

Social dynamics and sustainable intensification in Ethiopia

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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.




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Acronyms and abbreviations

Africa RISING	Africa Research in Sustainable Intensification for Next Generation
COVID-19	Coronavirus Disease 2019
CRGE	Climate Resilient Green Economy of Ethiopia
CSOs	Civil Society Organizations
FDRE	Federal Democratic Republic of Ethiopia
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GTP	Growth and Transformation Plan of Ethiopia
HERP	Home-grown Economic Reform Plan
ILRI	International Livestock Research Institute
NGOs	Non-Governmental Organizations
SNNP	Southern Nations, Nationalities and People's regional state
USAID	United States Agency for International Development
UN Women	The United Nations Entity for Gender Equality and the Empowerment of Women

Summary

The Africa RISING project aimed to provide pathways out of poverty for smallholder farmer households through sustainably intensified farming systems that improve food, nutrition, income security, and conserving natural resources. implemented in the highlights of Ethiopia and activities were led by the International Livestock Research Institute (ILRI) in two phases (2011-2015) and (2016-2021). This study was conducted in 2022 in North Shewa and Hadiya zones located in Amhara and Southern Nations, Nationalities and People's (SNNP) regional states in Ethiopia. Qualitative methods were used and a total of 9 key informant interviews and 16 sex disaggregated focus group discussions in Africa RISING and scaling sites were conducted.

The study had three objectives. First, a contextual analysis to describe characteristics of the sites, such as market access, available work opportunities, and gender roles and practices was undertaken. These context specific aspects play an integral role in innovation processes in both communities and households. Second, an analysis of social dimensions of technological innovation processes, that includes dissemination, awareness, and gendered technology preferences was performed. Third, perceived impacts and recommendations from research participants were solicited. Recommendations about how to design socially inclusive scaling of innovations and technologies are provided.

Findings reflect how gendered norms and practices influence technology adoption and uptake and how technologies influence gendered distributions of benefits and burdens. Gender specific norms and practices influence women's and men's household, cropping and livestock activities and mobility. In Africa RISING sites community level participatory decision-making processes, such as those surrounding technology selection were primarily with men while decisions concerning adoption in the household were often made jointly. In the scaling sites, opportunities for awareness creation, trainings, technology supply and follow up of adopted technologies were fewer than those in Africa RISING sites. Women and men's technology preferences differ, and technologies promoted by Africa RISING often matched women's and men's preferences, more often in Africa RISING than in scaling sites. Technologies had positive impacts on food production, food security and nutrition. Men reported increased awareness and skills about technologies and participation in demonstration activities. Newly introduced technologies, such as improved varieties of avocados, resulted in trade-offs in women's income and labor. Feed and fodder technologies had positive productivity and income impacts, and because women manage livestock product sales such as poultry and milk, women's income increased.

Conducting gender analyses *prior* to promotion of technologies is essential to mitigate harmful trade-offs. Using participatory community engagement approaches to develop complementary technology packages can redress trade-offs associated with new technologies. Gender responsive approaches should be used to promote technologies that women choose, prefer, and manage to improve productivity and hence, income and nutrition benefits. Socially inclusive scaling approaches that engage women and men will ensure that gendered preferences are reflected in the selection and promotion of technologies that meet both women's and men's needs and improve sustainable intensification in diverse households and communities.

Introduction

The Africa RISING project aimed to provide pathways out of poverty for smallholder farmer households through sustainably intensified farming systems that improve food, nutrition, income security, and conserving natural resources (Africa RISING, 2015; ILRI, 2015). The program was implemented in the highlights of Ethiopia and activities were led by the International Livestock Research Institute (ILRI) in two phases (2011-2015) and (2016-2021). The program aimed to achieve inclusivity by integrating gender issues in the research and development activities such as integrated systems improvement, monitoring and evaluation, scaling, and gender capacity (Africa RISING, 2015, 2016). Participatory research approaches were used to facilitate engagement of researchers and farmers for mutual learning and integration of farmers' interests in the research activities and innovation processes (ILRI, 2020). The program was supported by the United States Agency for International Development (USAID) as part of the US Government's Feed the Future initiative.

This study was conducted in 2022 in rural communities in North Shewa zone, Amhara regional state, and Hadiya zone in the Southern Nations, Nationalities and People's (SNNP) regional state of Ethiopia. The study had three objectives. First, a contextual analysis to describe characteristics of the sites, such as market access, available work opportunities, and gender roles and practices was undertaken. These context specific aspects play an integral role in innovation processes in communities and households. Second, an analysis of social dimensions of technological innovation processes, that includes dissemination, awareness, and perceptions and preferences of certain technologies was performed. Third, perceived impacts and recommendations, both from the perspectives of research participants and the authors are provided. The findings are used to inform recommendations for future projects that are scaling innovations and technologies in Ethiopia.

Background

Agriculture contributes to 32.8 % of Gross Domestic Product (GDP) and 73% of total employment in Ethiopia (FDRE, 2021). Livestock contributes to 20% of the total GDP, 40% of the agricultural GDP, and 37-87% of household income (Malabo Montpellier Panel, 2020). Efforts to improve agricultural productivity feature prominently in policies and development strategies, e.g., the Growth and Transformation Plans (GTP I & GTP II) Climate Resilient Green Economy (CRGE) strategy and the Home-grown Economic Reform Plan (HERP) (FDRE, 2010, 2011, 2015, 2019). However, productivity remains low, due to multiple factors that include climate change, soil fertility losses, increased land fragmentation, and degradation of natural resources (Stellmacher & Kelboro, 2019; Wendimu, 2021).

Innovations and technologies have the potential to simultaneously increase productivity, smallholder income, and enhance resilience to climate shocks (Bachewe et al., 2018). Constraints to adoption include limited access to productive and financial resources and knowledge and information (Zerssa et al., 2021). Little attention has been dedicated to understanding contextual factors that influence technology uptake (Kebede, 2019). Local socio-political dynamics that excluded certain community members affected adoption of malt barley in highland communities in Southern Ethiopia, for example (de Roo et al., 2019).

Gender in Ethiopia

Women's livelihood activities in Ethiopia and elsewhere in Africa have been underestimated and remained 'invisible' despite their relevance towards achieving food security and nutrition improvements (UN Women, 2021). Gender norms and practices often influence and result in differences in women and men's labor in productive and domestic tasks, access and ownership of productive resources, authority in decision-making over income, and

access to credit. Gender inequalities influence technology and innovation adoption processes, both by influencing which technologies are adopted and how technologies influence social dynamics in the household.

Gender division of labor

Gendered divisions of labor influence women and men's labor distribution in productive and domestic tasks. In Ethiopia, gendered tasks for boys include grazing cattle, weeding, harvesting and ploughing (Gella & Tadele, 2015). Girls may participate in weeding and harvesting, but generally do not plough or look after cattle. Instead, young girls assist their mothers and sisters in cooking food, looking after backyard gardens, feeding and maintaining poultry, milking and milk processing, washing clothes and cleaning the house and animal barn (ibid).

Married women's contributions to on-farm production in Ethiopia are often undervalued when compared with their domestic roles that include food production, childcare and other household chores, which many cultural norms designate as 'women's responsibilities' (Gella & Tadele, 2015). Women are expected to clean, fetch water, cook, collect firewood, and provide care for their children (Dito, 2011). By contrast, men are mainly responsible for agricultural related tasks and are not expected to help out in domestic work (ibid).

In Ethiopia, men are considered the 'supervisor' or 'manager' of farm activities, while women are considered subordinate, mere 'helpers' in agricultural production activities, despite their significant contributions to farming (Dito, 2011; Theis et al., 2018). Many labour-intensive agricultural activities such as land preparation, weeding, harvesting and transporting harvests require the active involvement of women and men, but their participation in the majority of agricultural activities does not result in their recognition as farmers on equal footing with men (Elias et al., 2015; Gella & Tadele, 2015).

Access to resources and benefits

Women seldom own or manage key productive resources that are essential to support agricultural intensification. Women's constrained access to and ownership of land, income, and access to credit undermines both household and community level intensification efforts. Land ownership is instrumental in supporting a households' abilities to intensify production. Women's limited access to, and ownership of land, has been well documented in the literature. In Ethiopia and elsewhere in Africa, women control less land than men, their tenure is insecure, and the land they control is often of poorer quality relative to men's land (Perez et al., 2015; Tsige, 2019). In Ethiopia, as in many sub-Saharan contexts, land is passed on patrilineally, from fathers to sons. Married women typically gain access to land through their husbands and exercise limited authority in management decisions (Bayu, 2015). Women's positions in households varies and influences their agency. In one study, married women were found to manage less than two percent of the family's plot, while women in female-headed households managed 88% the household farm plots (Mekonnen et al., 2018). However, women in female-headed households generally have insecure land rights. Upon death of a husband, widows may lose land to their husbands' families, especially his brothers, whose can reclaim land without being contested (Jaffe, 2017). Women who do not have land seek income generating activities to complement earnings, but may engage in low-skill, low-pay activities (Denton, 2002).

Credit arrangements alleviate farmers' capital constraints and enable them to invest in agricultural inputs. However, women's and men's access to credit often differ. In Ethiopia, the overall levels of credit access are low. Only 16 percent accessed credit, including only 1 percent who were female headed households (Elias et al., 2015). Other studies have found that men gain access to credit more easily than women due to the nature and terms of

credit arrangements (Tsige, 2019; Alebechew, 2018). Beyond the formal financial sector, a study that included West and East African countries found that women seek alternatives to formal financial services and participate in mutual insurance and risk-sharing networks, and benefit from non-agricultural services provided by social support institutions external to the village (Perez et al., 2015).

Extension services, whether public or private, are essential to support uptake of agricultural and livestock technologies. In Ethiopia, public and private external organizations that support agricultural production often provide support to men more often than women (Perez et al., 2015). Women have limited access to extension services and skills training from agricultural institutions (Tsige, 2019; Alebechew, 2018) and women in married households are less likely to have contact with agricultural extension agents and to participate in groups (Mekonnen et al., 2018). In Northwest Ethiopia, one study found that only 15.8% of women in female-headed households gained access to extension services, much lower than male heads of household (70.7%) (Elias et al., 2015). Explanations for such low uptake were attributed, in part, to a quota system that urged extension workers to target resource-rich farmers. Other factors that contributed to women's marginalization from extension services included extension workers' low motivation to work with women, and especially women with limited resources, because of their low status in farming (ibid).

Decision making and control

Women are marginalized from many agricultural decision-making processes (Tsige, 2019). Women's and men's abilities to manage income often differ as a result of socio-cultural norms. In Ethiopia, women have more control over decisions related to household milk consumption than decisions related to milk sales (Tavenner et al., 2019). However, increased market orientation and anticipated increases in sales of crops and livestock will likely reduce women's control over the few products they manage (Tavenner et al., 2019). Men in Ethiopia generally have more decision-making authority than women over income (Tsige, 2019) and male household members are, on average, more likely to engage in business and wage labor activities (Gella & Tadele 2015; Mekonnen et al., 2018). Female household heads are less likely to participate in business or wage-labor activities than female spouses of male household heads, likely due to labor-constraints in female-headed households (Mekonnen et al., 2018).

