

Small-scale mechanization options for rural communities in the Ethiopian highlands

Background

Farming operations on smallholder farms in Ethiopia are predominantly performed by human muscle power leading to high drudgery. The animal-drawn *maresha*, a symbol of agriculture in Ethiopia, is a labour-intensive system especially at land preparation stage when the soil is tilled 3–4 times before establishing a crop. Precision and efficiency in planting and fertilization are low on smallholder farms. Harvesting and post-harvest processing of major food security cereal and legume crops are done manually using human power, or livestock in the case of threshing. In addition, irrigation of high value crops on home gardens is also done manually using bucket system or the drag-horse.

Low horsepower (8–20 HP) two-wheel tractor (2-WT) based technologies offer an opportunity to tackle some of these challenges faced on smallholder farms in Ethiopia. Notable benefits from 2-WT based technologies on smallholder farms include reduced human labor for land preparation and planting; timely planting and increased precision in the use of seed and mineral fertilizers during crop establishment; reduced human labor for harvest and post-harvest processing (shelling and threshing) of maize, wheat, barley and teff. For the service providers, 2-WT based technologies are offering a source of income through provision of transport, planting, harvesting, threshing,

shelling and water pumping services for smallholder farming communities. Small-scale mechanization based on 2-WT technologies has opened opportunities for employment for rural youth who are organized in groups and are providing different services. Additionally, more employment opportunities are being created by individual service providers who are employing the youth because their mechanization businesses are expanding. In its second phase (October 2016–September 2021), Africa-RISING in the Ethiopian highlands, and CIMMYT and its partners are conducting generic research on 2-WT based technologies and scaling out these technologies in the maize and wheat growing regions of Ethiopia (Figure 1). The aim of the strategy is to increase the farm power available to Ethiopian farmers 10-fold (from the current 0.1 Kw ha⁻¹ to 1 kW ha⁻¹) by 2025. Through partnerships with the Ethiopian Ministry of Agriculture and Livestock Resources, agriculture equipment manufacturers and importers in the private sector, and microfinance/leasing and food processing companies, generic research and scaling out of small mechanization technologies are being implemented in Tigray, Amhara, Oromia and SNNP regions in Ethiopia.

Major achievements

Mechanizing farm operations has brought about various benefits for different stakeholders, including smallholder farmers, service providers, unemployed youths, agriculture equipment manufacturers and importers, as well as microfinance/leasing companies in Ethiopia. For farmers, the benefits have been visible at field and whole farm levels. These benefits include reduced human and livestock energy, reduced cost and time required for establishing and harvesting crops, threshing, shelling, and transportation.

A total of 2,124 (640 females and 1,484 male) direct beneficiary farmers who are permanent customers currently receive 2-WT based services from service providers, while 2,780 farmers were reached through demand/awareness creation field days and learning visits.

Table 1: Revenue generated by service providers from different 2-WT based technologies in different project sites in the first quarter of 2020

Region	District	Farm operation	Revenue generated (USD)
Amhara	Debre Birhan	Threshing	1,214.71
		Transportation	176.47
Amhara	Machakel	Harvesting	629.41
		Threshing	7,966.18
Oromia	Gudeya-Billa	Shelling	5,959.85
		Transportation	188.24
Total			16,134.86

Over the past three years, mechanized farming has significantly contributed for increase in production and productivity in Amhara and Oromia regions of Ethiopia. In this respect, wheat seeding, harvesting and threshing costs reduced by 40–54% with mechanization compared to traditional practices. Maize

productivity gains of 16–44% and 18% for wheat (Figure 2) have been documented compared to conventional practices. Field level gross margin gains of USD371/ha for maize and USD358/ha for wheat production were achieved by using 2-WT direct seeding systems compared with conventional practice. Local service providers have also generated income using 2-WT technologies (Photo 2 and Table 1).

The project initiated capacity building for 91 service providers and 10 local mechanics who received technical and agribusiness training between 2017 and 2020 in Africa RISING operational sites. In the process of testing and scaling out 2-WT based technologies, three equipment manufacturing and importing companies have actively participated in the project as more business opportunities opened in the rural communities. As of 2020, two leasing companies have secured business opportunities from the service providers who purchased more equipment due to expanding business lines in the rural communities they serve. The number of youth employed on a permanent basis by service providers ranges from 1–5 across the regions and the number often increases during the peak post-harvest processing period.



Photo 1: Two-wheel tractor powered wheat threshing and maize shelling provided by service providers in rural communities of Ethiopia (photo credit: CIMMYT/Walter Mupangwa)

Strong partnerships with the Ministry of Agriculture and Livestock Resources (MoALR), regional bureaus of agriculture, agriculture equipment manufacturers and importers, training centres and microfinance/leasing companies have been established since 2017. Through these partnerships, there has been co-investment towards scaling out of mechanization technologies by some partners. For example, MoALR initially invested in 100

2-WT and disc ploughs and has now added more equipment including 10 low horsepower 4-WTs, 10 trailers, 10 maize sheller engines, 10 threshers, 10 planters, 10 harrows, 10 ploughs and 10 cultivators for the scaling out of mechanization in rural communities.



