of the four Africa RISING sites

As part of a baseline and to facilitate targeted interventions, we conducted detailed analysis of soil health in the four sites (Basona, Lemo, Endamehoni, and Sinana). The results show variability between and within sites. In terms of texture, the highest difference between the four sites is observed in clay followed by silt. The mean percentage for sand is the lowest in comparison to the two-texture class. For clay, within variability is almost similar in all sites. Generally, within variability is highest for sand texture class. Lemo has shown relatively high within variability in all soil texture classes. Among the four sites, Endamehoni shows high mean pH value (7.3) followed by Sinana (7.1). The lowest is for Lemo (6.1). However, the variability within the site is the highest at Basona and lowest is Lemo. The four sites show no significant differences in both soil carbon contents. The within variability, however, is highest at Basona and lowest at Sinana. Generally, the Endamehoni

site shows higher mean calcium, magnesium and phosphorus. Iron is the highest in Lemo and the lowest in Sinana. The mean Boron value for all sites are almost similar, with the highest variability at Basona and Lemo. Manganese is higher at both Lemo and Sinana, with low coefficient of variation. Generally, Basona has highest within variability for all micronutrients analyzed while Sinana shows the lowest.

Time-series weather data analysis

Now that we have more than two seasons complete weather data, we have started detailed analysis and are on the verge of communicating results to local partners. The first step was to create an automated system that can facilitate data cleaning, analysis and display. We thus created an easy to use 'dashboard' (Figure 5). The tool help visualizes different weather data for selected sites.

Based on automatic weather station installed in the study areas, results show that mean daily rainfall is about 3.6 mm, while mean monthly rainfall is about 104.5 mm, with high overall rainfall variability. Monthly rainfall values for Basona (Gudo Beret kebele) range from 0.0 mm to 666.4 mm per month (Figure 6b). On the contrary, both the daily and monthly mean temperature shows less variability, ranging from 12.5 °C to 20 °C , with the mean value of 16.5 °C. Based on almost two and half year's period, the daily solar radiation ranges from 33.8 to 318.6 W/m^2, while monthly value ranges from 112.6 to 285.4 W/m^2 (Figure 6b). Both daily and monthly mean wind speed obtained using the measurements are 1.2 m/s, with less variability.

Figure 5. Dashboard to display and visualize data for selected sites.

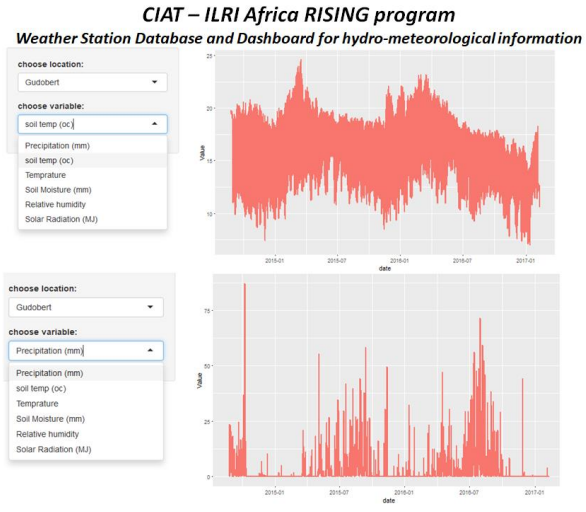
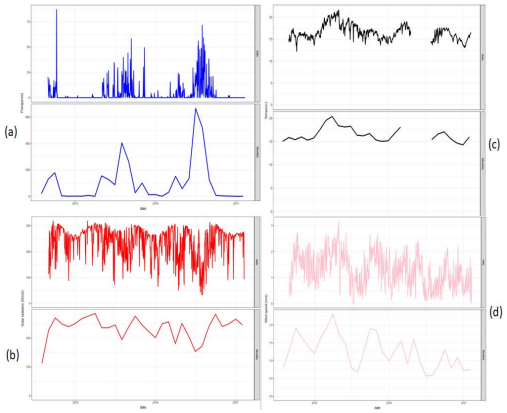
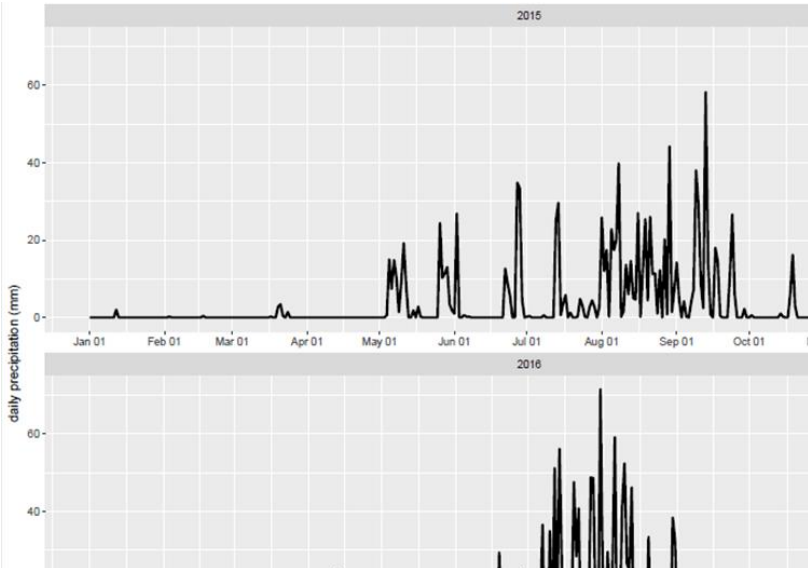