Household decision-making about agricultural technologies similarly reflects gendered power relations that often limit women's agency. In Ethiopia, Ghana, Tanzania men typically make decisions about technologies, including mechanized technologies such as irrigation (Thies et al., 2018). Furthermore, costs and benefits of technology adoption are not equally distributed across the household because one member of the household, typically the male head, generally has rights to productive resources, including management of resources (Theis et al., 2018).

Supportive policies

While policies to support women's ownership of land have been created, norms and customary rights continue to restrict women's management of productive resources. Women are often restricted by social norms from taking advantage of modern laws that are beneficial to them (Dito, 2011). Efforts to redress gender inequalities in access to and ownership of land include a land policy in Amhara region in Ethiopia that promotes equitable access to, and rights, on rural land. While this policy has resulted in more equitable distribution of land, cultural values and norms have persisted (Alebachew, 2018). One study in Ethiopia found that, while the differences between male- and female-headed households' proportions of land registered was small, there were gender gaps in knowledge about

tenure security, land transferability, and gender rights that led to gender differences in the adoption of soil conservation practices (Quisumbing & Kumar 2014).

Methods

This study was implemented in Africa RISING and scaling sites in April, 2022 (Table 1). In Africa RISING sites participatory action research was implemented to test, try out and increase adoption of technologies that were developed by local agricultural centers. Scaling sites are locations where technologies and innovations were disseminated through public private partnerships, some of which incorporated participatory learning approaches. Site sampling criteria were that Africa RISING and scaling sites, or woredas, were selected where there was significant uptake of diverse technologies and innovations. Eight intervention kebeles, four Africa RISING research and four scaling, were finally selected in close collaboration with Africa RISING field coordinators in North Shewa and Hadiya zones. Gudo Beret and Angolela in North Shewa, and Jawe and Upper Gana were selected from the Africa RISING sites. Gerba and Wele in North Shewa, and Morsuito and Dubanicho were selected from the scaling sites.

Table 1 List of study sites for the qualitative study

Site category	Kebele	Zone	Regional state	Distance from zonal town (in Kms)	List of Africa RISING technologies
Africa RISING sites	Gudo Beret	North Shewa	Amhara	27	Fava bean varieties (Dosha, Gora, Numan), wheat (Tsehay, Wane), potato varieties (Gera, Shenkola, Belete, Gudane), malt barley (Ibone, HB 1964), oat and vetch, fodder beets, feeding trough, PVS (field pea, lentil, faba bean, bread wheat, durum wheat, malt barley); Macaroni wheat (Bulala, Utuba, Fetan)
	Angolela	North Shewa	Amhara	10	Feeding trough, oat and vetch, fodder beet, food barley (demonstration)
	Jawe	Hadiya	SNNPR	8	Fava bean (Gebalicho, Dosha, Gora), wheat (bread wheat, Hidase, Kingbird, Wane, Limu, Digelu, Danife), barley (food barley, HB1307-white barley), potato (Gudane, Jalene), avocado (Hasi, Itinger, Nabal, fruite, Red 13, pinkerten), fodder beet, Tree Lucerne, oat and vetch
	Upper Gana	Hadiya	SNNPR	13	Wheat (limu, wane, daka, jojoba, shurima, hidase, kingbird, digelo, danife), macaroni wheat (Fetan),fava bean (Gebalicho, Dosha, Gora, Tumisa, hachalu, Moti, Didea, Oshbaka, Numan), barley (food barley-HB1307, hagere, HB 1966, adosha, agegnehu), malt barley (HB 1964), Bahati, Holker, bekoji 1, Ibon174, HB 1963), Chickea (Ajura, arerti, Dz1014, Habru, Hora, local), avocado (nabal, red 13, hasi, fruite, etinger, pinkerten, Enset 9endale, gewada, Kelsi), potato (Gudane, Jalene, belete); fodder beet, alfalfa, sweet lupin, oat and vetch, Tree Lucerne, Breccaria, feeding trough

Scaling sites	Gerba	North Shewa	Amhara	65	Wheat (Deka and Wane), Macaroni wheat (Fetan), Fava bean (Numan), vetch, oats and vetch, feeding trough
	Wele	North Shewa	Amhara	47	Wheat (Wane), Fava bean (Numan), vetch, oats and vetch, feeding trough
	Morsuito	Hadiya	SNNPR	18	Fava bean, wheat (hidase, dendea, danife, wane, angelho, lemu), wat and vetch, oats, fodder beet
	Dubanicho	Hadiya	SNNPR	11	Wheat (Ogalicho, Danife, kekebe, fuleme), avocado (hasi, nabal, etinger, fruite), enset, disho grass, Tree Lucerne, oat and vetch, oats, improved cow breeds (holstein, jersey and Borana)

Data collection

Data was collected in May and June 2022 in North Shewa sites in Amhara and Hadiya sites in SNNPR regional states. Key informant interviews and focus group discussions (FGDs) were used to collect information. Research participant selection was made with support from Africa RISING field coordinators. The field coordinators also provided details about the innovations and technologies promoted by Africa RISING in each kebele.

Four facilitators and four note takers from North Shewa and Hadiya sites were trained for 2 days. The training provided an overview on the Africa RISING program and instruments, such as the interview and focus group discussion guides tested and revised during the training session. The training session was facilitated in English and Amharic languages.

Key informant interviews were conducted with Africa RISING field coordinators, experts from the Office of Agriculture, and progressive farmers using an interview guide (Table 3, Appendix 2). In total, 9 key informant interviews were conducted. Information about Africa RISING practices, characteristics of the kebele, major changes, availability of work opportunities and climatic shocks were collected. The interviews were recorded with consent for accuracy in transcription. Each key informant interview took about an hour.

Participants of FGDs were men and women farmers who had adopted technologies and non-adopters. The field coordinators provided information about the beneficiaries, the types of technologies, the potential kebeles, and key informants for the study. FGDs were held in local languages, Amharic in North Shewa and Hadiyisa in Hadiya sites. In total, 16 sex-disaggregated FGDs (8 men, 8 women) were conducted. Each FGD was comprised of 9 participants on average (Table 2). Male facilitators and note takers were assigned to the men FGDs, and women facilitators and note takers were assigned to the women FGDs. The only exception was the Hadiya site where it was not possible to find a female note taker. FGD topics included social context, such as gender roles and responsibilities, access to agricultural information and services, and technological practices, decision-making around technologies such as testing and adopting new technologies, and perceived impacts of technologies (Appendix 1). Some sections of the guide adapted from GENNOVATE (<https://gennovate.org>), a global comparative research initiative to investigate how gender norms and agency influence men, women, and youth to adopt innovation in agriculture and natural resource management (NRM). FGDs were recorded with consent for transcription. Each FGD took about 1.5 hours.

Table 2 Men and women participants of FGDs

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

Table 3 Characteristics of key informants

Codes	Location	Zone	Sex	Position
Key informant 1	Debre Birhan	North Shewa	Male	Africa RISING Coordinator
Key informant 2	Gerba	North Shewa	Male	Livestock expert
Key informant 3	Gudo Beret	North Shewa	Male	Progressive farmer
Key informant 4	Debre Birhan	North Shewa	Male	Zonal livestock expert
Key informant 5	Wele	Hadiya	Male	Crop expert
Key informant 6	Jawe	Hadiya	Male	Livestock expert
Key informant 7	Upper Gana	Hadiya	Male	Crop expert
Key informant 8	Hosaena	Hadiya	Male	Africa RISING Coordinator
Key informant 9	Morsuito	Hadiya	Male	Progressive farmer

Data analysis

Qualitative data analysis approaches were used following reading of the transcripts. Deductive coding was informed by a code book developed by the project. The coding tree consisted of key thematic areas of the study such as gender context, markets, influential factors, change, major events, information and services access, technological practices, decision making, impacts, gender-specific issues, and impact. The deductive coding was followed by an inductive coding to identify additional themes. NVivo software was used for data retrieval and analyses (QSR International, 2022).

Results

Study site contexts

North Shewa

Amhara are the major ethnic group and the main religion is Ethiopian Orthodox. The presence of NGOs and private sector in all the kebeles in the North Shewa is reportedly low. Institutions include public institutions such as kebele administration, office of agriculture, health extension and agricultural cooperatives. Development groups (locally called *limat buden* refers to a group of 15 to 20 farmers organized by the local government for mobilizing farmers for socio-economic development) of men, women, and youth have also been common across the four kebeles. Residents of the kebeles established social institutions

such as burial and self-help groups (*iddir*), religious festive groups (*mahiber*), and rotational savings (*equib*) (Key informant interviews 1-5, North Shewa sites, June, 2022). In addition, seed multiplication and milk producers' cooperatives operated in Gudo Beret and Angolela kebeles respectively (Key informant interview 3, Gudo Beret, May 2022).

Outmigration is reportedly low. Work opportunities in the kebeles have not changed significantly in the last 5-10 years. Work includes casual labour jobs on farms, and entrepreneurship in poultry, livestock fattening, and farming on a rented land. *Debo*, a labour sharing arrangement was also practiced in all kebeles (Key informant interview 1, Debre Birhan, May 2022). There was a consensus among key informants that work opportunities were available mostly for young men and young women. In addition, key informants agreed that there have been improvements in road and health infrastructures in the past 5-10 years. Residents have good access to markets in nearby towns. COVID-19 has increased living costs, and led to challenges in gaining access to farm inputs and agricultural extension services (Key informant interview 4, Debre Birhan, May 2022). Rumours that milk consumption increases the chance of catching COVID-19 affected market sales during the first few months of the pandemic (Key informant interviews 1-5, North Shewa sites, May 2022).

Nuclear household arrangements are the most common arrangements, followed by extended family arrangements where the elders live with their married children or newlyweds share the same compound with parents (Key informant interviews 1-5, North Shewa sites, May 2022).

Local wealth is assessed based on size and number of plots owned, number and types of livestock owned, holding a bank account or investments in nearby towns. Accordingly, key informants characterized the kebele residents as very few rich, majority well-off, very few poor and very poor members (Key informant interviews 1-5, North Shewa sites, May 2022). Key informants also pointed out that agriculture and livestock were the main means of income for the rich, well off and the poor members of the community. For example, two farmers with the same size of land holding may have different socioeconomic position depending on their livestock ownership. The very rich residents have diversified livelihood means of income (Key informant 4, Debre Birhan, May 2022). In addition, wealth status influenced the level of investment in land, labour and technologies as a key informant elaborated:

“The rich can hire/buy more land and expand their agriculture and livestock activities. They can hire tractors and combine machines and engage in mechanized agriculture. They own milk cows and buy more good breeds at higher prices. They may fatten 2 or 3 bulls at a time. The well-off depend on agriculture and livestock for their income and livelihoods. Agriculture and livestock provide the poor at least some food to eat though they may not invest much and expand their activities like the rich and well off.” (Key informant interview 5, Wele, May 2022).