Photo 2: Post-harvest field day in Goshebado demonstration of two-wheel tractor (Photo credit: ILRI/Haimanot Seifu)

Lessons learnt

Lessons learnt from the experiences of implementing different mechanization technologies in the rural settings of Ethiopia include:

- Importance of partnerships in delivering project outputs in difficult times: the progress made particularly in 2020 during the COVID-19 pandemic has been possible through the effort of our project partners based in Amhara, Oromia and Tigray regions.
- Importance of adequately training service providers and development agents (DAs) in mechanization technologies: repeated training conducted since 2017 enabled the service providers and DAs to successfully facilitate project activities during the travel restrictions due to the COVID-19 pandemic and difficult security situations.
- Access to finance: the leasing scheme on agriculture equipment offers service providers an opportunity to acquire additional equipment and expand the mechanization services available for rural communities of Ethiopia.
- Identification of appropriate niches for different 2-WT based technologies: different mechanization services are required in different rural communities and it is critical to identify the right equipment to invest in while scaling out mechanization technologies.
- Awareness and demand creation: a number of options for advertising mechanization services are emerging in project sites. Advertising of 2-WT services using signposts with the service providers contact details has increased the number of clients for the SPs. The normal village meetings often convened by traditional leaders is another option in some communities.

Looking forward

Since 2017, Africa RISING, together with CIMMYT, has implemented agricultural mechanization in the four regions of Ethiopia. However, promotion of mechanization technologies in rural Ethiopia still has a long way to go. Documentation of adoption levels and drivers of adoption of the different technologies still need to be tackled. With the diversity of the country in terms of crops grown, agro-ecologies and farming systems, mapping of

appropriate niches for the different mechanization technologies is critical for future scaling out in rural Ethiopia. As more stakeholders get involved in mechanization, linkages of different mechanization technologies along value chains need to be explored and promoted in future initiatives. In addition, increased linkages of current and new service providers with the private sector is critical to ensure sustainability of mechanizing farming operations in rural communities of Ethiopia.

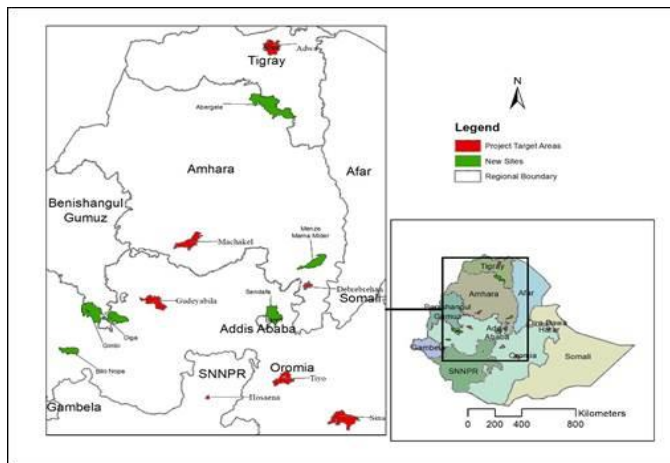


Figure 1: Map of Ethiopia showing parts of the country where two-wheel tractor based small mechanization technologies are being promoted since 2015

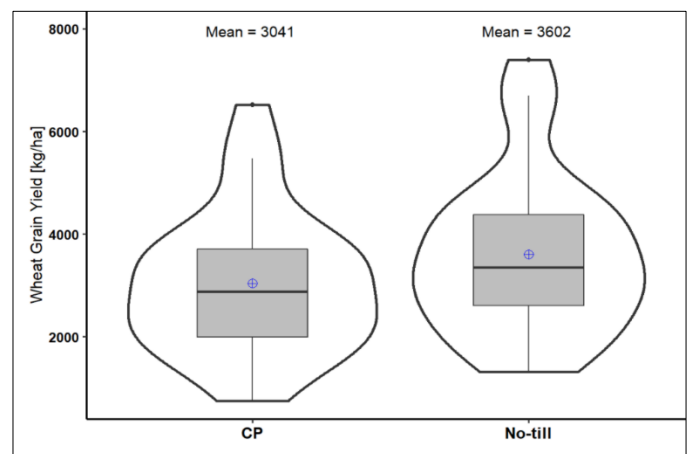


Figure 2: Wheat yield gain due to two-wheel tractor direct seeding practice on farmer fields



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 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 an associated project on monitoring, evaluation, and impact assessment. Prepared by Walter MUPANGWA (CIMMYT), Kindu Mekonnen (ILRI) and Haimanot Seifu (ILRI)

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