Figure 6. Time series (daily and monthly) (a) precipitation, (b) temperature, (c) solar radiation, and (d).



The on-and off-sets of rainfall have significant impact on crop cultivation. This is generally related to rainfall variability. Though we still don't have long-term dataset, quick analysis of the on-set and off-set the 2015 and 2016 rainy seasons show variation. In 2015, it shows that rainfall started earlier (early May) and continued until the major rainy season (Figure 7). However, the overall daily rainfall was not as high. In 2016, there was an interruption between the small and main rainy seasons, which started mid-June. However, the daily rainfall amount was higher than that of the 2015 season. It generally appears that the off-set of the rainy seasons coincided for the two years, though a late rainfall occurred in November for the 2015 season. When we have long-term dataset, we will conduct detailed analysis of the weather data and related to agricultural productivity as well as farmers decision making.

Figure 7. The distribution of daily precipitation for the 2015 and 2016 minor and major rainy seasons for the Basona (Gudo Beret) area.



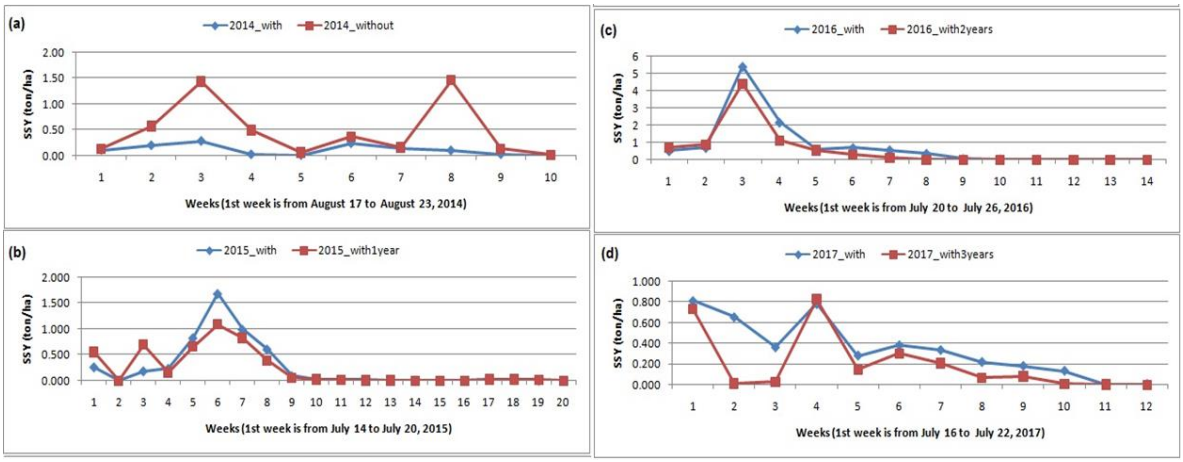
For sound agricultural advisory, it will be important to forecast weather conditions. Since our weather data does not cover long-time span, it will be essential to use global dataset. First, we will conduct 'bias' correction of the global dataset using our data from each of the four sites. We will then use the long-term bias-corrected global data to forecast key weather elements for the four sites. This task and dissemination of the analysis results of major weather elements will be one of the key upcoming activities.