Men and women access information and services from agricultural extension personnel, development groups, demonstration activities, cooperatives, media, mobile phones and social gatherings (FGDs, men, women, Gudo Beret, May 2022). Women indicated that they access financial information from savings and credit associations through women groups. Across all sites, agricultural information is obtained through social gatherings, agricultural experts, research centers, Africa RISING program, social gatherings, sharing of personal experiences, and mobile phones, and local institutions like cooperatives and development groups. Men in North Shewa access agricultural information from the media such as the TV and radio, development groups, farmer meetings, through mobile phones, social gatherings, peer learning, sharing experiences on good agricultural practices with other village members.

Agricultural extension personnel and exchange visits were critical in skills development through training on land preparation, weeding, row planting and fertilizer application. For instance, the extension personnel offered technical advice on how to prevent livestock and plant diseases like the gall disease, facilitation to adopt AR technologies through provision of tools during construction of feeding troughs (FGDs, Women, Angolela, Gudo Beret, May 2022).

Hadiya

Hadiya is the major ethnic group and protestant the main religion. The institutional context in Hadiya sites indicated low presence of NGOs and private sector. Government institutions include kebele administration, office of agriculture, health posts and schools operated in the kebeles. *Iddir* and *equib* have been the main social institution in the kebeles. Besides, development groups comprising about 20 farmers in a group, and 1 to 5 arrangements have been established in the four kebeles to enable mutual support among farmers in addressing their technical, financial or labour constrains in using improving their agricultural practices (Key informant interview 9, Morsuito, June 2022). In Upper Gana, development groups (men, women, youth) worked on livestock feeds, poultry and sheep production. A Farmer Training Centre (FTC) in the kebele also was used for establishing a fruit nursery, and for training and demonstration activities for farmers (Key informant interview 7, Upper Gana, June 2022).

Work opportunities are often exist in farming and livestock systems including crop production, livestock production, home gardens, poultry production, apiculture activities and participation in public work programs to a certain extent. The opportunities were mainly available for women and youth (Key informant interviews 6-9, Hadiya sites, June 2022). Key informants confirmed that progress as been made in work opportunities in the four kebeles, mainly due to the expansion of horticultural and poultry activities, however, access to land has been a challenge for youth in the four kebeles. Youth responses include migrating to South Africa, Ababa, Hosaena and nearby towns. For example, a key informant explained that:

“A farmer may have a big family size. He/she has to allocate some land for livestock, some land for home gardens to grow *enset* (false banana) and other crops. He/she has to grow crops on the 0.5ha for feeding the family and selling in the market. So, small landholding contributed to the low-income levels in our kebele. Most adults have land, might be big or small. However, the youth have no land. The livelihoods options for the landless youth are education and migrating to other places. (...) Parents who are well aware on the benefits of education send their children to school and support children up to college. The challenge is that most of the college graduate may end up jobless after all the hard work.” (Key informant 9, Morsuito, June 2022).

Nuclear household arrangements are the most common, with a few polygamous arrangements, often limited to elderly and Muslim residents (Key informant interviews 6-9, Hadiya sites, June 2022). all the four kebeles had good access to markets in the nearby Hosaena town. However, residents in the Upper Gana, Jawe and Morsuito kebeles had poor access to all weather roads, potable water and electricity, and there has been an overall slow progress of infrastructure development in the Hadiya sites in the past 5-10 years. COVID-19 disrupted access to agricultural extension and farm inputs, and crop yields were affected by shortage of rain in the last few years.

Similar to the North Shewa sites, wealth status in Hadiya is determined by size of land, number and types of livestock, and savings. In addition, key informants underlined the ability to feed the family throughout the year and sending children to school as important criteria to determine wealth status of residents (Key informant interviews 6-9, Hadiya sites, June 2022). Wealth status of the residents of the four kebeles is made up of few rich, few

very poor, half of the residents represented well-off, and a quarter of the residents represented the poor. It was observed that the types of houses indicated the wealth status of the residents. Often, rich farmers may build one big house with corrugated roof plus two thatched houses. Rich households were also associated with ownership of improved livestock breeds as a key informant elaborated:

“The rich are ‘model’ farmers, and they represent 25% of the farmers. They have corrugated roof houses, may own mills, more than 4 oxen, more than 4 cows (local and improved breeds), about 10 goats, and more than 1ha land. The well off could be 50%. Farmers in this category can feed their family, and may own two oxen, one cow. A poor person may have a house but do not own farm lands or livestock (20%). The very poor depend on selling hire for other farmers (5%).” (Key informant interview 7, Upper Gana, June 2022)

Agriculture and livestock have been central to the livelihoods of residents in the different wealth categories. For instance, the rich might benefit from trying and adopting technologies due to their ability to allocate land for testing technologies. The rich and well-off were also likely have better access to knowledge, trainings, and technologies that they can use to increase their income from agriculture and livestock. The poor and the very poor relied on agriculture and livestock activities for food because they did not have the resources to invest in technologies and expand their activities (Key informant interviews 6, 7, Jawe, Upper Gana, June 2022).

Agricultural extension personnel, development groups, demonstration activities, cooperatives, media, mobile phones and social gatherings are common sources of information on financial resources, farm inputs, soil and water conservation, and Africa RISING technologies and innovations (e.g. FGDs, Women, Men, Upper Gana, Dubanicho, June 2022). Types of information accessed includes information about improved crop varieties, weed control, improved agronomic and livestock production techniques, vegetable production and compost preparation.

Men access information about good agricultural practices from agricultural extension agents and their peer. Women FGD also showed that received trainings on cluster farming, land preparation and compost preparation, growing of vegetables and fruits and how to rear chicken through diverse activities (FGDs, Women, Gudo Beret, Upper Gana, June 2022).

Women access agricultural information from agricultural experts, the Kebele development agents, women groups, media, Africa RISING project, peers like friends and neighbors. Women also get information from farmer training groups as well as from their husbands after they attend training. Men in Hadiya accessed agricultural information from agricultural experts at the kebele and woreda levels and informally through peer interactions with friends and neighbors and social gatherings like church meetings.

However, access to extension services is gendered. Extension agents rarely consulted women and provided trainings except for women household heads. Men and women FGDs across the sites substantiated that women faced challenges in accessing agricultural extension services. Though home visits are convenient for women the low frequency and irregularities of the visits increased women’s dependence on their husbands to access information. For instance, women explained that:

“Agricultural extension agents usually meet men not women. They undermine women’s role in agriculture and they do not call women to trainings and meetings. In our community, women are not participating at any of trainings, meetings, and on events where information about agriculture is being shared. Men are the ones who go to such places, men are responsible of this. If men are not around, women may learn on behalf of men” (FGD, women, Morsuito, May 2022).

Gender Context

Household roles and responsibilities

- **Women carry out chores that include cooking, cleaning, childcare, fetching water, collecting fuelwood, and trading items in the market to buy food items.**
- **Men have few regular household roles.**
- **Men have recently begun to undertake some domestic chores, that were previously considered to be women's tasks.**

Women play important roles in the household, mainly carrying out chores that include cooking, cleaning, childcare, fetching water, collecting fuelwood, and trading items in the market to buy food items. In Hadiya sites, women engaged in scrapping of *enset* and making *kocho* (bread made of *enset*) for household consumption and market sell (FGDs, Women, Men, Morsuito, June 2022; FGD, Men, Dubanicho, June 2022). In North Shewa sites, women engaged in producing *areke* (local liquor) as income generating activity (FGDs, Women, Men, Gudo Beret, May 2022; FGDs, Women, Men, Gerba, May 2022). Participants of all men and women FGDs pointed out that gender norms defined the role women and men had in the household, and assigned women to carry out major household tasks. Women were also expected to undertake additional tasks at community level such as caring for the sick and elderly members. A women FGD in Hadiya site indicated that women were able to negotiate sharing some of their domestic chores with their spouses or grown up children as:

“Women are the first to wake up in the morning. They decide what to cook and prepare breakfast. Women in this community have to collect fuelwood because not all of us have access to electricity. We have to use fuelwood for all our cooking. Women wake their husbands and children up for breakfast, and send children to school. Women, as parents, are responsible for feeding children, buying clothes for children, and sending them to school. Going to mills is also women's responsibility. Sometimes, women's responsibilities may be negotiated and shared by husbands and children” (FGD, Women, Jawe, June 2022).

Men have few regular household roles. Including splitting wood and fencing the homestead in all the sites. However, there was a consensus among all FGDs that gender norms did not assign men many household tasks compared to women. In Hadiya sites, men and women FGDs in Africa RISING and scaling sites pointed out that there was a general perception among the community that there was nothing men can do regarding domestic chores (e.g. Key informant interviews 6, 9 Jawe, Morsuito, June 2022; FGDs, Women, Upper Gana, Dubanicho, June 2022; FGD, Men, Morsuito, June 2022). gender norms often discourage men from staying at home during the day as doing so was often labelled as 'womanish' and might influence their image as 'dominant' figures in the community (FGD, Women, Gerba, May 2022). FGDs of men and women in all the sites indicated that men played a supportive role in carrying out household activities in cases when women were busy or were not around.

There are indications that gender norms surrounding domestic activities are slowly changing across sites. All FGDs showed that there were signs that men have started to support and undertake more domestic chores, that were previously considered to be women's tasks. For instance, men have started fetching water to support women across all the sites. To some extent, men in Hadiya sites also helped women in uprooting *enset* and transporting the *enset* leaves, indicating changes in constraining gender norms (FGD, Women, Jawe, June 2022). The positive change could be associated with recent efforts in raising awareness on gender equality by the government and development partners. A key informant elaborated that:

“*Enset* was considered as women’s crop, and women were responsible for the whole *enset* processing. It is a tough work as women have to dig and scrap *enset*. There was not much work that men do in *enset*. This has changes and nowadays men help women in lifting the *enset* because it is heavy and tiresome. There are positive changes in gender norms as men and women started to believe in cooperation. The health extension system has also created awareness on gender and helped in improving the gender equality in the kebele.” (Key informant interview 7, Upper Gana, June 2022)

Agricultural roles and practices

- **Men carry out more labor intensive tasks than women. Overall, women carry out more tasks than men.**
- **Men are considered farmers, while women are considered helpers.**
- **Decisions on types of crops to plant, farm inputs, crop management and income are made jointly by men and women in married households.**
- **Women make the decisions on crops in female headed households.**

All key informants and FGDs of men and women in North Shewa sites acknowledged that men are primarily responsible for undertaking labor intensive farm activities that include ploughing, harvesting and threshing. Women undertake many tasks that including preparing land, clean seed, carry farm inputs (i.e. seed and fertilizer) during planting and fertilizer application, collecting harvest and taking it to the threshing field, and transporting grain to the storage. There was also consensus that women play significant role in post-harvest management. Women are also responsible for home gardening activities such as watering of fruits and vegetables. FGDs and key informants confirmed that women make important contributions to farming due to their engagement in all activities except ploughing (e.g. FGDs, Women, Men, Gerba, May 2022; Key informant interview 5, Wele, May 2022).