Soil/sediment yield reduction

Time series (2014, 2015, 2016 and 2017) sediment yield measurements at landscape level showed clear differences between sites with and without SWC practices (Figure 8). In 2014, the sub-watershed with no significant SWC practices showed about three-fold more sediment yield compared to that of with SWC measures. In the second (2015), third (2016) and fourth (2017) years of the study, both watersheds have been treated with SWC interventions. Thus, we compare differences in sediment yield due to ages of management practices. Generally, there is decline in sediment yield with integrated land and soil management interventions. The impacts of the interventions vary as time goes-by and it will be possible to note that 'older' year conservation

measures have relatively higher sediment yield compared to 'younger' ones. This highlights the need for maintenance and follow up.

Figure 8. Suspended sediment yield (SSY) at the outlet of two sub-watersheds at Basona (Gudo Beret) Africa RISING site (2014-2017); (a) with 2-year-old SWC and without; (b) with 3-year-old and 1-year old SWC; (c) with 4-year-old and 2-year-old SWC; and (d) with 5-year-old and 3-year-old SWC.



Transformation' of our sites to climate-smart villages

A notable achievement related to our recent work under the project is the collaboration established with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) on how to 'transform our Africa RISING sites to 'climate-smart villages' (CSVs). With such development, there will be a possibility to expand out 'scaling' work within the CSVs as more funds can be available for both research and development. Capacity development in the form of short-term trainings, MSc and PhD students will be key component of the support. This arrangement will help us show case our integrated technologies in the two CSVs.

Messages/ reflections

- Soil health varies between and within the different sites highlighting the need to develop customized interventions.
- In addition to rainfall variability, the onset of the rainy season can have huge implication on farm management and crop yield.
- Land and water management interventions bring significant improvement in overall ecosystem services. However, timely maintenance is needed as 'older' interventions start to show declined benefits.
- Integrated implementation of site- and context-specific options can facilitate creating multifunctional landscapes with higher synergies and lower tradeoffs.

Multipurpose two-wheel drive tractors

Introduction including constraints and objectives

Africa RISING phase II through CIMMYT in partnership with the Department of Mechanization in the Ministry of Agriculture and Natural Resources (MoANR), is promoting two-wheel tractor (WT) based mechanization in the four regions of Ethiopia (Amhara, Oromia, SNNPR and Tigray). CIMMYT and the MoANR selected different sites where the two WT based technologies are appropriate for implementation. The project aims at demonstrating the use of the two WT and its various accessories including no-till planters for wheat, teff and maize; wheat harvesters, maize shellers and threshers (for wheat, barley, teff), trailer for transportation and water pumps for irrigation. Between October and December 2017, planned field days and awareness creation campaigns were cancelled due to the political instability that was prevailing at that time.

Methodologies/ approaches

In 2017 growing season on-farm demonstrations seeded by two-WT drawn planters were established to serve the purposes of being learning centres for farmers and awareness/demand creation centres during the course of the year. Crops planted at the demonstration sites using two-WT planters included wheat and teff. Field days and small mechanization awareness campaigns were conducted at the on-farm demonstration sites in the second half of 2017 (Photo 6). Small mechanization equipment demonstrated during field days and awareness campaigns included planters, wheat harvesters, threshers, shellers, trailers and water pumps for irrigation. Small mechanization awareness campaigns were also conducted when other research institutions e.g. the International Centre of Insect Physiology and Ecology were conducting training sessions for the youth. Additionally, small mechanization technologies were also showcased at the Feed the Future farmers' days conducted at Finote Selam in the Amhara region.

Photo 6 . Wheat harvesting and water pumping during a field day conducted in Debre Markos.

Results/observations

The two-WT based planting and fertilization increased wheat yield (Figure 9) as a result of precise seed and fertilizer placement, and good crop density through row planting which also allowed better weeding during the growing season. During the post-harvest processing period running from December 2017 to March 2018, data has been collected to assess the cost savings for farmers who hire mechanization services from service providers. Detailed analyses of the results are still in progress. However, preliminary results show that smallholder farmers are reducing shelling costs by up to 50% by using a two-WT driven sheller compared with the traditional manual procedure (Table 7). The field data on shelling of maize shows that a two-WT driven sheller is able to process three tonnes of maize grain per hour. By taking a 65% efficiency (effective operation time per day), the shelling performance of the machine became 1.95 t hr^{-1} on average. Regarding shelling price charged by service providers, USD4.73 $tonne^{-1}$ of maize grain is the common price in Gudeya Billa. When this is converted to per hour basis, service providers are therefore charging farmers USD9.22 hr^{-1}. Based on this calculation service providers in the project area are making USD5.15 hr^{-1} profit on average using two-wheel tractor driven sheller.

Figure 9. Wheat grain yield (kg ha^{-1}) from on-farm demonstrations two-WT planted by service providers in 2017 growing season.

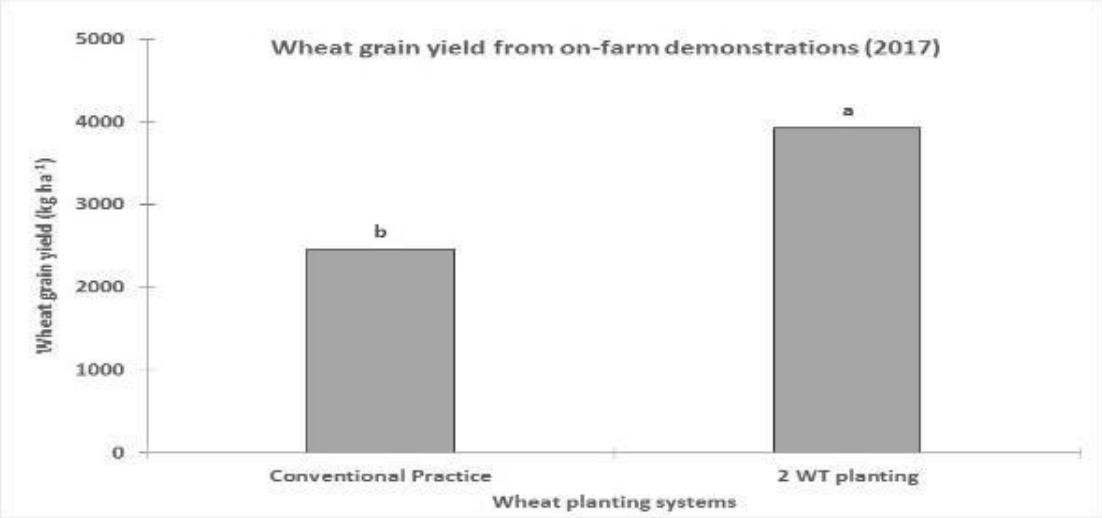


Table 7. Maize shelling cost reduction due to using two-WT driven sheller in Gudeya Billa woreda, Oromia region, Ethiopia.

Operation	**Unit**	**Unit cost (USD) $tonne^{-1}$**	**Quantity ha^{-1}**	**Total cost**
Shelling with conventional system	Tonne	9.45	5.5	52
Shelling with two-wheel tractor-based technology	Tonne	4.73	5.5	26.0
Reduction in cost of shelling as a result of using two-wheel tractor-based technology			USD	26.0
			%	-50%

Messages/ reflections

- Precise planting using two-WT planters reduces time required to establish a crop during the planting window. It also gives appropriate crop density from two-WT planting results in higher yields compared to conventional farmer practice of establishing a crop.
- Two-wheel tractor-based planting, shelling of maize and other services are profitable for both farmers that are getting services from service providers and the service provider entrepreneurs.
- Repeated training in the early years of using small mechanization equipment is critical for service providers.
- Training of site coordinators who over-see the ongoing small mechanization activities is also very critical for the smooth implementation of the project.