“Women’s role in the agriculture sector is very wide in addition to motherhood. They prepare and carry food to the field, make furrows, collect harvest, and prepare the threshing ground” (FGD, Men, Wele, May 2022).

Men and women jointly in land preparation, planting, loading the harvest on donkeys and transporting the harvest., women’s labour contributions were considered less intensive across the sites. For instance, participants of men FGD in Arica RISING site emphasized that women did not undertake labour intensive tasks like ploughing, and thus women have not been as active on the farm as men (e.g. FGD, Men, Angolela, May 2022). It was observed that men were the ones considered as farmers and women were given a lower position as “supporters of men” than as actual farmers. Besides, the consideration of farming as an outside activity done by men could have left women’s contribution with little visibility. For instance, men and women indicated that men were responsible for spraying chemicals, and women carry water and support men during spraying. Similarly, women explained that men did heavy tasks such as digging and pumping water while women did watering and caring for the plants such as avocados (FGD, women, Dubanicho, June 2022).

Similar to North Shewa sites, key informant interviews and FGDs of women and men in Hadiya sites shared that men undertake laborious farm tasks, such as oxen plough, digging, threshing, and collecting the leftover grain (i.e. cleaning the fields). Key informant interviews and FGDs confirmed that women are responsible for cleaning seeds and preparing and transporting food and drinks to the farm in all the sites (e.g. FGDs, Women, Men, Gerba, May 2022; FGDs, Men, Gudo Beret, Wele, May 2022; FGDs, Women, Dubanicho, Jawe, June 2022; FGDs, Men, Upper Gana, Morsuito, June 2022). However, women and men FGDs in Hadiya sites pointed out that the Women’s role on the farm is mainly to support men (e.g.

FGD, Women, Upper Gana, June 2022; FGD, Men, Morsuito, June 2022). This perception confirmed the general undermining of women's contributions in farming. ploughing a key labour-intensive farming activity carried out by men, that may explain, in part, why women's farming contributions are not valued in the same way as men (Key informant interview 1, Debre Birhan, May 2022; Key informant interview 8, Hosaena, June 2022). This situation persisted regardless of the fact that most of the farm activities such as land preparation, making furrows, planting, fertilizer application, spraying chemicals, weeding, harvesting and transporting were jointly done by men and women in both Hadiya and North Shewa sites. Men and women in all North Shewa and Hadiya sites underlined that decisions on what crops to grow in which plots were jointly made at household level. Whereas, decisions on what to plant in the home gardens were predominantly made by women. Men often make decisions when selling larger quantities of livestock and crops while women make decisions, often independently, when selling smaller quantities (to an amount woman can take to the market on their own). Men and women jointly decide on the amount to sell and using the income.

Livestock roles and practices

- **Men often purchase livestock and prepare livestock fodder and dry feeds.**
- **Women often clean, milk, feed, process milk, and sell poultry and milk products.**
- **Decisions on buying or selling oxen and dairy cows are jointly made by men and women in married households.**
- **Women manage sales of poultry and dairy products.**
- **Women in female headed households often manage livestock production and marketing decisions.**

In North Shewa sites, men and women FGDs confirmed that women's role in livestock include milking cows, preparing *atela* (liquid feed from local liquor), feeding livestock, giving water for livestock, livestock fattening (bulls, sheep), cleaning the barn, cleaning the feeding trough, washing cows for milking, washing milking utensils, delivering milk at the milk collection centers, and bringing cattle out of the barn. Participants of the FGDs underlined that poultry activities such as feeding chicken, collecting eggs, and feeding dairy cows and calves with nutritious feeds were mostly done by women. Men's roles in livestock include buying and preparing livestock feeds such as *frushka*, *fagulo* (oil cake), collecting and storing hay, buying and selling cattle, maintaining the barn, building feeding troughs, buying oxen and dairy cows, artificial insemination activities, and taking sick cattle to veterinary clinics. Men and women share tasks in milking cows, delivering milk, preparing livestock feeds, keeping cattle, feeding cattle, and maintaining the barn.

Women carry out most of the activities related to livestock production and their tasks include bringing the livestock out of the barn, cleaning the barn, feeding livestock, milking cows, and livestock fattening. Some livestock activities such as poultry production and keeping dairy cows are predominantly done by women. Men FGD participants emphasized that, since women spend most of their time at home, they are often responsible for livestock activities, such as:

“Milking cows and washing milking utensils is done by women. They [women] clean the barn and raise chicken and collect eggs. Since they [women] are always at home, they do many activities around the home including feeding livestock and caring for fattening bulls and giving feed for sheep. Men prepare hay, *frushka* (type of feed) for animals, monitor health of livestock, and take cows to animals' service centres for artificial insemination” (FGD, men, Angolela, May 2022).

In Hadiya sites, men and women FGDs explained that women bring livestock out of the barn in the morning and return livestock in the evening, feeding and giving water to the livestock, milking cows, processing milk and producing butter and cheese for domestic consumption

and market sell, cleaning the barn, stall feeding, caring for dairy cows, livestock fattening, preparing livestock feeds, attending the health of the livestock. Men's roles in livestock include setting up the barn, collecting or buying, and preparing livestock fodder and feeds such as hay, *frushka*, oats and vetch, and *Sesbania*, taking sick cattle to veterinary clinics, and artificial insemination. Men and women share tasks in giving water for cattle, harvesting grass, and preparing livestock feeds.

Women have more control in decisions about poultry, eggs, milk and milk products while men often make decisions to purchase or sell oxen, sheep or goats. Men decide on purchase of livestock feeds. Decision on purchase of dairy cows was done jointly by men and women. Men and women contribute labor to different activities and decision-making regarding livestock feeds and forages. Men's roles include production of fodder, foliage and purchase of dry feeds such as *frushka* and *fagulo*. Men contribute labor in production and harvesting of fodder and foliage. Women are responsible for preparing liquid feeds such as *atela*. Women contribute labor in feeding livestock and carrying out other livestock production activities.

Mobility norms and practices

- **Women and men's mobility differ by household type and location and result in gender-based differences in access to information, participation in meetings, trainings, and demonstration activities**
- **Married women's mobility, or their agency in deciding when to leave the household, is restricted compared to women in single headed households.**
- **Women must often ask permission from husbands to go farther than their homesteads and neighbourhoods while men consult women only when traveling long distances.**

Women in North Shewa may travel for specific activities such as attending funerals, religious festive, and selling *areke* in the nearby market. However, women must often ask for permission from their spouses to go to markets or meetings. In the same sites, men were expected only to consult their wives when traveling to farther places for a longer stay (e.g. FGDs, Women, Men, Gerba, Gudo Beret, May 2022). Gender norms constrain women's freedom of movement within the community. Participants of all women FGDs in Hadiya confirmed that women's asking for permission for mobility within the community and showing obedience to their husbands were important for having peaceful marriage and setting good examples for their children (e.g. FGDs, Women, Dubanicho, Morsuito, Jawe, June 2022). Men FGD participants in Hadiya sites agreed with women's need for permission to move within the community as:

"Women are secretive by nature. They may go without asking for permission if they think their husbands may not allow them if given the information. Men have higher position in our community. Our religion also suggests that men and women consult each other in any of their issues and ask for permission before going anywhere. If women break this norm and just go wherever they want to go without permission, they will face fights and conflicts on their return." (FGD, Men, Morsuito, June 2022).

By and large, men and women FGD participants across sites considered staying home and asking for permission to move within the community as decent behaviour for women. Yet again, women's movement was more restricted in Hadiya compared to North Shewa sites. The difference could be explained by the strict enforcement of gender norms in some locations, fear of conflicts in their marriages, showing respect to religious values, and the fear of exclusion from the community. In addition, men and women FGD participants in North Shewa and Hadiya sites indicated that women's workloads and responsibilities in the households such as child care also limited their mobility within the community. Women FGDs in North Shewa also indicated illiteracy, having children back to back, and jealousy of

husbands affected women's movements (FGDs, Women, Angolela, Gerba, May 2022). Both men and women FGDs in North Shewa also highlighted that widows have unrestricted freedom of movement (FGDs, Women, Men, Gudo Beret, May 2022). Participants of the FGDs elaborated that some women might refrain from going to meetings or trainings due to fear of asking for permission from spouses. Men and women FGD participants in Hadiya sites also agreed on the importance of consulting spouses before leaving the homesteads for protecting properties, reducing domestic conflicts, and safety and protection reasons (FGDs, Women, Men, Morsuito, Jawe, Upper Gana, June 2022). However, it was found that men may need to notify on leaving while women need permission for leaving their homesteads (FGD, Women, Dubanicho, June 2022).

Social dimensions of technological innovation in Africa RISING sites

Community engagement

- **Community level discussions increased awareness and created opportunities for dialogue between farmers and extension agents.**
- **Progressive farmers, often men, widows and married women who 'represented' their husbands, engaged in community level participatory decision-making processes such as technology selection.**

Key informant interviews in the Africa RISING sites of North Shewa and Hadiya confirmed that experts from the office of agriculture in collaboration with the local agricultural research centers chose 'proven and tested' innovations and technologies suitable to the agroecology. The Africa RISING project provided technical and logistic support and facilitated the process (Key informant interviews 1, 4, Debre Birhan, May 2022; Key informant interview 8, Hosaena, June 2022). These were followed by trainings of extension agents and progressive farmers (often married men) who then played important role in field trials and demonstration activities (FGD, Women, Gudo Beret, May 2022; FGDs, Women, Men, Jawe, Upper Gana, June 2022). All data sources in the Africa RISING sites substantiated that trainings, demonstrations, and exchange visits created awareness and information on the technologies and innovations. A key informant described:

"We [kebele office of agriculture] collaborated with the Africa RISING project in technology promotion and encouraging farmers to use improved crop varieties. The project also provided trainings to the experts in the office of agriculture. We knew the farmers so well. We identified 'model' farmers based on their willingness to try and adopt technologies and past experience in trying new things. The project worked with 'model' farmers in demonstrating the technologies. Then other farmers saw what the model farmers achieved and learned about the benefits of the technologies." (Key informant interview 6, Jawe, June 2022).