Capacity building

Africa RISING in the Ethiopian highlands has been organizing various capacity building programs for local and core CGIAR partners since 2012. The project benefited a total of 5,700 individuals during the reporting period through organizing trainings, field days, visits and workshops. From the total beneficiaries, more than 25% were female participants (Tables 8, 9, 10 and 11). The trainings, field days, field visits and workshops contributed beneficiaries to learn one from the other, and enhanced awareness of the beneficiaries to understand what Africa RISING project is, its focus areas, research approaches and outputs.

Table 8. Capacity building activities during the reporting period in Lemo Africa RISING site

Subject/ topic	**Number of men participants**	**Number of women participants**	**Total**	**Site**	**Beneficiaries**
Training—Feed and forage utilization	218	31	249	Southern Nations Nationalities and Peoples region (SNNPR)	Farmers, Development agents and extension experts
Visit—Africa RISING site and project activities	93	24	117	SNNPR	Development agents, extension experts and Wachemo University fourth year students
Field days—Feed and forage technologies and crop varieties	317	29	346	SNNPR	Farmers, Development agents, extension experts,
Workshop—Awareness creation on Africa RISING validated technologies	35	6	41	SNNPR	Extension experts, livestock and fishery office heads and local policy makers
Mid-season evaluation—Crop varieties and feed and forage technologies	40	3	43	SNNPR	Farmers and development agents and extension experts
Total	703	93	796		

Table 9. Capacity building activities during the reporting period in Basona Africa RISING site

Subject/ topic	Number of men participants	Number of women participants	Total	Site	Beneficiaries
Field days—Feed and forage technologies, crop varieties and watershed management	1586	324	1865	Basona/Amhara	Farmers, extension, researchers, lecturers and local policy makers
Training—Feed conservation and utilization and feeding trough construction for local carpenters	49	7	56	Basona/Amhara	Farmers, extension, researchers, lecturers and local policy makers
Workshop participation—CCAFS mitigation options tool (CCAFS-MOT)	1	0	0	1	Site coordinator
Mid-season evaluation—Faba bean PVS	23	15	83	Basona/Amhara	Farmers, extension and experts
Visits—External visitors outside Ethiopia to share Africa RISING experiences	47	15	62	Basona/Amhara	Researchers, University professors and others
Total	120	37	201		

Table 10. Capacity building activities during the reporting period in Sinana Africa RISING site

Subject/ topic	Number of men participants	Number of women participants	Total	Site	Beneficiaries
Field days—Feed and forage technologies and crop varieties	1408	311	1719	Oromia/ Sinana	Farmers, extension, researchers, lecturers and local policy makers
Mid-season evaluation—Faba bean, malt barley and chick pea	22	16	83	Oromia/ Sinana	Farmers, extension, researchers and lecturers
Training—Cultivated fodder management and utilization	73	22	95	Oromia/ Sinana	Framers, extension and University researchers
Workshop participation—CCAFS mitigation options tool (CCAFS-MOT)	1	0	0	Oromia/ Sinana	Site coordinator
Visits—External visitors outside Ethiopia to share Africa RISING experiences	1	0	77	Oromia/ Sinana	Researchers, University professors and others
Total	1505	349	1974		

Table 11. Capacity building activities during the reporting period in Endamehoni Africa RISING site

Subject/ topic	Number of men participants	Number of women participants	Total	Site	Beneficiaries
Field visit—Feed and forage technologies and crop varieties	1785	884	2669	Tigray/ Endamehoni	Farmers and extension
Field days—PVS on malt barley, faba bean; seed multiplication on wheat and lentil and oat-vetch and feeding trough livestock technologies	30	80	110	Tigray/ Endamehoni	Farmers, extension, researchers, training colleges, Union, University and NGOs.
Mid-season evaluation—PVS on faba bean, malt barley and chickpea	17	10	27	Tigray/ Endamehoni	Farmers, extension, researchers, brewery and lecturers
Training—Cultivated fodder management and utilization				Tigray/ Endamehoni	Framers, extension and University researchers
Workshop participation—CCAFS mitigation options tool (CCAFS-MOT)	1	0	0	Tigray/ Endamehoni	Site coordinator
Visits—External visitors outside Ethiopia to share Africa RISING experiences	5	2	7	Tigray/ Endamehoni	Researchers, University professors and others
Total	1838	976	2813		

Student research attachments

Currently, the Africa RISING project in the Ethiopian highlands has four PhD and one MSc students. Two of the PhD students have already submitted their dissertations and the other two are still writing. The MSc student is also writing his thesis.

Events from our sites, coordination office and CGIAR partners

Coordination office

16 November 2017: Africa RISING Addis Ababa office jointly with Basona Woreda team organized a field trip to the project intervention areas in the woreda. Around 30 participants representing USAID- Washington, US embassy here in Ethiopia, ILRI, CIAT, CCAFS, FtF innovation lab, Debre Birhan research institute, Debre Birhan university took part in the visit. This was part of the series of field visits organized in all Africa RISING sites to show our donor the progress we have been making and soliciting future partnership.

13 February 2018: Africa RISING team had participated at a half day USAID/Ethiopia Feed the Future Partners Meeting focusing on the progress on Using Digital Solutions to Increase Reach and Success. The meeting mainly covered how digital technologies are used in the agricultural sector mainly for technology adoption and financial transactions. There were presentations from various partners looking at the available digital technologies and the progresses being made in the use of this applications/tools.

CGIAR partners

9–16 October 2017: CIMMYT conducted an eight days refresher training for service providers was conducted at Melkassa Research Centre. Nine participants including 3 Africa-RISING project site coordinators took part in the training event. The purpose of the training was to build the capacity and refresh, in some cases, the existing technical knowledge of the service providers to use, operate properly, maintain and get used to the daily maintenance, check, tips and trouble shootings of the two-WT and its ancillaries (trailer, reaper harvester, sheller/threshers and water pump) but also to understand safety around two-WT technologies as well as road traffic rules, which are crucial in rural areas.

Africa RISING sites

Amhara

5 November 2017: Africa RISING Basona Worena site effectively organized a field day at Gudo Beret Kebele. The aim of the field day was to see the field performance of R4D and scaling activities conducted during 2017 main cropping season.

15–16 November 2017: Africa RISING site organized training on “Feed conservation and utilization” at Gudo Beret Kebele. The training aimed at giving some theoretical insight and to practically demonstrate alternative conservation methods for available fodders for farmers in the area.

24 December 2017: Africa RISING Basona site in partnership with the Woreda livestock development & promotion office had organized a field day at Goshe Bado Kebele. The objective of the field day was to show fodder related technologies (tree lucerne, feed shade and feeding trough) and the recently introduced transitional bee hive technology at Abegaz Ayifokru (Model farmer) homestead.

Oromia

4 October 2017: Africa RISING animal feed adaptation trials at Ilu-Sanbitu kebele were visited by experts and researchers from Madda Walabu University. The objective was to inspect disease incidence on Sweet Lupine adaptation trials.

19–21 October 2017: Africa RISING organized a field visit that covered Sinana, Goba, Dinsho and Agarfa woredas of Bale Zone. Participants were from the Bale zone office of agriculture and natural resource development office V/head, agronomist expert and woreda admin and offices of agriculture heads, zonal and woreda contact persons and kebele DAs. The major objectives was to conduct M&E of crop technologies scaling/pre-scaling works under the support of Africa RISING project at the four target woredas.

25 November 2017: Africa RISING participated on field day organized by Oromia Seed Enterprise (OSE) Bale branch. The objective was to demonstrate the performance of seed multiplication of improved varieties of various crops including malt barley, durum wheat, food barley, faba bean and bread wheat to all its customers.