Community level discussions increased awareness and created opportunities for dialogue between farmers and extension agents concerning the relevance of promoted technologies to improve incomes and livelihoods. Primary decision makers in households, who were mostly men, participated in community level decision-making process. Women explained that they seldom participated in either testing the technologies or demonstration activities. A widow who participated in the field trials explained that:

"We make decisions after consultation with the agricultural extension agent. Land is allocated for different crops for demonstration purposes. Then, we see the growth and the yield. We select a crop variety with many branches (like 15 branches), and a

variety that resists disease. Then, we ranked from 1 to 3 then adopt the best ones. Both men and women participate in variety selection. For example, if a woman has no husband or if the husband is away, she participates on his behalf.” (FGD, Women, Gudo Beret, May 2022)

Efforts were made to engage households in decision-making processes in one of the four North Shewa sites by inviting husbands and wives to the meetings on awareness creation on improved livestock feeds and fodder (Key informant interview 1, 4, Debre Birhan, May 2022). A key informant explained:

“In the past, we worked mainly with men and have seen that we did not achieve positive results by just training men. I can say that women, once they received trainings, are good implementers compared to men. As well, women run most of the activities at home. The more one works on activities closer to home such as livestock feeds, the more the benefits will be for women. So, we mainly work with women in our trainings on livestock feeds. For instance, milking of dairy cows, feeding livestock, cleaning the barn, and poultry are women’s activities. We do our best to train both women and men in the livestock interventions whenever we can. If not, we prioritize women in our training sessions over men.” (Key informant interview 4, Debre Birhan, May 2022)

Household adoption

- **Decisions about whether to adopt new livestock species, try new fodder and forage technologies, and labor and use of income from the adoption of new technologies are often made jointly by men and women in married households.**

At the household level men and women made decisions about whether to adopt based on exposure to demonstration sites and the feedback from family and other community members who had tried out technologies. Their decisions on whether to try out certain technologies was based on affordability, productivity, market value, disease resistance, and suitability with the agroecology (e.g. FGDs, Women, Men, Gudo Beret, Angolela, May 2022). Farmers (mostly men) visited demonstration sites to learn on the new fodder and forages (FGD, Men, Angolela, May 2022). Men play a significant role in the production and collection of fodder. Men and women jointly decide on adopting the varieties, try the varieties on a small plot, assess the benefits in terms of productivity and nutrition values, and decide whether to adopt the varieties or not. For example, participants of FGD in Hadiya site elaborated that:

“Decisions are made after discussing with community and family members about the new feeds and forage based on our needs. We discuss the types and importance of the new forage and feeds in detail. We also discuss on the types and size of the land required to plant the new forage or try the new feeds in our farm. We always take the land and number and types of livestock we have in making decisions about adopting new forage and feeds for the livestock.” (FGD, men, Jawe, June 2022).

Family members purchase livestock depending on household needs for owning a ploughing oxen, fattening bulls, and dairy cows. Factors such as availability of financial resources, background of the livestock in terms of milk productivity or draught labor, trustworthiness of the sellers, and availability of fodder and feeds influence the decision to adopt a livestock breed. It was common to seek guidance from experts and people with prior experiences on the breeds.

Decision about labor to be used in the adoption of new technologies are made jointly by men and women, however, there are exceptions, e.g., Hadiya. Men and women agreed that activities such as digging and lifting heavy weights were considered as men’s job and activities considered ‘light’ were women’s job. However, women FGD participants in Hadiya

sites emphasized that the decisions on labor were male dominated, exhibiting a slow progress in joint decision making in the patriarchal system. FGD participants elaborated the process as:

“Most of time, the head of household is expected to distribute tasks in our community. For example, in my home we share the tasks through discussion and based on the labour demand of the activity. Men in this community do heavy work. Labour-intensive tasks are assigned to men and others are assigned to women and children.” (FGD, Women, Upper Gana, June 2022).

Decisions about use of income from the adoption of new technologies are often made jointly. Income from adopting new technology was often spent on issues of common interest for the household such as covering expenses of farm inputs, food items, school, clothing for children or investing in livestock. Men and women in North Shewa described that sharing benefits from technologies was jointly decided by men and women. Men FGDs in Hadiya also underlined that there was no individual benefit in marriage and the benefits were spent on issues of priority for the family members.

Stakeholder engagement and communication in scaling sites

- **Opportunities for awareness creation, trainings, technology supply and follow up of adopted technologies were fewer in scaling sites compared to the Africa RISING sites.**
- **Scaling approaches included training extension personnel, exchange visits between progressive farmers, and farmer to farmer networking with members of development groups.**
- **Decisions about whether to adopt technologies are often based on the perceived economic benefits and neighboring farmers’ experiences.**

Scaling up processes relied upon close collaboration of the government and NGOs who were active in the woredas and facilitated learning opportunities between farmers, experts and other stakeholders. Scaling approaches included training extension personnel and progressive farmers and participatory approaches such as exchange visits among farmers and extension agents. Government institutions showed continued support and interest in scaling Africa RISING technologies and worked closely with Africa RISING field coordinators. Efforts were also made to work with cooperatives, such as Dicha Union on seed multiplication in Hadiya who supported women’s saving groups and avocado seeding production. In North Shewa sites, the Amhara Credit and Savings Institute provided farmers with credit services, and the establishment of farmers’ seed multiplication in Gudo Beret helped to increase the supply of improved crop varieties and supporting scaling processes. Most of the projects that NGOs managed in the scaling sites have phased out. A key informant in Hadiya explained:

“The project has two main partners. Research partners include CGIAR centres, Wachemo university, Areka agricultural research centre, and Worabe agricultural research centre. Development partners include NGOs (e.g. InterAid used to work with us, Send a Cow worked with us in Wolaita zone, Catholic agencies and World Vision worked with us in scaling improved wheat varieties under its AY3 project. Most of the projects by NGOs have phased out but we collaborated in scaling some of the technologies validated by the Africa RISING project” (Key informant interview 8, Hosaena, June 2022).

Perceived economic benefits had important influence in uptake of technologies. Decisions about whether to adopt technologies were often based on the economic benefits seen among other farmers. Men and women FGDs highlighted that the supply of technologies was inadequate to meet the demand (FGDs, Women, Men, Morsuito, Dubanicho, June 2022).

Scaling approaches often required low levels of investment in time and resources. A key informant in a scaling site North Shewa elaborated that:

“The use of feeding trough has become very common among farmers in this kebele. Farmers already know the benefits so well and they can build the feeding troughs by themselves. For instance, some farmers see what the model farmers have built and try to do the same. Then they come to ask us [the experts] to see what they have done. Farmers do not wait for the experts to go to their house and advise them on the technology. They are so motivated that they do it themselves by learning from each other.” (Key informant interview 2, Gerba, May 2022).

Experts in North Shewa scaling site reported that they reached out to married women and heads of female headed households through women’s social groups. Women’s social groups are a platform for sharing information on the benefits of technology adoption with the purpose of stimulating discussion among men and women on the technologies. This was a strategy to create awareness about technologies among women who have low levels of access to trainings and exchange opportunities. Trying out different types of engagement approaches has potential to increase participation of both men and women in scaling processes. A key informant explained:

“Women have their monthly social gatherings and we [experts] use such events to pass messages to men as well. Women are very serious on technology issues that save them time and labor. Once they [women] learned about the technologies, they will go home and encourage their husbands to adopt the technology. So, in cases men are reluctant, we pass the message and motivate them by convincing their wives first” (Key informant interview 5, Wele, May 2022).

However, women in scaling sites in Hadiya had fewer opportunities compared to men. For instance, participants of women FGDs in Hadiya scaling sites said that men controlled the income and women’s engagement in decisions depends on the willingness of the husbands (FGDs, Women, Morsuito, Dubanicho, June 2022).

Factors that affect technology uptake

Africa RISING sites

In North Shewa , women reported that factors that support technology adoption included awareness about the technology, technical support from experts, and access to credit from Amhara Savings and Credit Association. Constraints included disease occurrence (rust, gall disease), poultry disease, and financial problems, such as inflation, and high costs of technology adoption, e.g., fertilizer. Men reported that access to improved seeds, good prices for the improved seeds, availability of feed and trainings supported technology adoption. The constraining factors included high prices of agricultural inputs (fertilizer, chemicals that protect weeds), limited access to credit, poor markets and high prices of fertilizer.

In Africa RISING sites in Hadiya, women reported that factors that support technology adoption included the availability of extension personnel and experts, availability of fertile land and water pumps. Constraining factors included poor supply and delays in accessing improved seeds and breeds, rainfall fluctuations, and inadequate financial resources Men

reported that availability of fertile land and family labor in a family supported adoption. The constraining factors included inadequate finance to purchase technologies, inadequate supply of technologies, water shortages, and impacts of climate change, such as fluctuations in rainfall and increases in pests and diseases (Appendix 3, 4)

Scaling sites

In North Shewa scaling sites, women reported that factors that support technology adoption included the availability of health professionals, livestock and agricultural experts and credit services. Factors that hindered technology adoption included lack of good dairy cattle, road problems, inadequate supply of technologies, and financial constraints. Men reported supporting factors included the supply of improved seeds, credit, motivation to use technologies, and availability of improved animal breeds (cattle, sheep, chicken). Constraining factors included fava beans disease (worms, gall disease), rust (wheat, teff) and high fertilizer prices, shortages in supply of improved crop varieties and chemicals. In Hadiya scaling sites, women reported that factors that support technology adoption were credit unions, availability of fertile land, and increased awareness and knowledge about technologies. The constraining factors were inadequate financial resources, insufficient supply of improved seed and breeds, financial constraints, and water shortages (Appendix 5). Men reported supporting factors to be availability of fertile land, access to Water, and availability of family labor. The constraining factors were high costs of fertilizer, poor timing in the distribution of technologies and planting season, shortages of improved avocado seedlings and potable water (Appendix 3, 4).

Technology and innovation preferences

- **Women and men's technology preferences differ. Technologies promoted by Africa RISING often matched women's and men's preferences, more often than in scaling sites.**

Group participants were asked to identify new agricultural practices or innovations that had been introduced over the last 5 years. Then they were asked to identify the top 2 in the community, e.g., women identified the top 2 preferred technologies for women. Next, group participants were asked to identify the top 2 Africa RISING technologies. Participants provided explanations for their selections. The results from these two categories, top 2 technologies and top 2 Africa RISING technologies, were compared to assess how well Africa RISING 'matched' the group's preferred technologies.

Overall, in the Africa RISING sites 7/ 8 FGDs reported that at least one of the prioritized technologies was promoted by Africa RISING. Three out of four women's groups reported at least one of the prioritized technologies was promoted by Africa RISING. All men's groups, 4/4, reported that at least one of the prioritized technologies was promoted by Africa RISING. In scaling sites, there were more differences between the preferred and promoted Africa RISING technologies, 5/8 groups 'matched'. Across all sites, 5/8 women's groups and 7/8 men's groups reported that at least one prioritized technologies was prompted by Africa RISING. The difference between women's and men's responses warrants further research.