28 November 2017: Africa RISING various crop related innovations and technologies were visited during the farmer field day was organized by Sinana woreda office of Agriculture and NRM.

2 December 2017: Africa RISING Sinana Research site effectively organized a midseason evaluation field day on faba bean, chick pea and malt barley PVS at Ilu-Sanbitu kebele. The objective was to identify farmers preferred varieties among 5 to 6 varieties demonstrated for each of the three crops based predetermined selection criterion. 15 farmers (6 female and 9 male) participated. One researcher from the Sinana Agricultural Research Center (SARC), one agronomy expert from Sinana woreda agriculture and NRM, 2 from Africa RISING and ICARDA participated on this occasion.

5 December 2017: As part of the farmer field day that was organized by Sinana district office of Livestock and fishery resource development, Africa RISING feed technologies at Ilu-Sanbitu kebele, were visited.

20 December 2017: In collaboration with partners from zone and woreda extension as well as Madda Walabu University, Africa RISING Sinana Site organized farmers' training on cultivated fodder management and utilization in Goba district on. Six model farmers engaged in Oat+vetch production and seed multiplication as part of scaling in W/makida kebele took part. Two woreda experts and one DA were also participating. The objective of the training was to fill knowledge gap on management and utilization of Oat+vetch.

2 January 2018: Africa RISING Sinana site successfully organized mid-season evaluation field day at Selka kebele. The objective was to identify farmers preferred varieties among the varieties demonstrated on each of the two crops (malt barley and Faba bean) based on selection criterion developed by the researchers. Six candidate varieties of malt barley and faba bean PVS trials were evaluated by male and female farmer groups. A total of 12 farmers - 5 of them females, 3 kebele level DAs, 1 cereal researchers from SARC, 1 lecturer and IP facilitator from MWU, and 1 expert from Sinana woreda extension participated on the event.

10 January 2018: With the invitation from Bale Zonal administration and extension offices Africa RISING participated and made presentation at the Agricultural development planning advisory council (ADPLAC) meeting.

15–19 March 2018: Africa RISING was well recognized at the recent 1st international conference that Madda Walabu university organized under the title Enhancing Sustainable Development towards Climate Change Adaptation and Resilient Environment. Africa RISING Sinana involved in the conference through financial support as well as presenting various part in relation to the theme of the conference.

SNNPR

27–28 February 2013: Practical and theoretical trainings on the utilization and management of fodder beet and sweet lupine was concluded at Heyse and Upper Gana kebeles in the south. In Heyse kebele only a total of 40(35 farmers, 3 development agents, 1 health extension workers and 1 woreda expert) people who came from three kebeles (Hayse, Jawe and Shecha) attended the training.

Tigray

6 November 2017: Africa RISING Endamehoni Site successfully conducted a mid-season evaluation on Malt barley, Faba bean and chickpea PVS. Five Female and seven male farmers did participate to evaluate the performance of the varieties. In addition to the farmers, three experts from Raya brewery, Alamata Agricultural research center and Endamehoni Agriculture office participated in the evaluation.

Communications and knowledge sharing

The main communication channels supported are:

- Wiki internal workspacee(http://africa-rising.wikispaces.com/ethiopia_highlands)
- Project updates on the program website (africa-rising.net/category/countries/ethiopia/)
- A monthly partner meeting in Addis Ababa
- A Yammer network with internal updates
- Photos: https://www.flickr.com/photos/africa-rising/sets
- Repository: https://cgspace.cgiar.org/handle/10568/16500

Africa RISING Ethiopia outputs by type

Blogs

Site-specific nutrient management can double grain yields contributing to food security

International Women's Day 2018: Bekelech Belachew, a model woman farmer in southern Ethiopia

Growing multi-purpose trees to address forage gaps in Ethiopia

Challenges and opportunities in intensifying farming systems in Ethiopia: Results of a participatory community analysis

Africa RISING Ethiopia organized a training on apple and mango production in Tigray, Ethiopia

How Africa RISING project in Ethiopia is scaling its validating innovations/technologies

The level of women farmers' participation in five stages of the agricultural research process and implications for food security in Ethiopia

Farmers get guidelines for managing and using fodder in Ethiopia

Technology showcases in Africa RISING Phase II in Ethiopia

Toolkits developed to support Africa RISING partners' capacities in Ethiopia

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Case story

International Women's Day 2018: Bekelech Belachew, a model woman farmer in southern Ethiopia

Bekelech Belachew, 53, lives with her husband and five children in Jawe Kebele, Lemo District in the Southern Nations, Nationalities, and Peoples' region of Ethiopia. Jawe is one of the kebeles where the Africa RISING project has been operating since 2012.