Women in Gerba prioritized chicken breeds due to the benefits in increased production of eggs. Women also prioritized dairy cows because of increased income to cover household expenses. Women also decide how to use the income from avocado, dairy and poultry production. Participants quickly adopted feeding troughs, a technology promoted by Africa RISING that prevents wastage of feed and fodder and saves women's time and labor (FGD, Women, Gerba, May 2022). Men in Morsuito said that avocados are important because of their nutritional value and high market value (FGD, Men, Morsuito, June 2022). Also,

improved livestock fodder and feeds (i.e. oats and vetch, and fodder beets) improve the nutritional status of livestock, increasing milk and meat productivity, and income generated from livestock rearing. Feeding livestock is mainly a responsibility of women. The technology saves women’s time and energy and reduces the wastage of livestock feeds (FGD, Women, Gerba, May 2022).

Improved avocado varieties were important for women whereas improved potato varieties were the most important technologies and innovations for men in Africa RISING and scaling sites of Hadiya. Improved livestock fodder and feeds were important for both men and women because they alleviate feed shortages. Men in Hadiya preferred *Gudane*, an improved potato variety due to the high yield, short growing season, and suitability to the local agroclimatic condition. FGD participants in Jawe site also emphasized the importance of water pumps to meet the water needs of avocado production. The importance of improved avocado varieties for women were described:

“Avocado (*Red13, fruit, Etinger, True leaf*) is very important for women because there is high market value and demand for it and we use it for household consumption. It is a means of income for women as they can sell the fruit and buy the items they want for household consumption. When women use this technology, they reduce their dependence on their husbands. They earn income and they don’t even have to ask permission to sell avocados.” (FGD, Women, Upper Gana in Hadiya, June 2022).

		Top 2 prioritized technologies	Top 2 preferred AR technologies	# of prioritized technologies that are AR technologies
North Shewa Women				
Africa RISING Sites	Gudo Beret	Improved crop varieties, improved livestock breeds	Feeding trough, improved wheat varieties	1
	Angolela	Improved dairy cows, weed killers	Feeding trough, livestock fodder and feeds (vetch and oats, fodder beet, mixed wheat bran)	0
	North Shewa men			
	Gudo Beret	Warehouse, improved crop varieties	Improved crop varieties, feeding trough	1
	Angolela	Feeding trough, livestock fodder and feeds (fodder beets, oats and vetch)	Feeding trough, livestock fodder and feeds (fodder beets, oats and vetch)	2
	Hadiya women			
Jawe	Avocado (Etinger, Red13, Fruite, True leaf), water pump	Avocado Etinger, Red13, Fruite, True leaf), water pump	2	

	Upper Gana	Avocado, barley	Avocado (Red 13, Hasi, Fruite, Etinger, True leaf), livestock fodder and feeds (Oat and vetch, Disho grass, fodder beet)	1
	Hadiya men			
	Jawe	Potato (Gudane), livestock fodder and feeds (oats and vetch)	Potato (Gudane), livestock fodder and feeds (oats and vetch)	2
	Upper Gana	Avocado, Potato (Gudane)	Avocado, Potato (Gudane)	2
Scaling sites	North Shewa women			
	Gerba	Improved chicken breeds, improved dairy breeds	Feeding trough, bread wheat (Deka, Wane)	0
	Wele	Improved chicken breeds, herbicides	Wheat (Wane), fava bean varieties (Numan)	0
	North Shewa Men			
	Gerba	Combine harvester (teff, wheat, barley), improved crop varieties	Bread wheat (Deka and Wane), fava bean (Numan)	1
	Wele	Improved crop varieties, improved livestock breeds (cattle, sheep) and improved feeds	Wheat (Wane), Livestock feeds (Fodder beets, oats and vetch)	2
	Hadiya Women			
	Morsuito	Livestock fodder and feeds (Oat and vetch, Disho grass), fava bean varieties (Gabalicho, Doisha)	Livestock (oat and vetch, Disho grass), Wheat (Danife)	1
	Dubanicho	Avocado, wheat (Danife)	Avocado, livestock fodder and feeds (oat, oat and vetch, Disho grass)	1
	Hadiya Men			
	Morsuito	Wheat (Danife), Potato (Gudane)	Avocado, Oats and vetch	0
	Dubanicho	Wheat (Danife), potato (Gudane)	Wheat (Danife), potato (Gudane)	2

Local impacts in Africa RISING sites

- **Technologies had positive impacts on food production, food security and nutrition.**
- **Men reported that the impacts of participating in Africa RISING technology processes included increased awareness and skills about technologies and participation in demonstration activities.**
- **Technologies, such as avocados, resulted in trade-offs in women's income and labor.**
- **Feed and fodder technologies had positive productivity and income impacts, and because women manage livestock product sales such as poultry and milk, women's income increased.**

Innovations and technologies had positive impacts on productivity, food security and nutritional improvements. For instance, a women FGD said that the technologies have increased availability and diversity of food, fodder, and livestock feed. Adoption of improved avocado varieties increased the availability of nutritious food and diversity of diets both at household and community levels (FGDs, Women, Jawe, Upper Gana, June 2022). Men said that dietary habits have changed and now include additions such as avocados and potatoes that improve the health and wellbeing of children and adults (FGD, Men, Upper Gana, June 2022).

Technology awareness and innovation processes

Men, more often than women, reported increased levels of awareness about technologies, participation in demonstration activities, and skills to use technologies. Men and women described an increased motivation to adopt technologies following exposure to innovations and technologies in the project.

“Especially those farmers that are model and innovative farmers have benefited much. They have built houses in towns. It is the lazy ones that did not benefit from technologies... We are happy by the technologies we adopted; we can get everything here without going far. Technologies have benefited us economically and in motivating us to work hard. In the future, youth will have great opportunity with technologies.” (FGD, Men, Angolela, May 2022).

Technology tradeoffs: women's income and labour

The introduction of avocados generated tradeoffs in income and labor because of gender specific tasks, specifically women's increased income, because they manage income from avocado sales and increased labor because of women's responsibilities in water collection. In locations where there were water shortages, women's practices of fetching water were further compounded. Providing complementary technology packages, such as seedlings and water pumps, could alleviate tradeoffs.

Men and women in Hadiya reported that avocados improved food production, food security, and. Women and men in Hadiya highlighted increased household income through the selling of avocados. Engagement in avocado production specifically increased women's income in Hadiya. Men and women FGDs valued the shorter growing period of the improved avocado varieties compared to the local varieties. Women FGDs in Upper Gana said that the shorter tree length of the improved varieties also made harvesting easier for women. However, men and women FGDs explained that activities in avocado production in Hadiya

were time and labor intensive. Improved varieties require frequent watering and monitoring to provide good yields (FGD, women, Upper Gana in Hadiya, June 2022). Women's limited access to water for irrigation incurred additional time and labor spent fetching water (Women, FGD, Jawe, Upper Gana, June 2022). Consequently, women's workloads increased, but not men's.

"The technologies have immense benefits for food security and income. We earn money by selling our avocado produce. We have increased control of financial resources. For example, we are highly engaging in avocado production and marketing, and controlling the benefit obtained from it. We make most of the decisions about avocados." (FGD, women, Upper Gana, June 2022)

Women, however, reported increased labor burdens due to the cultivation of avocados. The gendered tradeoff in labor was elaborated.

"Women do most of the domestic chores, and growing avocados adds burden on their time and labour. So, growing avocados brings additional tasks to women but not for men. The drawback of growing avocados is its high labour and water demand." (FGD, women, Jawe, June 2022)

Men suggested the introduction of technologies like water pumps to reduce women's labor fetching water.

Feed and fodder: productivity and income impacts

Men and women in North Shewa reported that Africa RISING technologies led to a reduction in livestock feed wastage. Technologies and innovations in livestock fodder and feeds also reduced men's time and labor spent searching for grass or other feeds.

Women in North Shewa reported that improved livestock feeds and methods of feeding increased milk production that increased their income because they typically manage sales from dairy products. Women who sell dairy products, chickens and eggs, dairy and poultry production reported increased income due to introduction of improved feeds and fodder, for example mixed wheat bran, and were able to support paying school fees in North Shewa sites (FGD, women, Angolela in North Shewa, May 2022).

"We get many advantages from improved troughs. Loss of feed has reduced because of the improved feeding trough, we saved our labour and time, too. We are happy about the technologies we adopted; we can get everything here without going far" (FGD, men, Angolela, May 2022)

Women said that the adoption of technologies also enabled them to prepare livestock feed from locally available resources such as wheat bran.

"We have benefited economically and the project taught us to use locally available resources as livestock feeds. For example, we used to throw wheat bran, but now we use it as livestock feed. The improved cattle feed has increased milk production. Due to the introduction of mixed wheat bran, milk production and income has increased. There is improvement in income, and it saves time and energy. The introduction of technology has created equal job opportunities for us as more and more women are buying dairy cows to engage in milk production" (FGD, Women, Angolela, May 2022).

Men and women said that improved livestock fodder and feeds increased the availability of feeds and productivity of livestock, saved time and resources spent searching for livestock feeds, and supported the adoption of zero grazing practices in the community.

Local impacts in scaling sites

Men and women in Hadiya reported that Africa RISING technologies led to increased crop and livestock productivity due to improved feed and crop varieties. Due to the increased productivity and sale of milk and avocados, there was also an increase in household income. Women in Hadiya noted that there was an increase in women's workload alongside benefits of increased nutritious food in the household.

Additionally, women (one group) reported that women's control of resources and participation in household decision-making increased.

“There are immense economic impacts. For example, if we take fodder (*oat and vetch*), it addressed our feed shortage. We have access to livestock feed and fodder in the rainy season and in the dry season. It increased our milk production which will help us to get more money and generate more income. We are also able to buy clothes and school materials for our children by selling milk products as a result of improved livestock feeding. The technology brings better nutritional value for our cattle, and we benefit from selling quality milk products. We also have better resource control as we earn money from sell of milk products. We sell milk products and the items we need using the income. Being able to do so is so important for women.” (FGD, Women, Morsuito, June 2022).

Men reported increased awareness of technologies and enhanced closer contacts between farmers and agricultural research activities. Men complained that local or indigenous disease resistant crops were not promoted. Also, improved crop varieties that were promoted, such as *Deka* varieties, are not preferred by women for baking injera.

“There are immense economic impacts. For example, if we take fodder (*oat and vetch*), it addressed our feed shortage. We have access to livestock feed and fodder in the rainy season and in the dry season. It increased our milk production which will help us to get more money and generate more income. We are also able to buy clothes and school materials for our children by selling milk products as a result of improved livestock feeding. The technology brings better nutritional value for our cattle and we benefit from selling quality milk products. We also have better resource control as we earn money from sell of milk products. We sell milk products and the items we need using the income. Being able to do so is so important for women.” (FGD, Women, Morsuito, June 2022).

Research participant recommendations

FGD participants were asked to provide recommendations to improve technology adoption in Africa RISING.

Women in North Shewa recommended that future projects consider increasing equipment, such as potato storage facilities and threshing machines, increasing improved varieties of fava beans, wheat, barley, lentils, vegetables and fruits and introducing improved dairy cow breeds. They also suggested improving access and supply of fodder seeds and improved seeds, timely supply of herbicides and disease resistant varieties and fertilizer. Improving prices of agricultural inputs and technologies were recommended. Women would like the research findings to be shared through Amharic newspapers, meetings organized by the agricultural or livestock officer and in the media through their agricultural experts. Men in North Shewa requested more support in the distribution of seeds after multiplication, support in finding markets and credit access. Men recommended increasing access to harvesting machines, combine harvesters, mowing and sowing machines milking machines and roof water harvesting technologies to overcome the challenges of water shortage. Men recommended supplying improved breeds of sheep and bulls and improving the supply of improved seed varieties, lentil seeds and tractors, and varieties that reduce women's workload. The AR project should introduce different disease prevention measures for crops like teff, wheat, fava beans and lentils. The research findings can be communicated through written materials like magazines and manuals, agricultural experts and through digital forms in flash disks.

Women in Hadiya reported that the AR project should provide modern water pumps, solar technologies, improved livestock feeds, vegetables and dairy cows. They recommended fair and equitable distribution of benefits from AR, and for agricultural experts to serve everyone equally and free from injustice, corruption and rude behavior. The project should ensure adequate supply of improved seeds and livestock feeds. Women recommended that there should be intensive training about how to use and manage technologies and should incorporate exchange visits. The results of the findings should be communicated through training, meetings, demonstrations and field visits.

Men in Hadiya recommended expanding small-scale irrigation works in the kebele, introduction of technology to enable people to engage in honey production, increasing the supply of avocado seedlings, fava bean, wheat, potato, *enset* and coffee, increasing the supply of improved sheep, goats, chicken and forage and feeds. They reported the need for technologies that reduce women's' burden in fetching water. Men recommended that the project activities should increase access to training so that more farmers can adopt AR technologies and advice to prevent *enset* disease. The research findings should be shared through meetings, trainings and mobile phones.

Summary of key findings

Gendered contexts

Gender specific roles and practices influence who carries out household, agricultural and livestock practices and women's and men's mobility.

- Decisions on types of crops to plant, farm inputs, crop management and income are made jointly by men and women in married households.
- Men often purchase livestock and prepare livestock fodder. Women often clean, milk, feed, process milk, and sell poultry and milk products.
- Decisions on buying or selling oxen and dairy cows are jointly made by men and women in married households.
- Women manage sales of poultry and dairy products.

- Women and men’s mobility differ by household type and location and result in gender-based differences in access to information, participation in meetings, trainings, and demonstration activities

Africa RISING innovation processes

- Community level discussions increased awareness and created opportunities for dialogue between farmers, often men, and extension agents.
- Progressive farmers, often men, widows and married women who ‘represented’ their husbands, engaged in community level participatory decision-making processes such as technology selection.
- Decisions about whether to adopt new livestock species, try new fodder and forage technologies, labor and use of income from new technologies are often made jointly by men and women in married households.

Stakeholder engagement in scaling sites

- Opportunities for awareness creation, trainings, technology supply and follow up were fewer in scaling sites compared to the Africa RISING sites.
- Scaling approaches included training extension personnel, exchange visits between progressive farmers, and farmer to farmer networking with members of development groups.
- Decisions about whether to adopt technologies are often based on the perceived economic benefits and neighboring farmers’ experiences.

Technology preferences

- Women and men’s technology preferences differ. Technologies promoted by Africa RISING often matched women’s and men’s preferences, more often than in scaling sites.

Local impacts in Africa RISING sites

- Technologies had positive impacts on food production, food security and nutrition.
- Men reported that the impacts of participating in Africa RISING technology processes included increased awareness and skills about technologies and participation in demonstration activities.
- Technologies, such as avocados, resulted in trade-offs in women’s income and labor.
- Feed and fodder technologies had positive productivity and income impacts, and because women manage livestock product sales such as poultry and milk, women’s income increased.

Conclusion

Findings describe how gendered norms and practices influence technology adoption and how technologies influence gendered distributions of benefits and burdens. Technologies generate trade-offs in income, labor, and other factors that support sustainable intensification. Conducting gender analyses *prior* to promotion of technologies is essential to mitigate harmful trade-offs, such as significant labor increases among women or men. Using participatory community engagement approaches to develop complementary technology packages can redress trade-offs associated with new technologies and labor requirements,

e.g., water pumps to meet increased watering requirements of new varieties. Gender responsive approaches should be used to promote technologies that women choose, prefer and manage to improve productivity and hence, income and nutrition benefits, e.g., livestock feed and fodder technologies that increase milk production. Socially inclusive scaling approaches that engage women and men will ensure that gendered preferences are embedded in the selection and promotion of technologies that meet *both* women's and men's needs and improve sustainable intensification in diverse households and communities.

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Appendix 1 Focus group discussion guide

FGD topics included social context, such as gender roles and responsibilities, access to agricultural information and services, and technological practices, decision-making around technologies such as testing and adopting new technologies, and perceived impacts of technologies (Appendix 1).

Name of Facilitator:

Name of Note-Taker:

Is this FGD being recorded: Yes/No

Date: _____ **Location of Interview:** _____ **Sex of the group:** _____

Time start: _____ **Time finish:** _____

Social context

Gender roles and responsibilities

We would like to start the discussion by getting a better understanding of women and men’s activities and responsibilities in the household and farming activities in [community name]. In some cases, women and men may work together and we would also like to understand where and how this happens.

1. Domestic work and household tasks
 - a. What are women’s main tasks in the household?
 - b. What are men’s main tasks in the household?
 - c. Do women and men share in any of these tasks? Please explain.
2. Agricultural tasks
 - a. What are women’s main tasks in farming?
 - b. What are men’s main tasks in farming?
 - c. Do women and men work jointly in any of these tasks? Please explain.
3. Livestock tasks
 - a. What are women’s main activities in livestock rearing?
 - b. What are men’s main activities in livestock rearing?
 - c. Do women and men work together in livestock activities. If so, please explain.
4. Mobility
 - a. Out of every ten women in your community, how many of them move about freely on their own in the public spaces of the community? *[Please ask the FGD members to select their rating privately and then post and discuss the responses.]*

Number of women who move freely out of every 10 local women

Practically <u>no</u> women move freely on their own in the village	1	2	3	4	5	6	7	8	9	10	Practically <u>all</u> women move freely on their own in the village
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Responses	
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[Please be sure to probe on reasons for the perceptions on women's physical mobility, and

- b. Must women or men consult with their spouse prior to leaving the homestead? Please explain.
- 5. Selling agricultural goods
 - a. Do women sell agricultural products on their own or separate from men? If so, please list those products that women sell.
 - b. Do men sell agricultural products on their own or separate from women? If so, please list those products that men sell.
 - c. What agricultural goods are sold jointly?
- 6. Selling livestock
 - a. Are women responsible for selling livestock and livestock products on their own or separate from men, e.g. milk, meat, hides. If so, please list.
 - b. Are men responsible for selling livestock and livestock product on their own or separate from women, e.g. milk, meat, hides. If so, please list.
 - c. What livestock and livestock products are sold jointly?
- 7. Thank you for providing this information. Now, would you say that, in [community] there are major differences between households when it comes to how women and men carry out tasks? For example, do wealthier households differ from poorer households? What other factors, if any, might influence different ways of doing things, e.g. men have migrated and women stay behind and manage all activities.
- 8. Generally speaking, have there been any changes in social practices related to any of these activities, or others not mentioned, in the last 5- 10 years? Please explain.
- 9. Have there been any major events in the areas in the last 5-10 years? If not mentioned ask about;
 - a. COVID-19
 - b. Climate change?
 - c. Others...

Access to agricultural information and services

- 1. What are common sources of agricultural information and technologies for women?
- 2. What are common sources of agricultural information and technologies for men?
- 3. Do women learn from agricultural extension agents? Why or why not?
- 4. Do men learn from agricultural extension agents? Why or why not?
- 5. What kinds of resources are available in [community] that enable men and women to **learn** about and try—or possibly create themselves—something novel that could make their livelihoods more productive or that could improve the wellbeing of their families? These resources might include sources of information, but might also include resources like insurance, credit, cooperatives, etc.
- 6. Now we would like to learn more broadly about the factors that support technology uptake in households. These could include those resources in the community that we just discussed, but may also include other factors in households. Please list.
- 7.

	Two most important for the [sex of FGD]*
Factors that support uptake of technologies	
Factors that hinder uptake of new technologies	

8. Among the factors that support uptake of technologies, which two do you think are the most important for the [sex of FGD] of the community? Why? *[Create the second column, and indicate the 1st and 2nd second most important factors.]*
9. Now, let's think about barriers. What are the factors that hinder local people from trying out and adopting new technologies?
10. Among these, which two are the most important barriers for the [sex of FGD]?

Technological practices

1. Now I'd like to focus on new local practices surrounding agriculture. Thinking back over the past five¹ years or so, what new cropping or livestock have people here tried out or experimented with?

[Please tailor this question to the local context. . Be sure to take the time necessary to facilitate a rich and inclusive discussion of these new practices. If new varieties are mentioned, for instance, ask how they differ from other varieties, whether they are widely used, about their advantages and disadvantages... If the discussion does not flow, it may be useful to prompt about "hardware" (e.g. new seed varieties, animal races, machines...) and "software" changes (new learning, relationships, or organizing), as well as their gender dimensions. Any reference about a change in agricultural activities opens the door for this kind of probing.]

<i>New agricultural or NRM practices</i>	<i>Most important for the [sex of the FGD] of the community (top 2)</i>	<i>Most important for the [opposite sex of FGD] of the community (top 2)</i>	<i>Ranking of the most important Africa Rising technology for [Sex of the FGD] of the community (top 2)</i>

¹ The time period for inquiring about new agricultural or NRM activities can vary from 3 to 10 years as appropriate for the community. Three years could make sense for a community with many, many interventions; while 10 years may be more appropriate for a remote community with few interventions.

(Please add the second and third columns step-by-step after asking the relevant questions below)

2. Which of these new agricultural practices have been the most important for the [sex of FGD] in the community? Why important? And which have been most important for the [opposite sex of FGD]? Why? *[Please rank the top 2 in order of importance for each sex, and be sure to get explanations for the ratings.]*
3. Among the technologies that were listed, which ones were promoted by AfricaRising? FGD participant may not always know which technologies specifically were introduced by AfricaRising, so please consult the list* and also cross check with field officers. For some of the following questions, we will focus specifically on AR technologies.
4. Was [THE NUMBER ONE **AfricaRising technology** RANKED NEW PRACTICE FOR THE SEX OF THE FGD] rapidly adopted by local people, or were there any problems with its uptake? [If so] Why? [Pause for responses.]
5. What do you think about the time and labor needs associated with this technology?