Bekelech Belachew and her husband in Hossana in April 2017 (photo credit: ILRI\Simret Yasabu).

Bekelech and her husband (a retired teacher) have farmed food crops and kept livestock on their half-acre plot of family land for many years. But productivity has been very low due to the limited land, poor rainfall, limited access to water, inability to diversify crops, shortage of animal feed, and limited income, among other factors.

Bekelech taking part in a training focusing on Management and Utilization of Improved Forages (Photo credit: ILRI\Simret Yasabu).

Engagement with Africa RISING

Six years ago, when the Africa RISING project started its action research in Jawe, Bekelech joined the project and started involving in the research protocols from the project to improve livestock fodder production. She also started cultivating avocados (a high value tree) and begun water development and small-scale irrigation.

Within two years, she had become an active participant in the various social learning platforms organized by Africa RISING such as research group meetings and field days. She joined farmer exchange visits to Tigray and Amhara regions in 2014. The visits combined learning from the watershed management interventions in both regions which are led by the International Center for Tropical Agriculture (CIAT), and lessons on improved avocado production from Butajira, led by the World Agroforestry Centre (ICRAF).

After the visits, Bekelech constructed water percolation ditches on the upper side of her farm and a dug shallow well on the lower side. She started using the water from the shallow well to grow vegetables such as cabbages, beetroot and carrots. In recognition of her efforts, Africa RISING and CIAT gave her a geo-membrane (lining sheet for water harvesting ponds) which she used in a rainwater harvesting pond to collect more water to expand irrigation activities.

Africa RISING and ICRAF also gave her six grafted avocado seedlings sourced from the horticultural centre in Butajira. The following year, she bought 10 additional seedlings from the centre to expand her avocado farm.

She also put an effort to improve the feed gaps her cattle were experiencing. In this regard, she planted tree lucern (a multipurpose fodder tree that the project introduced), and started mixing it with crop residues for livestock feed.

Bekelech's farm is now a learning site (Photo Credit: ILRI\Simret Yasabu)

Achievements

Bekelech says she has experienced a chance of fortunes in farming resulting from her engagement with the project. 'I have achieved a lot,' she says. 'The skill and knowledge I have gained enabled me to improve how I farm and to try out new crops which has increased my farm output.' Using irrigation for farming has also increased income for her family. She says she has earned more than ETB 5,000 (USD 180) by selling vegetables. Sources of family income are also now more diversified; and due to dietary diversification, her family is now healthier and nutritionally secured. Her animals are fed cultivated fodder which has increased their productivity.

Bekelech Belachew uses the water from the shallow well to grow cabbages, beetroot and carrots (photo credit: ILRI\Simret Yasabu).

Her best practices in farming have been recognized by the regional government and she received a prize at the model farmer's festival in 2017.

Bekelech's farm is now a learning centre for others seeking to know how to intensify farming in similar small land holdings in the region. The Natural Resource Department of Wachemo University is now using her farm as a site for practical farming lessons and she travels to other parts of the region and country to share her farming experiences.

Written by Workneh Dubale.

Edited by Simret Yasabu

Opportunities and challenges

Opportunities:

- Increasing demand for the Africa RISING validated technologies/innovations;
- Most of Africa RISING validated technologies/innovations are in alignment with the Ethiopian government development priorities; and
- Strong partnership with CGIAR centres, local universities, research institutions, extension, NGOs, communities, some private entrepreneurs and development partners.

Challenges:

- The delay for fund releasing is hampering project operations and allocation of funds for CGIAR centres.