Decision-making around technologies

Testing and adopting new technologies

10. How are decisions about whether to try or adopt a new technology commonly made in this community?
11. How do [sex of FGD] here generally decide whether to use improved varieties? *[Pause for responses.]*
12. How do [sex of FGD] usually decide on whether to purchase or sell livestock?
13. How do [sex of FGD] usually decide on whether to try out new feeds and forages?
14. When a new technology is adopted, how are decisions about labor usually made?
15. How are decisions about the distribution of benefits made?
16. Thank you for this discussion. I would just like to inquire if decision making about AR technologies were similarly made/ or different from the way decisions are usually made in any of the previous questions? If so, how?
17. Have there been any **changes in social norms**, roles and practices in the last decade surrounding technology adoption? Please explain.

Impact of technologies

Now I would like to understand some of the positive and negative impacts of AfricaRising technologies on livelihoods. In the previous exercise, we found [# of AR technologies] were mentioned. Among these, what were some of the main impacts on households and communities? Can you please explain these in detail?

Impacts may be economic, such as increased income. They may also have had impacts on women's labor in households, resulting in increased labor for women, but not for men. Perhaps women gained control of a certain resource, or lost a certain resource when a specific technology was adopted. If participants are quiet, please probe and please try include all the types of impacts, positive or negative, that people in [community] may have experienced as a result of specific AR technologies.

We are now coming to the end of this discussion. We thank you for your time and we would also like to hear from you what recommendations or lessons you would like for AfricaRising

to consider in future work scaling some of the more successful technologies? Any advice on promising technologies that we should consider?

We would like to share the findings with you. What would be your preference to hear from us?

Thank you for being so generous with your time!

Appendix 2 Key informant interview guide

Key Informant Interview Guide

The objective of key informant interviews will be to gain a better understanding of the broader context of the study sites. More specifically, social and environmental change dynamics over the last 5- 10 years will be of interest to better understand the influence and effects of the introduction of new technologies in Africa RISING field sites.

Name of Interviewer:

Date:

Location of Interview:

Time start:

Time finish:

Respondent Details

1. Name
2. Position
 - a. Time spent in the position
 - b. Location(s) where position has been held
 - c. Roles and responsibilities in the position
3. Age
4. Gender

Roles in or related to Africa Rising

5. Are you familiar with the project Africa RISING?
6. Do you work directly or indirectly with Africa RISING?
7. If yes, please describe your experience with the project in terms of:
 - a. Type of engagement
 - b. Length of time of engagement
 - c. Types of activities
 - d. Locations you work in

Characteristics of the woreda

8. What are some of the social characteristics of the area:
 - a. ethnicity
 - b. age
 - c. religion
 - d. other social characteristics, e.g. landless
9. Please describe some of the local institutions, their activities and who they work with: e.g. NGOs, public and private institutions
10. Is in our out-migration common? Please explain, including who migrates, where, temporary/permanent.

Change

11. Has Covid 19 led to major changes in the community? Please describe these changes.
12. What are the types of current work opportunities, or paid work, that are available? For whom are these opportunities, e.g. women or men, specific group.
13. How have these work opportunities changed in the last 5-10 years? Please explain.
14. Please describe the infrastructure, including presence and quality of roads, markets (vegetable and livestock)
15. What major infrastructural changes have occurred in the last 5-10 years?
16. Have there been any significant environmental changes and/or shocks in the area?
 - a. Please describe these events and any impacts on livelihoods, such as changes in use or access to natural resources.

Livelihoods, farming and livestock practices and technologies

17. What are the common household arrangements in the area and what is their estimated percentage?
 - a. Nuclear:
 - b. Polygamous:
 - c. Extended families:
 - d. Other arrangements:
18. What are the main activities of households in the area?
19. How would you characterize the socioeconomic position of members of the community?
 - a. Rich
 - b. Well off
 - c. Poor
 - d. Very poor
20. For these different households what is the role of agriculture and livestock? In other words, do all types of households engage in agriculture and livestock activities?
21. What are some common practices, technologies or innovations in the area? Can you also tell me about whether these are recent, or for how long these practices have been common?

Social practices

22. What are common and current gender norms, roles and practices in:
 - a. The household
 - b. Agriculture
 - c. Livestock practices?
23. Have there been any changes? Why?
24. What are the most common technologies adopted by households? Do households tend to adopt singly technologies? Or packages of technologies?
25. Technologies in households
 - a. Types of household
 - b. Decisions about adoption
 - c. Labor
 - d. Benefit distribution
26. Are feed and fodder uptake of technologies common in the community? Please describe.

Appendix 3: - Top two factors that support or hinder uptake of technologies

Sites	Top 2 factors that support uptake of technologies	Top 2 factors that hinder uptake of technologies
Gudo Beret, North Shewa Africa RISING site	Awareness creation works on technology, Technical support from expert	Disease occurrence (rust, gall disease), Poultry disease
Angolela, North Shewa Africa RISING site	The support of an agricultural expert, Access to credit from Amhara Savings and Credit Association	Financial problems/inflation, High costs of technology adoption e.g. fertilizer
Gerba, North Shewa scaling site	Health professionals, livestock expert	Lack of good dairy cattle, Road problem
Wele, North Shewa scaling site	The presence of agricultural experts, Credit service	Shortage of supply of technologies, Financial constraints
Jawe, Hadiya Africa RISING site	Availability of extension personnel to support us technically, Availability of fertile land	Inadequate supply and delay in accessing improved seeds and breeds, Rainfall fluctuations
Upper Gana, Hadiya Africa RISING site	Existence of government agricultural experts in the kebele, Water pump	Fluctuations of rainfall, Shortage of budget/financial resources
Morsuito, Hadiya scaling site	Presence of credit unions at kebele, Availability of fertile land	Shortage of budget/financial resources, Insufficient supply of improved seed and breeds.
Dubanicho, Hadiya scaling site	Availability of fertile land, Increased awareness and knowledge on technologies	Financial constraints, Shortage of water

Appendix 4: Factors that support or hinder women's or men's uptake of technologies

Factors that support women's uptake of technologies in North Shewa	The most important factors that support uptake of technologies
<ul style="list-style-type: none"> i. Access to markets ii. Access to technology and mobile phones iii. Increased awareness of improved technologies iv. Adoption of new and improved varieties v. Presence of improved seed varieties vi. Adequate and productive land vii. Presence of livestock experts viii. Support from agricultural experts ix. Presence of health insurance and health professionals x. Presence of savings and credit associations 	<ul style="list-style-type: none"> i. Awareness of improved technologies ii. Technical support from agricultural expert iii. Presence and access to credit iv. Presence of health professionals
Factors that hinder women hinder of technologies in North Shewa	The most important factors that hinder uptake of technologies
<ul style="list-style-type: none"> i. Presence of frost ii. Inadequate financial resources iii. Increased inflation iv. Financial constraints v. Poultry disease vi. Rust and gall diseases vii. High illiteracy levels viii. High prices of technologies ix. Lack of adequate information on technologies x. Inadequate water xi. Shortage of farmland xii. Poor livestock breeds xiii. Rugged land topography xiv. Poor roads 	<ul style="list-style-type: none"> i. Occurrences of diseases ii. High cost of inputs/ technologies such as fertilizer iii. High inflation rates and financial constraints iv. Poor livestock breeds v. Poor roads

Factors that support men's uptake of technologies in North Shewa	The most important factors that support uptake of technologies
<ul style="list-style-type: none"> i. Availability of markets and market linkages ii. Availability of mobile telecommunication and media iii. Presence of improved seeds 	<ul style="list-style-type: none"> i. Availability of livestock feed and trainings ii. Access to improved seeds iii. Availability of credit sources

<ul style="list-style-type: none"> iv. Trainings on seed multiplication and other technologies such as seed preparation and feeding troughs v. Availability of livestock feeds vi. Presence of cooperatives societies 	<ul style="list-style-type: none"> iv. Availability and adoption of improved breeds
Factors that hinder men's uptake of technologies in North Shewa	The most important factors that hinder uptake of technologies
<ul style="list-style-type: none"> i. Impacts of climate change ii. Limited access to credit iii. Market inflation iv. Lack of equal access to agricultural training v. High cost of agricultural inputs vi. Lack of adequate experts to fix refrigerators and water pumps vii. Scarcity of agricultural land viii. Scarcity of fertilizer, seeds, chemicals and rainwater ix. Poor market linkages 	<ul style="list-style-type: none"> i. Limited access to credit and markets ii. High cost of inputs (fertilizer, seeds and chemicals) iii. Presence of diseases e.g gall diseases in fava beans and rust in wheat and teff

Factors that support women's uptake of technologies in Hadiya	The most important factors that support uptake of technologies
<ul style="list-style-type: none"> i. Access to improved seed varieties ii. Presence of agricultural extension services iii. Availability of fertile agricultural land iv. Availability of water pumps and labour v. Government support in agricultural technologies vi. Improved education levels vii. Better understanding of technology adoption viii. Presence of credit facilities ix. Presence of cooperatives x. Support from NGOs 	<ul style="list-style-type: none"> i. Availability of agricultural extension officers ii. Availability of fertile land and water pump iii. Availability of credit unions at kebele iv. Increased awareness of improved technologies
Factors that hinder women uptake of technologies in Hadiya	The most important factors that hinder uptake of technologies
<ul style="list-style-type: none"> i. Low rainfall amount ii. Shortage of water iii. Inadequate financial resources 	<ul style="list-style-type: none"> i. Inadequate rainfall amount/water ii. Inadequate supply and delays in accessing improved seed varieties

<ul style="list-style-type: none"> iv. High illiteracy levels among farmers v. Small land holdings vi. Shortage of water vii. Inadequate supply of improved seeds viii. Low levels of agricultural training ix. Lack of good governance x. Poor roads xi. Poor access to markets 	<ul style="list-style-type: none"> iii. Inadequate financial resources
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Factors that support men's uptake of technologies in Hadiya	The most important factors that support uptake of technologies
<ul style="list-style-type: none"> i. Adoption of improved technologies ii. Access to agricultural information through agricultural extension agents iii. Availability of agricultural land and family labour iv. Presence of FTC v. Supply of improved seed varieties vi. Health insurance vii. Good roads and access to roads viii. Presence of micro finance organizations 	<ul style="list-style-type: none"> i. Availability of fertile land and family labour ii. Access to water
Factors that hinder men uptake of technologies in Hadiya	The most important factors that hinder uptake of technologies
<ul style="list-style-type: none"> i. Inadequate and fluctuations in rainfall ii. Inadequate financial resources iii. High inflation iv. Presence of pests and diseases v. Lack of expertise to operate technological tools vi. Limited technology to meet demand vii. Shortage of improved livestock breeds viii. Shortage of improved avocado seedlings and lack of nurseries 	<ul style="list-style-type: none"> i. Inadequate financial resources ii. Limited access to new technologies iii. Fluctuation of rainfall/inadequate water iv. Pests and diseases v. High costs of inputs vi. Delay in distribution of farm inputs

ix. Lack of good governance	
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